EUROPEAN CAPITAL STRUCTURES AND THE MACROECONOMIC, CORPORATE AND TAXATION ENVIRONMENTS

by

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ABSTRACT

The objective of this thesis is to determine whether European firms exhibit firm-specific optimal capital structure solutions. If the capital structure of the firm is irrelevant then the finance manager should concentrate upon the maximisation of the returns from the firm's investment projects alone. Alternatively, if the capital structure is relevant then the finance manager should strive to attain the capital structure which minimises the cost of capital to the firm, and thus maximises the value of the firm.

The firm is positioned within three environments: the macroeconomic environment, the taxation environment and the corporate environment, and it is with respect to these environments that optimising behaviour may be measured. A variety of conventional and modern econometric techniques are employed to study the interaction of the capital structure with the environments within which it is placed to determine whether behaviour of an optimising nature may be ascertained. To allow for as comprehensive a perspective as possible, the processes which determine capital structure policies are tested and modelled across average, marginal, dynamic and long-run time-frames, to enable operational capital structure policies to be distinguished from strategic capital structure policies of the firm.

The conclusions suggest that there exists a behavioural dichotomy between larger and smaller firms, based upon differences in the sophistication of information systems present within the finance function of the firm. Larger firms engage in full-optimisation behaviour at the strategic level by targeting the long-run path of the capital structure ratio in relation to key taxation, macroeconomic, and corporate environment variables, endo-exogenous interaction effects, and consideration of the effects of the two-way causal interrelationship between the capital structure ratio and the corporate environment. Smaller firms engage in a form of bounded-optimisation behaviour at the strategic level, targeting the capital structure ratio upon the norm for the industry to which the firm belongs, upon the capital structure ratio of larger firms, or on the basis of some other targeting criterion. For both larger and smaller firms, departures from the long-run path of the capital structure ratio, determined by the strategic capital structure policy, are caused by operational capital structure policy adjustments. The operational capital structure policy of both larger and smaller firms is determined mainly by those exogenous factors which determine the explicit costs of finance, although endo-exogenous interaction effects and the two-way causal interrelationship between the capital structure ratio and the corporate environment also exert an influence.

Overall, the theoretical and empirical analyses of the European research provide very strong support for the existence of firm-specific optimal capital structure solutions.

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I. Attendance and participation of staff seminars, during which research work was presented.

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III. Attendance at the BAA ICAEW Doctoral Colloquium in Finance and Accounting at Brunel University in April 1993

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CHAPTER 1

INTRODUCTION

> "Finance has changed from primarily a descriptive study to one that encompasses rigorous analysis and normative theory; from a field that was concerned primarily with the procurement of funds to one that includes the management of assets, the allocation of capital, and the valuation of the firm in the overall market; and from a field that emphasized external analysis of the firm to one that stresses decision making within the firm." (Van Horne (1986), p.5)

Economists such as Van Horne (1986) and Jensen and Smith (1984) argue that before the 1950's, the finance area was defined by the financial instruments, institutions and procedures which characterised it, whereas the theoretical underpinning of the area was almost entirely prescriptive and plagued by logical inconsistencies. Disillusionment with this state of affairs encouraged economists to search for a more objective and scientific means of assessment of the corporate financing decisions of the firm, spurred on by the rapid development of new methods and techniques in economics, and the desire of finance managers for analytical techniques to enable more sophisticated monitoring and control of their firms. Up until the 1950's, questions concerning important finance issues such as the optimal mix of debt and equity finance that the firm should employ remained unanswered, apart from the contribution of a number of extremely crude models. Some argued that the mix of the firm's finances was of no consequence to the firm and that finance managers should employ their energies to the maximisation of the returns on their investment projects rather than consideration of the financing mix. Others argued that the mix of the firm's finances were of great importance to the firm, as the finance manager could maximise the value of the firm by minimising the average cost of its capital, thus producing an optimal capital structure solution.

The watershed in finance theory came in the form of the theoretical models of Modigliani and Miller (1958, 1961), which revolutionised thinking in the two most important fields of finance: capital structure theory and the theory of dividend policy. The central message of these models was that the debt and dividend policies of the firm did not affect its valuation, given assumptions such as efficient capital markets and the absence of imperfections. However, although the models were to provide the framework for theoretical and empirical enquiry of the subsequent decades, the assumptions underpinning them were extremely restrictive and the relevance of either the capital structure or dividend policy of the firm appeared to be very sensitive to the assumptions made. Subsequent papers on the subject of capital structure theory sought to determine whether the relevance of the funding mix gave rise to a valuation effect when the assumptions were relaxed, particularly those assumptions related to taxation. The key capital structure models to follow were to correctly introduce corporate taxes (Modigliani and Miller, 1963) and corporate taxes in conjunction with personal taxes (Miller, 1977), proposing that the firm's capital structure was relevant, and then irrelevant, respectively. More recent research has concentrated on studying the effects of various market imperfections and the impact of various external factors on the corporate capital structure, representing to some extent a movement away from all-encompassing general equilibrium models towards the study of the influence of separate capital structure determinants. New developments in econometrics within the last decade mean that finance research has now entered a new phase whereby the interactions and processes which characterise financial markets may be examined to a far greater level of complexity, thus facilitating entirely new perspectives on the determination of the corporate capital structure and enabling the question of capital structure optimality to be re-examined.

The main objective of this research is thus to determine whether firm-level optimal capital structure solutions exist for European quoted firms, and if they do, what are the most important determinants, whether direct or indirect, of such optimal solutions. The question of optimality is best addressed by studying the relationship between the corporate capital structure decision of the firm and the determinants of that decision, because consideration of the question of optimality necessarily requires certain points of reference. Examination of the relationship between measures of the corporate capital structure and capital structure determinants (which represent the points of reference) enable examination of the processes which generate the capital structure policies of the firm. Study of the capital structure policies thus reveals whether firms appear to engage in optimising behaviour, or whether the capital structure decision appears to be of only marginal importance to the individual firm.

The theoretical work and empirics of this research are undertaken from the perspective of an economist, a perspective which has implications for the approach employed. The theoretical work is developed on a conceptual basis, by means of the creation of a series of theoretical constructs, which are drawn together to produce a model of European corporate capital structure determination which is hopefully both coherent and intuitive to the non-specialist reader. The theoretical discussion neither becomes too dominated by detailed accounting issues, nor is it framed by strict mathematical representations of the constructs developed. The empirical models which underlie the theoretical development of the research are generally intended to be illustrative, rather than to be employed as high-powered predictive and meticulously specified models. Furthermore, the econometric techniques used are described with respect to their employment as research tools, and thus such descriptions are not intended to represent elaborate expositions of the underlying econometrics. However, each method is fairly comprehensively described and discussed with respect to its use in applied econometric research as the research progresses.

The style of the research is positive rather than normative. It is a study of what the capital structure behaviour of the European firm is, rather than a suggestion of what such behaviour "should be". The approach is objective, as far as possible, although the choice and application of the empirical techniques necessarily involves an amount of subjectivity. European firm capital structure behaviour is examined to determine whether the corporate finance theories which exhibit a strong Anglo-American bias hold for a wider and more diverse group of financial economies.

The focus of the research is the long-run external financing decision of European quoted firms. Only quoted firms are studied as the data limitations do not enable the study of smaller, non-quoted firms. Long-term debt and equity are assumed to be homogenous instruments for the purposes of this research, since to differentiate between the different forms of long-term debt and equity would render the enquiry intractable. Thus long-term debt covers both the long-term bank debt and long-term debt issued to individual and institutional investors. Equity covers the entire range of forms of equity issued by the firm. As external finance is the focus of the study, retentions as a form of finance are not expressly modelled and discussed in this research, except where they impact significantly on the choice between debt and equity finance. The use of short-term debt as a substitute for long-term debt is considered only briefly, as such consideration unnecessarily widens the scope of the research. The study of the capital structure environment is conducted from the corporate rather than the investor perspective, as the finance market objective functions which underlie the two perspectives are necessarily very different. However, the investor-side of the market is still examined, but from the perspective of the firm-side of the market.

The structure of the research is designed to represent a steady progression from the timelessly static through to the long-run time-frame within which the finance manager operates. Chapter 2 examines the influence of taxation upon the corporate capital structure decision of the firm. It discusses the development of the theory and related evidence from the origins of conventional theories, through the pivotal contributions of Modigliani and Miller, to the modern theories of finance which move away from the development of general equilibrium frameworks. The chapter attempts to evaluate the theoretical and empirical support for a distinct tax advantage to debt, considering also those factors which might alter the magnitude of any advantage, such as the incidence of tax exhaustion and changes in tax rates and tax systems.

Chapter 3 examines the influence of macro economic and corporate factors upon the capital structure decision of the firm. The theory and evidence describing the influence of macro economic factors concentrate mainly on the important effects of inflation and various institutional factors upon the capital structure choice of the firm. The corporate-influence theory and evidence described is far more extensive, and includes: the examination of the influence of corporate measure factors such as the firm's accounting structure, bankruptcy risk and scale factors; behavioural factors such as the influence of investment and production decisions and the influence of industry-targeting norms; and investor-related factors such as the influence of issue-related costs, the information signalling nature of finance decisions and agency problems. The chapter also summarises the overall influence of the macro economic, corporate and taxation environments, and suggests how the finance manager may prioritise these influences when making a capital structure decision.

Chapter 4 formulates the hypotheses arising from the existing literature that are to be tested throughout the research. The structure and relationship between the hypotheses are explained, such that the central hypothesis is addressed by testing the macro economic, taxation and corporate hypotheses, which in turn are addressed by testing numerous subsidiary hypotheses. The methodology is discussed, explaining how explicit hypothesis testing, in conjunction with econometric modelling, enables the existing literature hypotheses and the new research hypotheses to be addressed over average, marginal, dynamic and long-run time-frames. The chapter engages in preliminary analyses of patterns evident within the main data sets, with particular reference to the influence of the tax system and country within which the firm is positioned. Finally, the chapter also presents an indirect test of the Miller (1977) financial leverage clientele hypothesis.

Chapter 5 examines determinants of the corporate capital structure using direct and indirect methods. The indirect studies comprise testing for the significance of industry effects upon the corporate capital structures of UK firms, and testing for the incidence of tax exhaustion across European firms. The more direct studies comprise modelling the average and marginal capital structure decision time-frames. A bivariate regression analysis enables the average time-frame to be studied, to determine the factors influencing the capital structure decision at a point in time. A multivariate logistic regression analysis enables the marginal time-frame to be studied, to determine the most important influences of the incremental capital structure decision.

Chapter 6 introduces a time series extension to the European research. The nature of the time series data set to be analysed and its associated limitations are examined, and the merits of introducing a macroeconomic perspective to the research are discussed. The rationale for the weighting method employed to facilitate the distinction between the capital structure policy behaviour of larger and smaller firms is discussed in some detail. The main purpose of the chapter, however, is to examine, by means of a detailed graphical analysis, inter-temporal movements in European corporate capital structure ratios. Additionally, prima facie bivariate capital structure relationships with respect to taxation and macroeconomic environment factors are identified, and the impact of key European taxation and macroeconomic events on the movement of corporate capital structure ratios is examined. Such graphical analyses are conducted as a precursor to more formal econometric analyses.

Chapter 7 describes the methodology and hypotheses necessary to test the central hypothesis from a bivariate time series perspective. A detailed examination of the methods employed towards the development of bivariate time series models is presented. The methods described are: unit root testing to determine the order of integration of the time series variables; cointegration testing to identify those time series variables which are cointegrated with the DDE ratio; Granger causality analysis to determine the direction of causation within a bivariate corporate capital structure relationship; the construction and estimation of autoregressive distributed lag (ADL) models to determine the factors which influence the DDE ratio in the short-term; and the construction and estimation of bivariate error correction (EC) models to determine the short-run and long-run processes present within key capital structure relationships. Hypotheses arising from the existing literature and the development of the European research are then presented. Such hypotheses form the basis for the expected specification of the bivariate corporate capital structure models to be estimated, although more general finance theory, econometric theory, and potential data limitations also contribute to the development of expected model specifications.

Chapter 8 presents the results arising from the bivariate corporate capital structure time series analyses which derive from the application of the methodology discussed in chapter 7. The results address the bivariate time series hypotheses and provide a greater understanding of the processes underlying capital structure determination by examining the influence of the taxation, macroeconomic and corporate environment factors upon corporate gearing. The bivariate error correction modelling exercise is then extended to the multivariate perspective, by means of the Johansen (1988, 1989) procedure, to enable a greater understanding of the interaction of the capital structure ratio with the environments within which it is determined. To further investigate the nature of a potential behavioural dichotomy based upon the scale of the firm, a cointegration analysis is undertaken to determine whether smaller firms engage in a different form of capital structure behaviour from larger firms, referred to as intra-ratio targeting. The final section summarises the salient results of all of the time series analyses to address the central hypothesis and to present an overall model of European capital structure determination to explain the operational and strategic behaviour of both larger and smaller firms.

Finally, chapter 9 draws together the salient results from the European research to produce an overall model of European corporate capital structure determination, thus enabling the central hypothesis to be addressed. It discusses briefly conclusions arising from the review of the existing theoretical and empirical corporate finance research and discusses the development of hypotheses which are underpinned by those existing research conclusions. It describes the results of naive cross-sectional and inter-temporal descriptive analyses, which serve as a precursor to the econometric modelling undertaken, providing a perspective within which to position the salient results of the European research. The structure of the econometric modelling undertaken is then discussed, reiterating the significant insights provided by each modelling stage towards the precise nature of capital structure optimisation across Europe. The European corporate capital structure model is briefly summarised by examining the operational and strategic capital structure policies employed by larger and smaller firms. The chapter also identifies the pivotal determinants of the corporate capital structure as well as describing those circumstances in which corporate gearing may itself impact upon the corporate environment of the firm. The central hypothesis is then addressed by examining four strict criteria essential to the existence of firm-level optimal capital structure solutions. Limitations of the European research are then identified, and the potential impact of such limitations upon the body of results is determined. Finally, the main contributions of the European research to the corporate capital structure area are summarised, and recommendations for further research are made.

CHAPTER 2

THE INFLUENCE OF THE TAXATION ENVIRONMENT UPON THE CAPITAL STRUCTURE OF THE FIRM

2.1 Introduction

"In this world nothing can be said to be certain, except death and taxes."
(Benjamin Franklin, 1789)

Corporate finance is still a relatively new development within economics, though much of the seminal theory which once proved contentious is now enshrined within finance texts, enabling a positivist analysis of a once purely pragmatist area. Though corporate finance theory encompasses the study of both the investment and financing decisions of the firm, it is the latter which initially spurred the rapid development of the area. However, both decisions are intrinsically linked as the cost of capital is employed by finance managers as the discount rate for investment decisions. If the cost of capital changes with the type of funding instrument issued to raise the investment funds, then the capital structure choice (the mix of debt and equity) of the firm impacts directly upon the investment decision. King (1977) noted that there are three main types of corporate funding: retained profits, the issue of new shares, and corporate borrowing. If the firm's capital structure choice is relevant, then, the firm should strive to minimise its cost of capital, implying that there may exist some optimal level of debt-to-equity. Conversely, if the firm's capital structure choice is irrelevant, then the firm may ignore the mix as the cost of capital is constant and thus does not impact on the investment decision.

Development of finance theory stemmed from growing disillusionment towards the pragmatic guide-lines and conventional wisdoms concerning the limitation of debt issuance. The central papers in the area were written by Modigliani and Miller (hereafter referred to as MM) in an attempt to produce a more coherent, rigorous and mathematically derivable framework, culminating eventually in a general equilibrium model of the corporate capital structure environment. MM initially made many simplifying assumptions to produce simple models of capital structure determination, particularly with respect to corporate and personal taxes. However, they soon realised that taxation was perhaps one of the most fundamental determinants of the corporate capital structure, and that progress in the area might only be achieved by incorporating taxation into their models. Indeed, the examination of the influence of taxation allowed MM to produce both capital structure relevance and irrelevance propositions, depending on the extent to which corporate and personal taxes are accounted for.

Corporate finance theory largely developed from the capital structure debate refuelled by the MM models, and therefore these models are described in some detail. The models propose taxation to be one of the most important determinant of the corporate capital structure, and therefore, consistent with this proposition, chapter 2 concentrates upon the influence that the taxation environment has upon the capital structure of the firm. Only that theory and empirical evidence relating directly to taxation factors is discussed in this second chapter, as chapter 3 considers the important effect of non-tax factors. Where available, evidence is reviewed which strengthens or weakens the theories examined, allowing greater weight to be attached to those theories which appear to have some real-world application. This chapter does not claim to cover all of the literature on the influence of taxation on corporate capital structures, as such a body of literature is immense, but seeks merely to provide a structured perspective on the incidences where tax impacts upon the firm's funding choice.

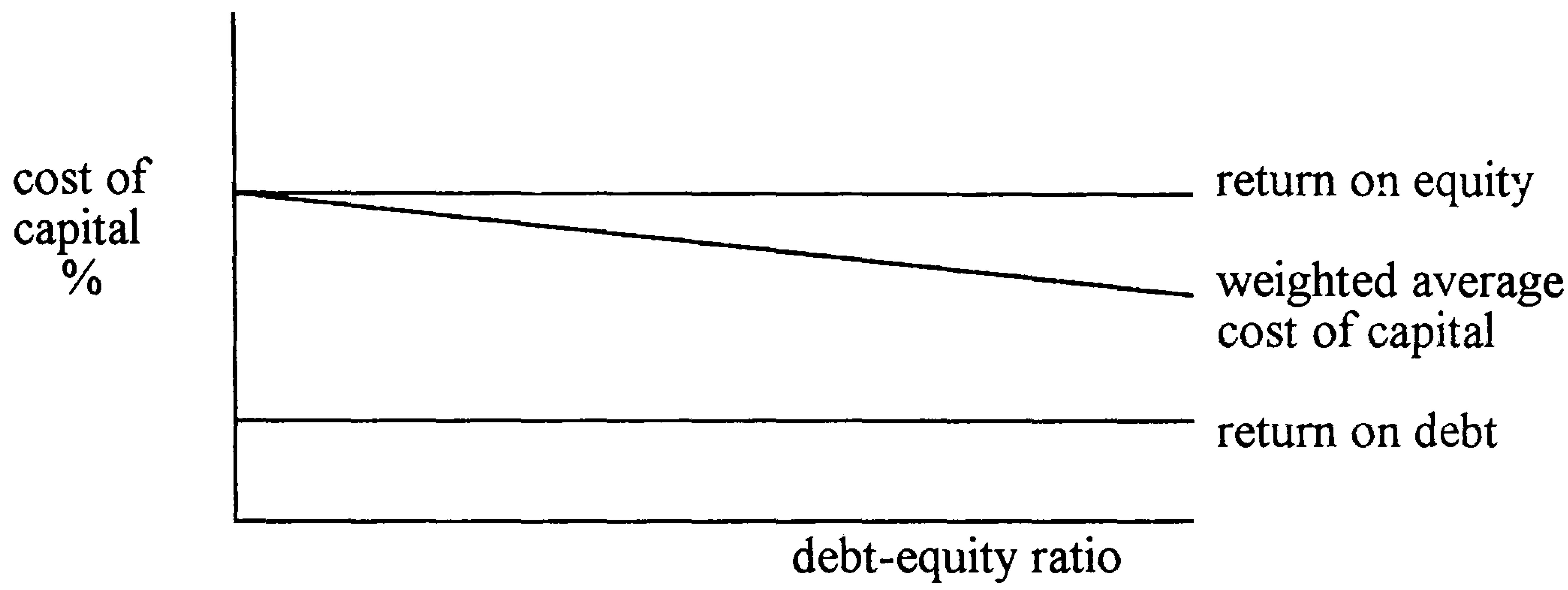
The structure of chapter 2 serves to divide the literature into theory groupings which may be more easily discussed. Such a structure is not ideal, as many tax factors are interrelated, rendering the isolation of separate factors extremely difficult. However, the dividing of the literature in this way more readily enables empirical testing of the importance of such factors later in this report. Section 2.2 describes the conventional models of corporate capital structure, before the imperfection of taxation is introduced. Section 2.3 describes the contributions of Modigliani and Miller, both together and separately, a section which introduces the theoretical framework and empirical methodology employed by much of the subsequent literature. Section 2.4 examines the concept of the tax advantage to debt, considering the models and empirical work related to the MM propositions. Section 2.5 introduces a further complication to the corporate finance/taxation environment, which may be important in the real-world, that is, the incidence of corporate tax exhaustion. Section 2.6 discusses the influence of tax reform and changes in tax rates upon the firm's capital structure. Section 2.7 attempts to briefly consider the effects of differing tax systems upon the firm's funding choice. Finally, section 2.8 draws together the theory and evidence reviewed to attempt to summarise the nature of the influence of taxation on the corporate capital structure, paying particular attention to those tax factors which are most instrumental in capital structure determination.

2.2 The conventional models of corporate capital structure

2.2.1 The Net Income Approach

Durand's (1952) Net Income Approach ignores any implicit costs that may be associated with debt, and assumes that the interest rate payable is the only cost of debt. As debt holders are essentially priority claim holders on the firm's earnings (and assets), the return they demand is less than that of equity holders, reflecting the lower risk of the former compared to the latter's claim, as illustrated in figure 2.1.

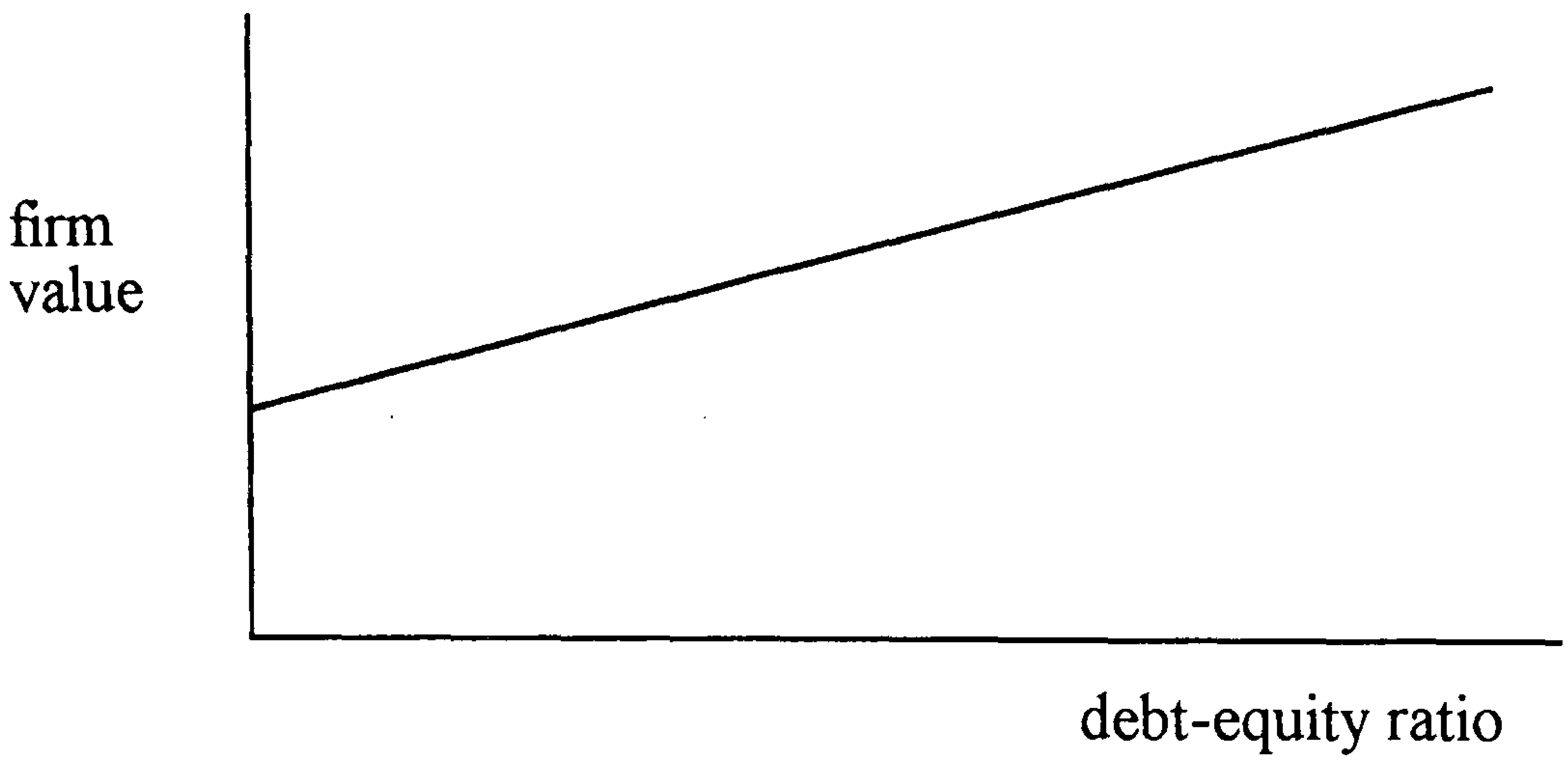
Figure 2.1
The cost of capital under the Net Income Approach



Therefore, the net operating income of the firm paid to debt holders is discounted at a lower rate than that paid out to equity holders. The weighted average cost of capital decreases and the value of the firm increases as the debt-equity ratio increases, as illustrated in figure 2.2. The Net Income Approach would appear to advocate the issuing of a limitless amount of debt to reduce the cost of capital and thus maximise firm value.

The approach may be criticised in two important respects. Firstly, it is likely that equity holders will demand higher returns as the debt-equity ratio increases, to compensate them for the increased risk of their claim on the firm's income. The increased risk causes the returns to equity holders to become more variable, as the increased debt claims are mandatory and have precedence over equity claims. Secondly, the risk of bankruptcy is ignored, which is an unrealistic implicit assumption, because it may be an important limiting factor to the debt-equity ratio in the real world. Indeed, the limitless employment of debt which the model advocates is simply not observed in the real world.

Figure 2.2
The relationship between the debt-equity ratio and firm value under the Net Income Approach

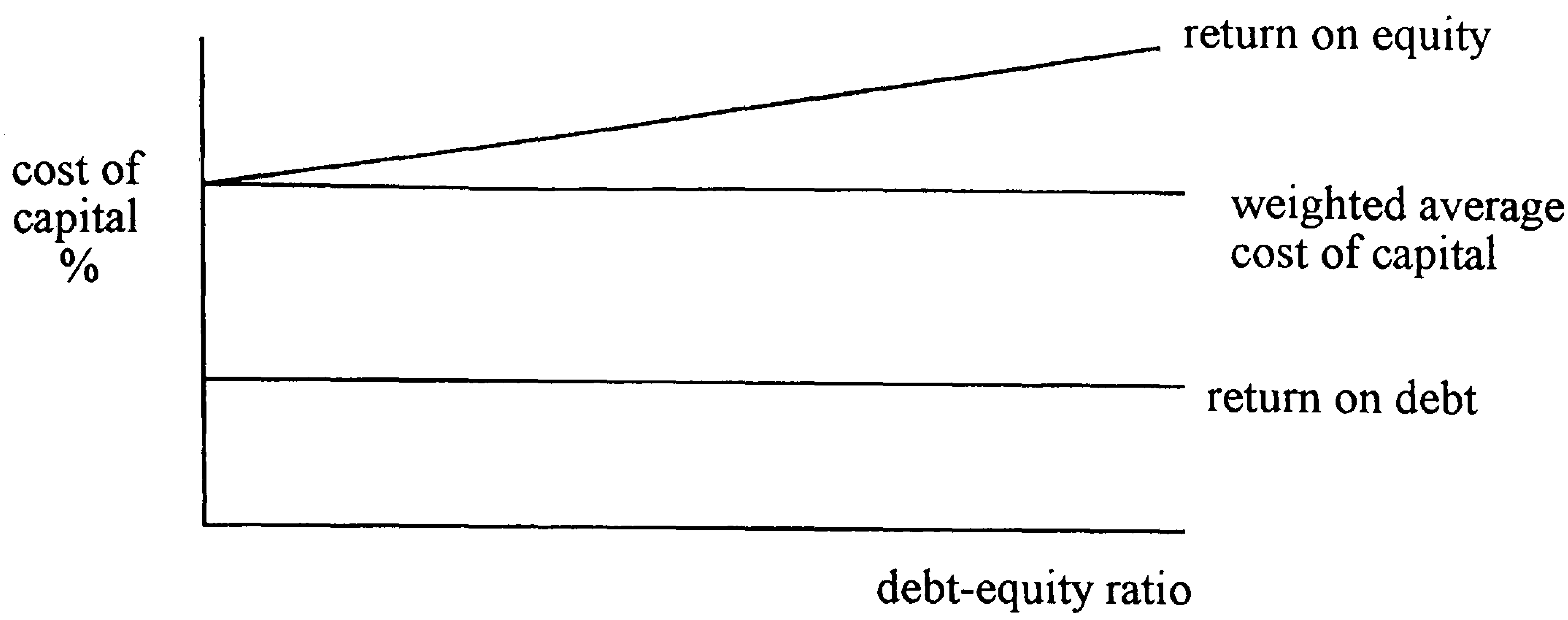


2.2.2 The Net Operating Income Approach

Durand's Net Operating Income Approach assumes that there are both explicit costs and implicit costs associated with debt finance. The explicit cost is the debt interest rate whereas the implicit cost reflects the increased returns demanded by equity holders as the proportion of debt in the capital structure increases. As the cheaper debt funds are increased, the returns demanded by equity holders increase in direct proportion, and thus the weighted average cost of capital remains constant as the debt-equity ratio increases, as illustrated in figure 2.3.

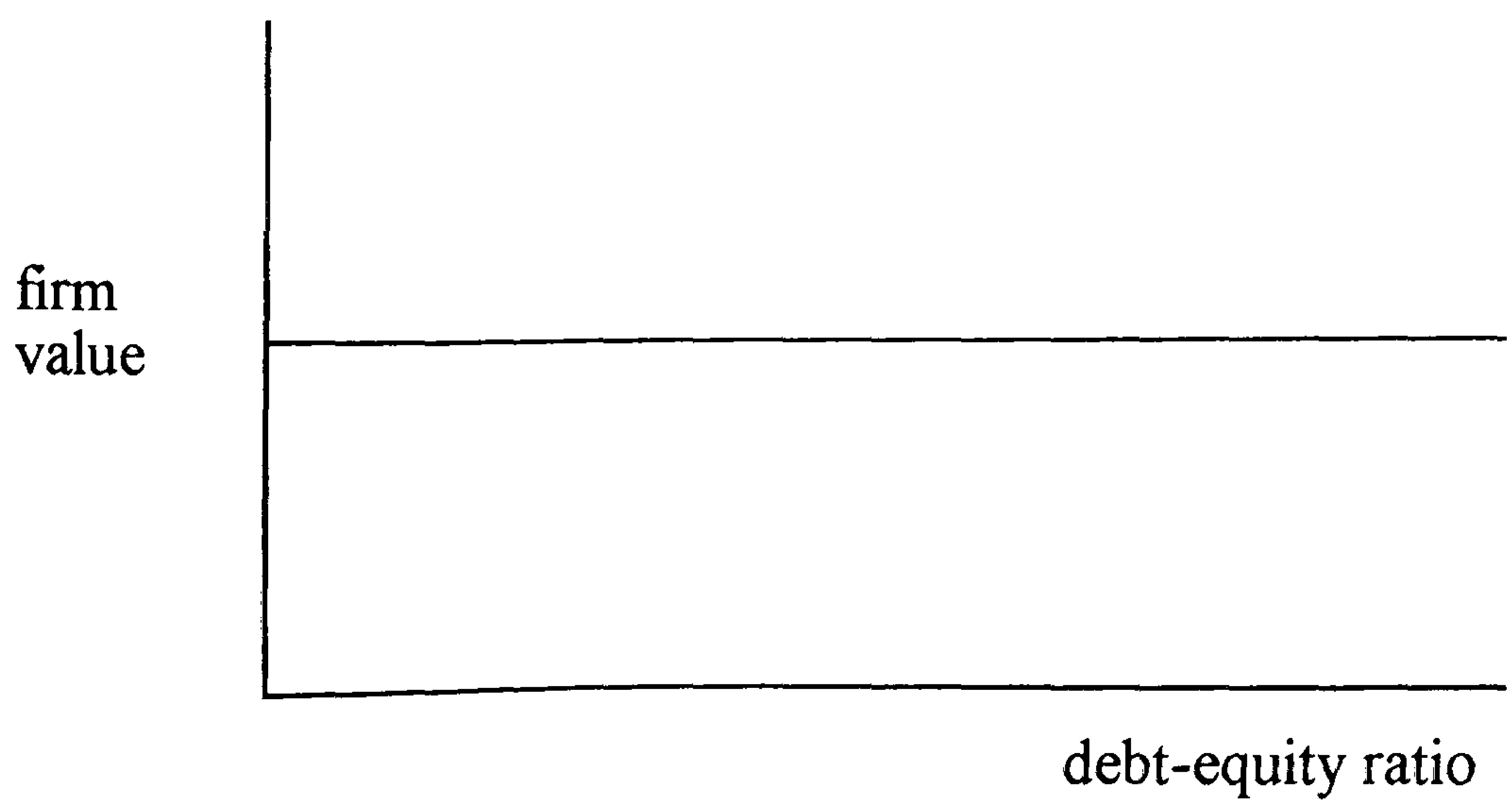
The Net Operating Income Approach thus proposes that there is no advantage to the firm of issuing debt rather than equity to fund its investments and thus there is no optimal capital structure, as illustrated in figure 2.4. The market value of the firm remains constant whatever the level of debt, and thus the choice of capital structure is irrelevant.

Figure 2.3
The cost of capital under the Net Operating Income Approach



The Net Operating Income approach may be criticised in a number of respects. Firstly, it is questionable that the weighted average cost of capital remains constant because debt holders would perceive an increased risk associated with their returns at high debt levels and would demand a higher return, causing the weighted average cost of capital curve to increase at high debt levels. Secondly, the exact offsetting of the benefits of the increased debt and the increasing equity return will only occur if there is perfect dissemination of information in investor markets. However, the Net Operating Income Approach represents an improvement upon the Net Income Approach as it recognises that there are implicit costs associated with capital structure decisions.

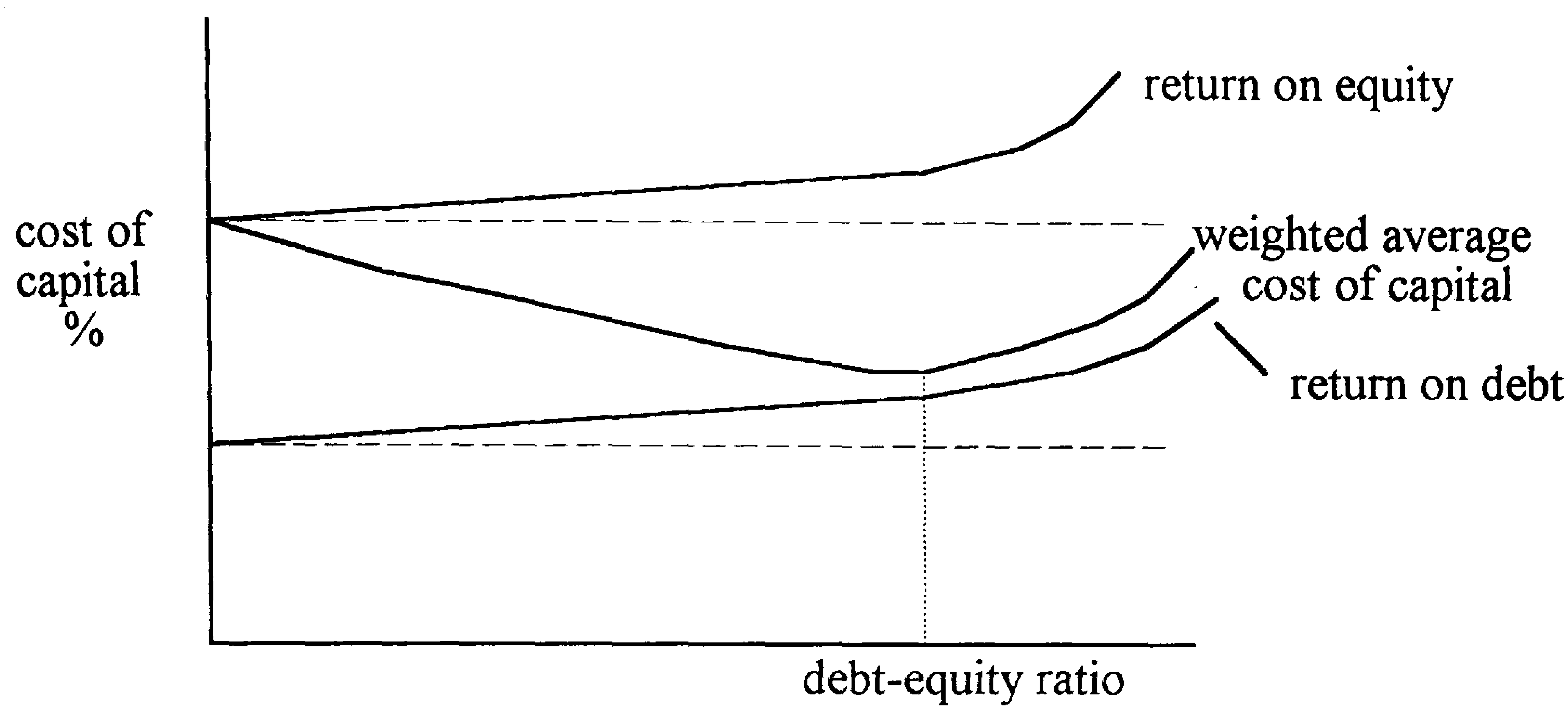
Figure 2.4
The relationship between the debt-equity ratio and firm value under the Net Operating Income Approach



2.2.3 The Traditional Approach

The Traditional Approach assumes that firms may attain an optimal capital structure, through the use of some moderate level of debt financing. Figure 2.5 illustrates this.

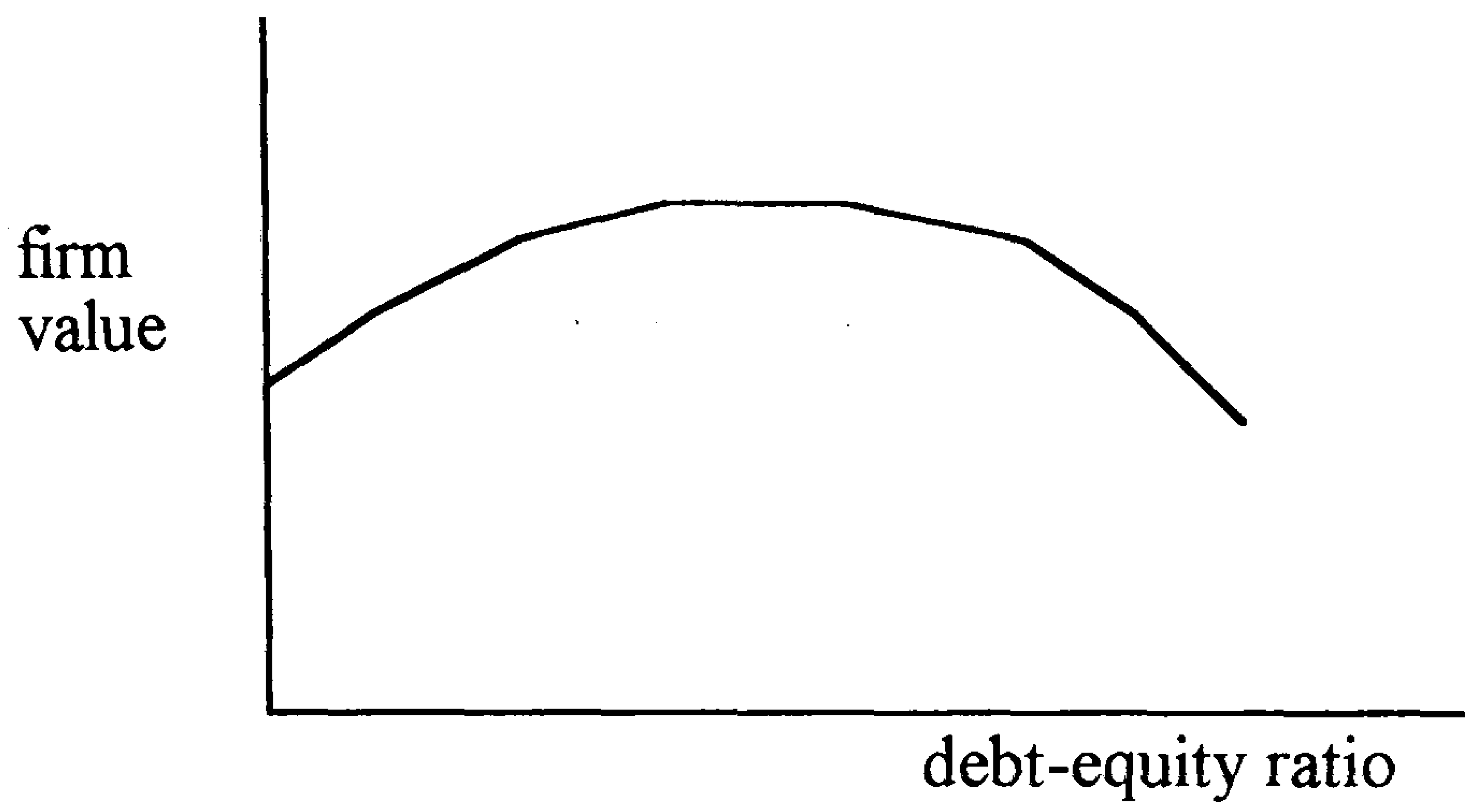
Figure 2.5
The cost of capital under the Traditional Approach



As the level of debt rises, the return that equity holders demand increases gradually at first, and then steeply at some higher level of debt as the risk of bankruptcy becomes significant. The returns demanded by debt holders also increase in a similar manner, rising steeply when the risk of bankruptcy becomes significant. An optimal level of the debt-equity ratio thus exists where the weighted average cost of capital is minimised, that is, where the benefits of the cheaper debt are exactly offset by the increased returns demanded by equity holders <u>and</u> debt holders. The Traditional Approach therefore considers the explicit and implicit costs associated with increasing debt with respect to both equity holders and debt holders, and advocates the use of some positive moderate level of debt in the firm's capital structure, as illustrated in figure 2.6.

The model is an improvement upon the other conventional models for a number of reasons. Firstly, it introduces the concept of bankruptcy costs (risk) and explains how such costs increase the return demanded by equity holders (to compensate them for the increased risk of those returns) and debt holders (in the form of monitoring costs). Secondly, the model proposes an optimal positive but moderate level of debt, which is consistent with real world evidence. However, the model is still extremely naive, is a partial-equilibrium approach, and takes no account of the most important distortion to the corporate finance market, that is, taxation.

Figure 2.6
The relationship between the debt-equity ratio and firm value under the Traditional Approach



2.2.4 Summary of the conventional corporate capital structure models

The conventional models are therefore naive models, developed within a perfect market framework, and ignore important real-world finance market distortions such as taxation. There is also very little empirical evidence which could be used to directly support or refute the propositions of such models. Indeed, the extreme debt positions proposed by the NI Approach are simply not observed in the real world and the capital structure irrelevance proposition of the NOI Approach is notoriously difficult to test directly. Even the Traditional Approach is questionable, as it is still relies upon many restrictive assumptions. However, examination of the models is essential to a greater understanding of the development and contribution of the seminal Modigliani and Miller models which followed.

2.3 The Modigliani and Miller capital structure models

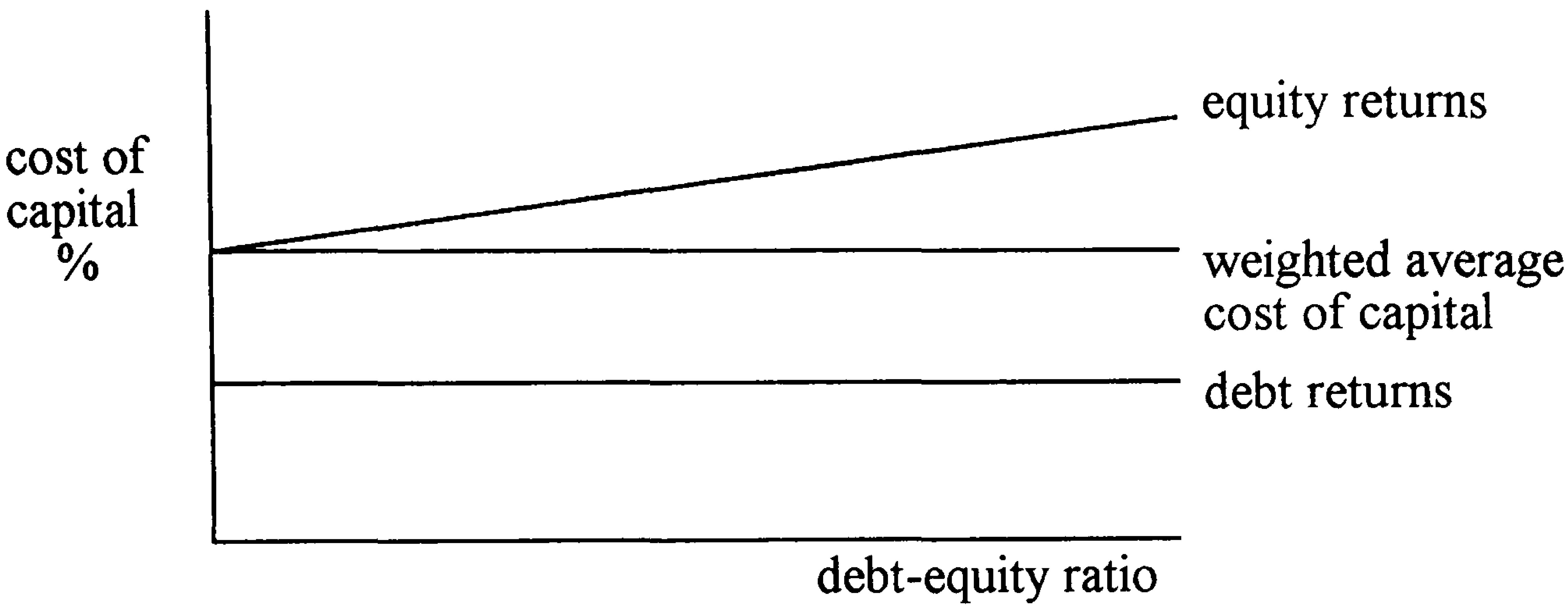
2.3.1 Introduction

The conventional models of corporate capital structure attempted to explain how firms determined the mix of funding instruments used to finance their investments. The models varied in complexity, depending mainly on the degree to which the implicit costs associated with debt and equity were accounted for. The Traditional Approach produced a proposition of the existence of an optimal firm-level capital structure containing some moderate level of debt, a proposition which appeared to be reflected in real world observation of firm capital structures. As the conventional models lacked any formal mathematical derivation, the area remained dominated by arguments based in pragmatic conservatism and institutional guide-lines. However, the revolutionary paper of Modigliani and Miller in 1958 marked the beginning of a rapid development in the field of corporate finance, mainly because the model they produced was mathematically derivable and empirically testable. Section 2.3 discusses the 1958 and subsequent Modigliani and Miller papers, as they progress from the non-tax to the general equilibrium taxed environment.

2.3.2 The Modigliani and Miller (1958) model

Modigliani and Miller in their ground-breaking paper of 1958 produced a mathematical model of the corporate capital structure, questioning the optimal capital structure proposition of the Traditional Approach, and setting in place a coherent framework for the theoretical development and empirical testing of subsequent models. Their main proposition was that the firm cannot increase its value merely by packaging its cash flows differently. The model they developed made many simplifying assumptions such as: the existence of efficient capital markets; the absence of bankruptcy costs and transactions costs; the ability of equity holders to borrow at the same rate as companies; and the existence of two firms of identical income and risk which differ only with respect to gearing. They argued that as the level of debt increases, the weighted average cost of capital remains constant. This is because as the relatively cheaper debt (lower returns paid to debt holders than equity holders) is increased in the firm's capital structure, it is exactly offset by the increased returns demanded by equity holders (which reflects the increased risk of the firm's earnings being paid entirely to debt holders in the form of mandatory interest payments). This invariance is illustrated in figure 2.7.

Figure 2.7
The weighted average cost of capital within the MM (1958) model



Indeed, MM proved, more formally, that the return demanded by equity holders is equal to the expected return from an ungeared firm plus a premium which is a linear function of the amount of debt in the firm's capital structure:

$$i_j = \rho_k + (\rho_k - r).\frac{D_j}{S_j} \qquad \text{Equation 2.1}$$

where:

i_j= the expected rate of return on the stock of any company j belonging to the kth class

ρ_k = the expected return from an identical ungeared firm

r = the risk-free rate of interest

D_j = the market value of debts to the company

S_j= the market value of a firm's common shares

Therefore, the increased risk associated with increased debt is immediately, exactly and proportionately accounted for in the increased returns demanded by equity holders. The invariance of market value to capital structure changes is underpinned by the concept of arbitrage. If the total bonds and equity of a firm sell at a price greater than the total equity of another identical firm which employs no debt, the arbitrage process ensures that the prices converge in equilibrium, and thus there is no equilibrium advantage to the geared over the ungeared firm.

The MM model thus proposes that the capital structure chosen by the firm is irrelevant and that the firm should only concentrate on maximising the returns from its investment projects and not on the financing of those projects. However, the assumptions employed by MM to develop the model are restrictive and some are unrealistic. Each assumption shall be briefly discussed. The assumption that there are no bankruptcy costs must be questioned, as the assets of the firm when sold at their "break-up" value may only reach, say, half of their going-concern value in the event of bankruptcy leading to liquidation. The legal and accounting costs of bankruptcy are also likely to be significant. Though bankruptcy costs are probably significant at high levels of debt, they may be insignificant to the average firm. Bankruptcy costs are examined in more detail in chapter 3. The assumption that capital markets are efficient is reasonable as there is strong evidence to support it. Brealey (1970) produced evidence in support of weak-form efficiency and Firth (1967) produced evidence to support semi-strong-form efficiency. The assumption of zero transactions costs is unrealistic as the brokerage costs, for example, borne by investors are likely to be significant, preventing frequent dealing in equity and bond markets. The assumption that there exists two firms of identical income and risk, differing only in respect to the presence or absence of gearing is questionable. However, Stiglitz (1969) shows that the MM theorem does not depend on the existence of risk classes in his general equilibrium state preference model, although the assumption that individuals can borrow at the same market rate of interest as firms and the assumption that there is no bankruptcy remain important to this proof.

Authors such as Weston (1963) argued that the assumption that equity holders can borrow at the same rate as companies is unrealistic. Firms have the advantage of economies of large borrowing and generally also have significant collateral to support such borrowing, whereas investors have neither of these benefits. However, investors may effectively gain such corporate borrowing facilities by investing in investment trusts and other intermediaries. Overall, the interest gap remains a significant characteristic of the finance market, which questions MM's concept of arbitrage and home-made gearing.

Probably the main shortcoming of the MM (1958) model is that it failed to correctly account for corporate taxes, an error which spurred the 1963 model to follow. Empirical evidence to test the MM (1958) propositions is provided by MM themselves (1958), Weston (1963), Barges (1963), and Sametz (1964).

MM(1958) cited studies by Allen (1954) and Smith (1955), who studied 43 large electric utilities and 42 oil companies, respectively, to examine the effect of gearing on the cost of capital and the effect of gearing on equity returns. They found that the slope coefficient in a regression of the cost of capital on the debt-equity ratio was insignificantly different from zero, confirming their irrelevance proposition and questioning the optimum proposed by the Traditional Approach. They found also that the slope coefficient in a regression of equity returns on the debt-equity ratio was significantly positive, confirming their proposition that equity returns increased with gearing to maintain the capital structure irrelevance proposition. This result also questions the Traditional Approach as the slope should be insignificant if the approach holds. Therefore, MM argued that the evidence from these two studies supports their capital structure irrelevance proposition.

Barges (1963) strongly criticised the empirical work that Modigliani and Miller conducted to support their 1958 model. His first criticism was that, for the "utilities" that they examined, MM did not have a sufficient number of observations on certain parts of the capital structure range to allow the bold inferences made. Barges noted particularly that most of the observations for debt-to-total-market-value ratios fell between 50% and 80%. The second criticism was that, for the oil companies, their nature is too diverse and thus cannot even approximate a homogeneous risk class, which MM (1958) require as a fundamental in their analysis. The differences in the oil the markets, products and so on, of the oil companies render them a very heterogeneous grouping. Thirdly, Barges questioned the use of current earnings as an approximation to expected future earnings. Particularly in the oil industry, stock values tend to reflect the value associated with oil properties and reserves which do not contribute to current earnings but will certainly contribute significantly to future earnings.

Barges did not suggest that these three criticisms are capable of refuting the MM (1958) empirical work, but argued that they make the MM tests appear weaker and less convincing. However, a fourth and final criticism that he proposed:

> "is sufficiently great to cast serious doubt on the meaning and validity of the tests". (Barges (1963), p.23)

This criticism centred on biases within the MM empirical work. Barges listed five main heterogeneous factors, which cause variations in yields within a risk class: business risk; the degree of market imperfection; dividend policy; errors of measurement; and firm size. The bias that these factors produce is enough to undermine the empirical work of MM (1958) because the bias caused by the heterogeneous factors all pulls in the same direction. Therefore variations within the risk class cause variations which are not accounted for in the regression model testing of the MM research.

Barges proceeded, then, to test three industry classes which were less prone to the deficiencies just described, and which were adjusted for the shortcomings of the MM (1958) empirical work. The industry classes were: Class I railroads, department store companies, and cement companies. He conducted two types of tests. Firstly, he examined the relationship between the average cost of capital and the total market value of the firm, and secondly, he tested to determine whether equity returns increased as firms' employment of debt varied from zero up to some moderate debt level. For the railroad companies, a positive relationship was found between equity returns and the debt-equity ratio, which appears to support the MM (1958) hypothesis. However, when the relationship between average cost of capital and the debt-equity ratio was tested, it revealed a significant relationship, which strongly refutes the MM hypothesis that the choice of capital structure is irrelevant. For the department stores and cement companies, there was found to be no significant correlation between equity returns and the debt-equity ratio up to the moderate debt range. Thus, as equity returns did not increase with increasing debt, then MM (1958) appears to be questioned, as this was a fundamental part of their theory.

Barges concluded that:

> "...on the basis of the evidence presented herein, the hypothesis of independence between average cost and capital structure appears untenable". (Barges (1963), p.103)

Thus, Barges questioned the methodology of the MM (1958) empirical testing, produced evidence in support of a relationship between the weighted average cost of capital and the debt-equity ratio, and questioned the increase of equity returns as the level of debt rises; all of which must weaken the MM (1958) irrelevance proposition.

Weston (1963) criticised the MM (1958) empirical studies and conducted his own empirical testing with certain corrections. He expressed four main criticisms of the empirical tests of MM. Firstly, the arbitrage operations of MM were not possible because personal leverage is not a perfect substitute for corporate leverage. Secondly, he questioned the identification of risk class with an industry, as industries such as the oil industry are extremely heterogeneous. The oil industry, for example, consists of firms, at different stages of vertical integration, with markets ranging from regional to international, and with varying degrees of diversification (horizontal integration). Thirdly, Weston argued that the time period studied was unrepresentative as equity prices in the late 1940's were low, and thus earnings-price ratios were high, a phenomenon more likely to produce favourable results for MM. Finally, the MM measure of the current earnings-price ratio understated the cost of capital of a firm experiencing earnings growth. Therefore, Weston strongly questioned the methodology and data of the MM empirical tests.

Given the apparent shortcomings of the MM tests, Weston conducted his own tests upon the electrical industry, which he argued was more homogeneous than the oil industry. His main correction was to account for the influence of the growth of earnings per share on both the cost of equity and the overall cost of capital, as he found such growth to be highly correlated with these measures. Once growth was accounted for, the level of gearing no longer exerted a significant influence on equity returns and the cost of capital became significantly related to the level of gearing. Weston therefore argued that his evidence, with the important correction for growth of earnings, supported the Traditional Approach and questioned the results of the MM(1958) study. Thus, he argued that not only were the MM tests methodologically unsound, but new evidence suggested that the MM proposition of capital structure irrelevancy did not hold.

However, Sametz (1964) produced evidence which supported, to some extent, the MM(1958) capital structure irrelevance proposition. He studied the debt-equity ratio of US non-financial corporations over the period 1901 to 1962 and found that:

> "It seems clear that the major secular constant in corporate financial decision--making is the aggregate debt-equity ratio ..." (Sametz (1964), p.451)

Sametz compared the periods 1901-1929 and 1930-58 and found that there had been no more than a 2 per cent change in the debt-equity ratio over those periods, even though the structure of debt and equity changed significantly over these periods as short-term debt and internal equity rose and long-term debt and external equity decreased. He argued that in the MM (1958) model, where the debt-equity and pay-out ratios are variables, the comparative the costs of equity finance and debt finance are irrelevant because the mix of the capital structure does not affect the average cost of capital as the sum of interest rate on debt and the risk differential must be equal to the earnings-price ratio. He concluded that any debt-equity ratio may be considered optimum and might as well be left unchanged, therefore providing some indirect support for the MM (1958) propositions.

In addition to a pure critique of the restrictiveness of the assumptions of the MM (1958) model, some authors sought to determine which of the MM assumptions are essential to the proposition that the financing decisions of the firm are irrelevant, as a means of generalising and thus strengthening the proposition.

Stiglitz (1969,1974) argued that in addition to the perfect market assumption made by MM, it is essential that bonds issued by firms and individuals must be free of default risk. He argued that the most restrictive assumption underlying the capital structure irrelevance proposition that individuals can exactly "undo" any financial policy undertaken by the firm is that of no bankruptcy. The reason for this, he argued, is that it is not reasonable to assume that the price of bonds for which there is a positive probability of default at maturation would be the same as the price of a riskless bond. Indeed, bankruptcy alters the opportunity set facing the individual so that the value of the firm is changed and the financial policy of the firm becomes relevant.

However, Fama and Miller (1972) demonstrated that the capital structure irrelevance proposition still holds when debt is risky as long as stockholders and bondholders protect their claims on the firm with "me-first" rules. Under such rules, bondholders would ensure that their debt is senior to any new debt issued, such that the old bondholders are paid off before the newer bondholders in the event of bankruptcy.

Also, stockholders would ensure that the firm does not conduct its financing decisions so as to improve the positions of any bondholders. Therefore, given these me-first rules, the market value of a firm remains unaffected by its financing decisions even if debt is risky.

The generalisation of the capital structure irrelevance proposition was developed even further by Fama (1978), who showed that even the "me-first" rules are unnecessary to the capital structure irrelevance proposition when allowing for risky debt. His argument is underpinned either by the assumption that investors and firms have equal access to the capital market or the assumption that no firm issues securities for which there are not perfect substitutes available from other firms.

Fama assumed that the capital market is perfect, that firms and individuals have equal access to capital markets, that all market agents have access to all available information and agree about its implications for firms and securities, and that the investment strategies of firms are given. Given these assumptions, if unprotected securities are issued at time 0, then at time 1 firms may be able to use their financing decisions to affect the positions of their security holders. At time 0, neither the range of securities that can be traded nor the instruments chosen by investors are affected by the financing decisions of firms in an equal access market because if firms did not offer the positions that investors would like to hold, then investors could create their desired positions by trading among themselves. Therefore, the positions that investors take at time 0 do not change regardless of changes in the financing decisions of firms at time 0. At time 1, if some investors benefit or lose from their unprotected positions, such expropriation occurs to the same degree for any set of financing decisions by firms at time 0. When equal access to capital markets is assumed, the financing decisions of firms will not affect the positions that investors take in firms, the prices that they pay for such positions, or the market values of the firms. Therefore, even when bonds are risky, as long as equal access is assumed, the financing decisions of firms are still irrelevant to investors. Intuitively, the creators or purchasers of bonds are never surprised by any event that occurs during the life of a debt contract, and thus the price of the debt contract always fully reflects the probability of expropriations that may occur.

Alternatively, it may be assumed that there are always perfect substitutes for all securities issued by any firm, the capital market is perfect, complete agreement exists, the investment strategies of firms are given and the firm aims to maximise its total market value at whatever prices are observed in the market. If these assumptions are made then changes in the financing decision of the firm do not affect the firm's market value, investors, or the prices of different types of securities. If unprotected securities issued by different firms at time t-1 are perfect substitutes then any expropriations at time t will be the same for all firms, and therefore expropriations will be the same for all financing decisions made at time t. At time t, when the state of the world is known, firms make their financing decisions and a general equilibrium is established whereby equilibrium prices and firms values are determined. If a firm which has unprotected securities changes its capital structure then the change cannot bring about expropriations beyond those of the firm's original financing decisions at time t. Therefore, even where debt is risky and me-first rules do not hold, the market can regain a general equilibrium if other firms exactly offset the firm's capital structure change, resulting in the aggregate supplies and prices of different securities remaining unchanged.

Therefore, by employing either of the two assumption sets, Fama demonstrated that the market value of the firm is not affected by its financing decisions, and additionally, that a firm's financing decisions have no effect on its security holders. This is because there are mechanisms that shield the opportunity set facing investors from the effects of firms' financing decisions. The Fama (1978) paper thus generalises the MM (1958) capital structure irrelevance proposition by relaxing some of its restrictive assumptions, particularly the assumption that debt is free from default risk. The effect of this is to strengthen the proposition, giving it greater support, as it does not rely on such a restrictive assumption set.

The Modigliani and Miller (1958) model therefore developed a coherent framework for the analysis of the corporate capital structure decision. The invariance of the overall cost of capital as debt increases was an appealing proposition, as it suggested that managers should concentrate upon the investment decision and disregard the form of the investment funding. The arbitrage proof underpining the invariance proposition was demonstrated by authors such as Fama (1978) to hold under a far less restrictive set of assumptions, thus strengthening its appeal. The evidence in support of the model is weakened by the non-homogeneity of the industries studied and by the lack of consideration of growth. Correction for such failings produced evidence which strongly questioned the applicability of the MM (1958) model to the real world finance market and appears to support the Traditional Approach with its capital structure relevance proposition. However, neither the MM model nor the related empirics correctly considered the effects of taxation, which were to become of central importance to the literature which was to follow. The correct consideration of taxation therefore represents an important development in capital structure theory, bringing the theoretical developments closer to the real world corporate capital structure environment.

2.3.3 The Modigliani and Miller (1963) model

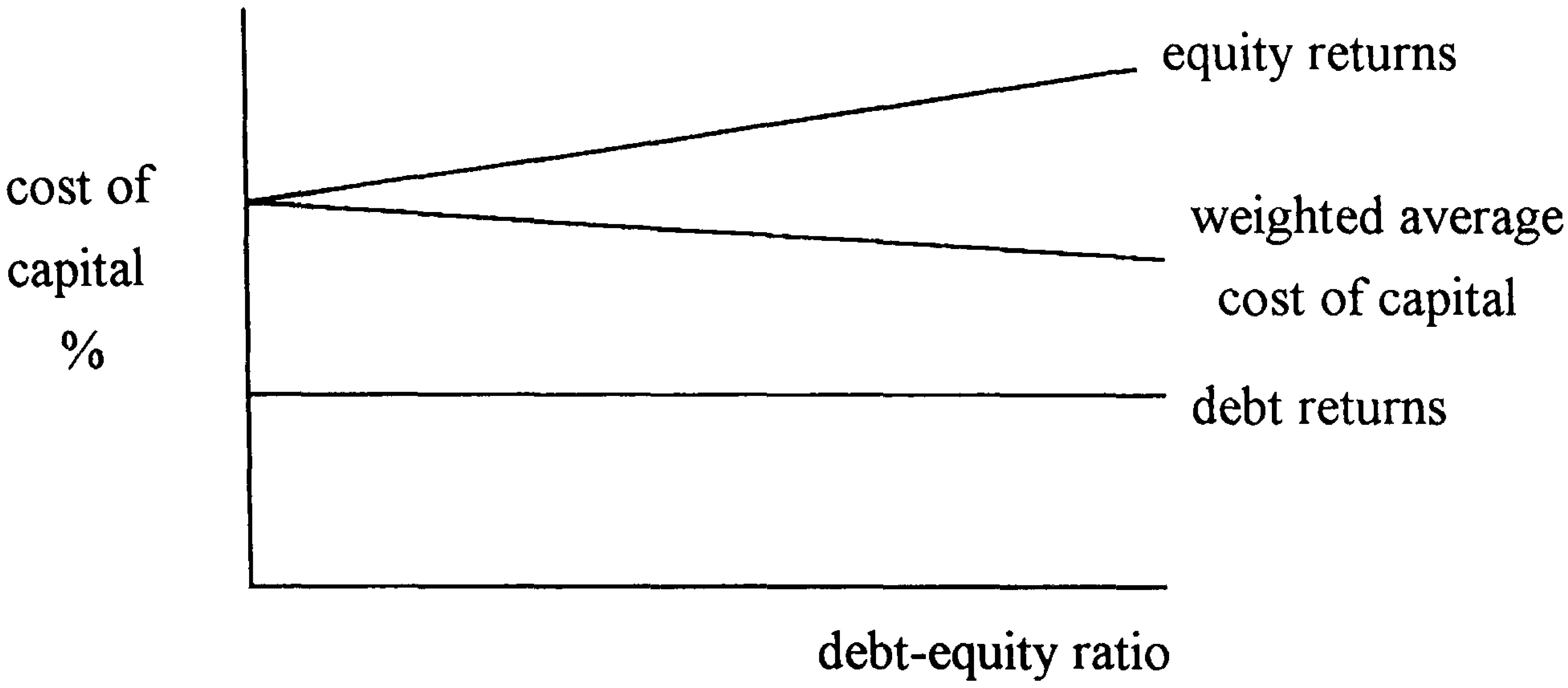
The MM (1958) model failed to correctly take into account the important impact of corporate taxes. Their 1963 paper is known as the "MM Tax Correction Paper", as it corrected a fundamental error made in the earlier paper. The 1958 paper stated that:

> "It can be shown ... that the market values of firms in each class must be proportional in equilibrium to their expected returns net of taxes ..."
> (MM (1958), p.272)

MM recognised that this statement was erroneous. If two firms of equivalent risk have different degrees of gearing, even though one firm may have an expected post-tax return double that of the other firm, the actual post-tax return will not always be double that of the second firm. There is thus no arbitrage mechanism to ensure the proportionality of values to their expected post-tax returns because the distribution of post-tax returns of the two firms is not proportional. They argue that this "arbitrage" renders firm values within a risk class a function of expected post-tax returns as well as the tax rate and gearing level of the firm, in effect increasing the tax advantage to debt to a significant level. Therefore, a tax advantage to debt arises from the corporate tax deductibility of debt interest payments, whilst under a classical tax system dividend payments are not tax-deductible against the corporation tax bill. The value of the firm thus becomes the value of an identical ungeared firm plus the value of the tax shield. The tax shield is simply the effective corporate tax rate multiplied by the market value of debt issued. Therefore, the greater the debt-equity ratio, the greater is the tax shield and the greater is the value of the firm.

Figure 2.8 shows that the weighted average cost of capital decreases constantly as the degree of gearing increases. Though the equity holders demand higher returns to compensate them for the higher risk associated with increased debt, the much cheaper post-tax debt outweighs this, and thus the overall cost of capital decreases as debt increases.

Figure 2.8
The cost of capital under the MM(1963) model



The MM (1963) tax advantage to debt proposition appears to advocate a limitless use of debt financing, such that firms should ideally employ 99.9 per cent debt in their capital structures. This is a weak result as such extreme capital structures are not observed in the real world. However, MM argued that the distinct tax advantage to debt does not necessarily lead to extreme gearing positions due to such factors as the tax status of investors, limitations imposed by lenders and the need to maintain some spare corporate debt capacity. Franks and Broyles (1979) argued that financial conservatism was inadequate as a reason for the lack of evidence of extreme debt positions across firms, and further argued that the increasing financial risk, moral hazard, monitoring costs and legal problems related to extreme debt would force banks to limit the firm's borrowing to moderate levels. Many other factors, such as tax exhaustion, may limit the firm's use of debt, but these factors are considered in later sections.

To summarise, the Modigliani and Miller (1963) model revealed that, when corporate taxes were added to their model, a distinct tax advantage to debt existed, resulting from the tax-deductibility of debt interest payments.

MM (1966) sought to support their 1963 model with evidence from the electric utilities industry. They argued that their sample suffered less from the criticisms made concerning the 1958 empirics, and that the study sample was large, extremely homogenous, utilised uniform accounting conventions and exhibited highly stable earnings. For the years 1954, 1956 and 1957, they computed two-stage least squares models of the valuation of the firm. To ascertain the contribution of the different factors to market value, they multiplied the model coefficient estimates by the sample mean values for each of the years. The factors they modelled were: the capitalised earnings on assets currently held, the tax subsidy on debt, growth potential, and the difference between infinite size and the mean size of firms in the industry. The most important contributor to market value in this model was the capitalised earning power of assets currently held, which is an unsurprising result. The next most important contributor was the tax subsidy to debt, followed by the future growth potential and the size measure. As the tax subsidy was found to be significantly related to the value of the firm, this supported the MM (1963) model.

However, as with the evidence related to the 1958 model, the MM empirics of 1966 were subject to some fundamental criticisms with regard to the data, the methodology employed, and the strength of the results. Boness and Frankfurter (1977) argued that even the electricity industry was diverse in nature and may not be considered analogous to a risk class. Freear (1980) argued that MM's data sets were too narrow to distinguish between support for the 1958 or 1963 models. Freear thus argued that tests of the narrow middle capital structure range could not be used to represent the full range of capital structure ratios from the underlying population, particularly for extreme gearing positions. This is a particularly important criticism as it is at such extreme capital structure ratios that models may be more readily distinguished, and thus the MM (1966) empirics cannot support such a strong inference. Evidence from Sametz (1964) also strongly questioned the MM post-tax propositions. In his study of the capital structures of US non-financial corporations, as discussed earlier, he found that the aggregate debt-equity ratio remained very stable. He argued further that, as the corporate tax rate rose substantially over the study period, a rise in the debt-equity ratio would be expected, as the tax advantage to debt increases. However, the stability of the debt-equity ratio questions the MM (1963) model, because any increase in the tax advantage to debt was not reflected in corporate capital structures over the period.

Therefore, though MM's 1966 empirical evidence represented a significant methodological improvement upon their 1958 empirics, their study was still flawed with data problems, and evidence from Sametz strongly questioned the significance of any corporate tax advantage to debt. However, evidence from Hamada (1972), Masulis (1980,1983) does provide some support for the MM (1963) model.

Hamada (1972) examined the effect of the firm's capital structure on the systematic risk of common stocks, as a means of testing the MM (1963) model. The MM theory predicts that all firms in the same risk class have the same capitalisation rate regardless of their degree of gearing, and thus ungeared betas should be equal, and geared betas should change with the level of gearing. The Traditional view would postulate that the ungeared beta should remain constant up to some critical level of gearing. Hamada argued that:

> "... by specifying reasonable a priori risk-classes, if the individual firms had closer or less scattered A-betas (unlevered betas) than B-betas (levered betas) then this would support the MM theory and contradict the traditional theory." (Hamada (1972), p.448)

The data studied were US Compustat and CRSP data for 304 firms for the period 1948 to 1967. Three statistical tests were employed to determine this degree of spread: calculation of the standard deviations of the beta distributions; a Chi-square test of the total sample beta distribution compared with specific industry beta distributions; and the computation of an analysis of variance of betas between industries. It was found that the ungeared betas were far less spread than the geared betas and that there was more clustering of ungeared than geared betas. The ratio of estimated variance between industries to the estimated variance within industries was far less for geared than for ungeared betas. The results thus supported the post-tax propositions of the

MM (1963) model, supporting the proposition that there exists an optimal level of gearing deriving from the corporate tax advantage to debt compared to equity.

Masulis (1980) examined the change in the market value of the firm following capital structure changes, by studying the impact of pure capital structure changes, in the form of exchange offers, on security prices. He defined an exchange offer as follows:

> "... an exchange offer gives one or more security classes the right to exchange part or all of their present holdings for a different class of firm securities." (Masulis (1980), p.148)

He utilised the "Comparison Period Returns" approach which allowed security-specific announcement effects to be separated from unrelated market pricing effects, to study 163 US exchange offers from 1962 to 1976. The results of the study were that gearing increases produced a common stock portfolio two-day announcement period return of 7.6 per cent, with 79 per cent of such stocks exhibiting positive returns for that period. Gearing decreases produced a return of -5.4 per cent, with 84 per cent of stocks showing negative returns. Therefore, Masulis' study provides strong support for the MM (1963) distinct tax advantage to debt proposition. Moreover, by examining different types of security class exchanges, and by isolating effects by means of separating his sample into exchange-type sub-groups, Masulis found evidence of a corporate tax shield effect and a wealth distribution effect across security classes, though no evidence of an expected cost of bankruptcy effect. Thus, not only did Masulis find evidence of a strong relationship between gearing and firm value, he also found evidence that this was partly caused by a tax subsidy to debt effect.

Masulis (1983) again studied US exchange offers to ascertain the nature of the relationship between equity returns and gearing changes. For a sample of 133 US exchange offers between 1963 and 1978 he regressed equity returns upon an expected "normal" return on equity, gearing increase and gearing decrease variables, and other regressors representing wealth transfers between holders of other firm financial instruments. The estimated model was able to explain 54 per cent of the variability in returns following announcement of exchange offers. The gearing change variable coefficients were significant and positive, revealing a greater reaction to gearing increases than decreases. The model confirmed the results of his empirical study of 1980, showing that changes in firm gearing are positively related to equity prices and firm value. He therefore concluded that:

> "This evidence was shown to be consistent with tax based models of optimal capital structure and leverage induced wealth transfers across security classes as well as with information effects concerning firm value which are positively related to changes in firm debt level."(Masulis (1983), p.125)

Therefore his work supports the MM (1963) post-tax propositions of a distinct tax advantage to debt, as well as the information signalling models created by authors such as Ross (1977).

The MM (1963) model, which proposed a distinct tax advantage to corporate debt, appears, on balance, to be supported by the evidence reviewed. Though the model logically proposes an optimum level of debt of almost 100 per cent of the firm's capital structure, it is clear that firms do not employ such gearing levels, and thus some optimal positive "moderate" level of debt would appear more reasonable, particularly if such factors as bankruptcy costs, agency costs, and so on, offset some of the advantages to debt finance. Such factors are discussed in detail in chapter 3, along with other non-tax factors influencing the corporate capital structure decision.

2.3.4 The Miller (1977) general equilibrium model

The MM (1963) model was criticised for the reason that, although it took corporate taxes into consideration, it did not consider the effect of personal taxes. The Miller (1977) general equilibrium model corrected for this shortcoming, and proposed that the presence of taxes on personal income was capable of reducing or even eliminating any corporate tax advantage to debt.

The value of the tax shield to equity holders in the firm becomes:

$$\text{Tax shield value} = \left[1 - \frac{(1-T_C)(1-T_{PS})}{(1-T_{PB})}\right].B_L \qquad \text{Equation 2.2}$$

Where:

T_C = the corporate tax rate

T_{PS} = the personal income tax rate on equity

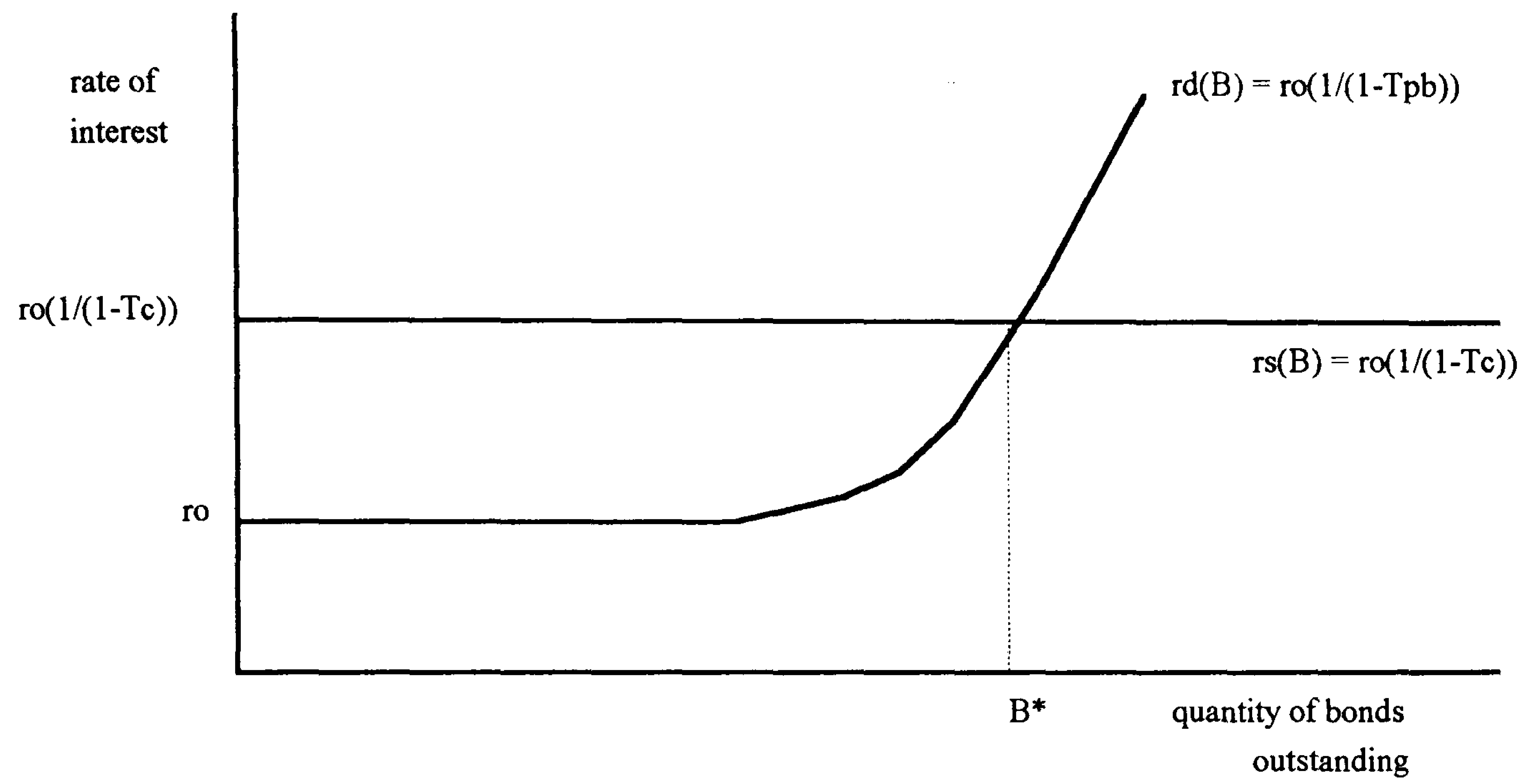
T_{PB} = the personal income tax rate on debt

B_L = the market value of the geared firm's debt

The value of the tax shield reduces to zero, intuitively, when all the tax rates are set to zero. In the event of the equity income tax rate equalling the debt income tax rate, the tax advantage to debt is merely $T_C.B_L$, that is, the tax advantage to debt proposed by the MM (1963) model. In the event of the equity income tax rate being less than the debt income tax rate, Miller argued, the tax advantage to debt is much less than the value, $T_C.B_L$, and may even be reduced to zero or a disadvantage to debt. However, when $(1-T_{PB})$ equals $(1-T_C)(1-T_{PS})$ in the equation, there is no advantage to the firm at all of issuing debt as opposed to equity, and the market is in equilibrium.

Miller illustrated his general equilibrium proposition in a diagrammatic form. He made the simplifying assumptions that: personal tax rates on equity income are zero and that all bonds are riskless and there are no transactions costs or other issue costs. In figure 2.9, $r_d(B)$ represents the demand for bonds by investors and r_0 is the equilibrium rate on fully tax-exempt bonds. Miller argued that the flat section of the demand curve, $r_d(B)$, shows the demand for fully taxable bonds by fully tax-exempt investors, as only such tax-exempt investors would be interested in purchasing bonds at the low interest rate, r_0. However, the interest rate must be higher than this rate to persuade taxable investors to purchase bonds, as the higher interest rate must compensate them for the taxes they must pay on debt income. This produces a demand rate of interest of $r_0 / (1-T_{PB}^{\alpha})$. To attract higher tax bracket investors the demand interest rate must rise further. At B^*, the demand rate of interest equals the supply rate of interest (the tax-exempt rate grossed up by the corporate tax rate), $r_0 / (1 - T_C)$, and thus the quantity of bonds B^* represents the market equilibrium level of debt. Therefore there is a market equilibrium debt-equity ratio, in aggregate, of B^*, but no optimum for the individual firm.

Figure 2.9
Equilibrium in the market for bonds within the Miller (1977) model



The model represented a significant improvement upon the 1963 model as it included both corporate and personal taxes, which are probably the most important distortions in finance markets. For the first time, a coherent general equilibrium model of capital structure was created, bringing together both firms and investors in the same model to reach an equilibrium. It is interesting that the capital structure irrelevance conclusion emerged again, a conclusion similar to the pre-tax MM propositions but for the fact that the 1977 model proposed an aggregate optimal capital structure.

Probably the main criticism of the Miller (1977) model concerned the initial simplifying assumption that the personal tax rate on equity is effectively zero, although some of the other assumptions that were retained from his earlier models with Modigliani were still questionable. Miller and Scholes (1978) argued that, in the US, individuals can postpone the realisation of capital gains until their death by utilising various tax shelters, thus escaping capital gains taxes. However, it is observed that individuals do indeed pay taxes on capital gains and also on dividend income in the real world, an observation which weakens Miller's 1977 model.

Miller noted that the model is consistent with the fact that the US corporate debt ratio did not rise substantially despite the enormous increases in tax rates since the 1920's, mainly because, he argued, the tax rate changes moved in the same direction.

The most comprehensive tests of the Miller general equilibrium model were conducted by Kim, Lewellen and McConnell (1979) (hereafter known as KLM). They extended Miller's analysis to show how financial leverage clienteles would emerge from his tax framework for the US, and then conducted tests upon three empirically testable implications of the leverage clientele hypothesis. The results of their extension of the Miller framework were that the investors with marginal tax rates greater than the corporate tax rate would demand the equity of ungeared or negative-geared firms, whereas investors with marginal tax rates less than the corporate tax rate would demand the equity of firms which are highly geared. Thus, firms would respond to such demand by specialising their capital structure mix in either zero or high gearing ratios.

The empirically testable implications of their analysis are as follows. Firstly, it would be expected that firms of similar nature, such as the same industry group, would not have similar capital structures, otherwise investors would not be able to achieve both adequate diversification and the amount of corporate gearing they desire. Secondly, they argued that there should be a negative cross-sectional relationship between firm capital structures and equity holder tax rates, if investors specialised their portfolios in relation to the gearing policies of firms. Moreover, the equity of firms with low gearing should be held by high bracket tax payers and highly geared firms' equity should be held by low bracket tax payers. Thirdly, the distribution of firm gearing ratios should be bimodal, with one mode centred at zero gearing and the other centred around some high gearing level, following from Miller's 'bond holder surplus' concept. Equity holders associated with the lower mode should be high tax bracket investors, paying tax at a rate higher than the corporate tax rate, whereas equity holders associated with the higher mode should be low tax bracket investors, paying tax at a lower rate than the corporate rate. Such testable implications of the Miller model are only indirect, KLM argued, as they are tests of implications rather than tests of hypotheses deriving directly from the model. The tests were conducted upon data from US firms and investors for the period 1964 to 1970.

The first implication is not tested by KLM. However, there are a number of other authors who have tested this implication, that is, the similarity of capital structures within an industry. Such evidence is discussed in detail under the concept of target capital structure ratios in chapter 3, and thus the results are only briefly summarised here. Schwartz and Aronson (1967), Scott (1972), Scott and Martin (1975), amongst others, found evidence in support of the existence of significant differences in gearing ratios between, but not within, particular industries. There is less evidence of the converse, but authors such as Ferri and Jones (1979), did find a wide dispersion of gearing ratios within the same industry. Therefore, evidence on this first implication of Miller's model is mixed, though probably questions rather than supports the implication. Firms of similar nature <u>do</u> appear to have similar capital structures.

The second implication to be tested was the relationship between corporate capital structures and investor tax rates. To do this, KLM ranked the sample by the debt-equity ratio of firms, divided the sample into deciles, and calculated the mean gearing ratios and mean tax rates of the associated equity holders. However, they found little evidence of the negative cross-sectional relationship between gearing ratios and investor tax rates, implied by the Miller model. Therefore, investors of specific tax brackets are not attracted to firms merely because of their gearing policies, a result which questions Miller's concept of financial leverage clienteles.

The third implication of the Miller model to be tested was the existence of a bimodal corporate capital structure distribution. For both total-debt-to-total-capital and long-term-debt-to-long-term-capital, KLM found evidence of a bimodal distribution. The lower modes were found to be close to zero, as expected, but the upper modes, in the 30-35 per cent range, fell short of what might be expected and were not pronounced. Thus, there is some weak evidence of bimodal corporate capital structures, giving some support to the Miller model. Related to the third implication, KLM tested to discover whether the equity of low (high) tax bracket firms was owned by investors with marginal tax rates greater (less) than the corporate tax rate. However, they found no evidence of this, a result which questioned the Miller model. They also regressed the corporate gearing ratios upon the marginal personal tax rates and other characteristics of equity holders in such firms and found that although the marginal tax rate variable was significant, the overall power of the model was very weak.

The evidence deriving from tests of the three implications of the Miller model suggested that there is only weak evidence to support the existence of financial leverage clienteles, a result which questions the concept upon which the Miller model was created. KLM thus concluded that:

> "Financial managers should not be especially concerned about tailoring their firms' capital structure policies to specific shareholder tax groups nor, by extension, about disrupting such a clientele if they decide to change those policies." (Kim, Lewellen and McConnell (1979), p.108)

Though the Miller model represented a more complete consideration of the effect of taxation on corporate capital structures as well as producing a general equilibrium framework, it is generally not supported by evidence from the real world. The model must therefore be considered an impressive framework, spurring further development in the area, but its lack of support by available empirical evidence might suggest that other important variables must be considered in addition to taxation for a more complete understanding of corporate capital structure determination.

2.3.5 Summary of the contributions of Modigliani and Miller

Modigliani and Miller were responsible for: the development of corporate capital structure theory in a more formal, mathematical framework; the creation of a coherent general equilibrium model; the theoretical development of the important influence of taxation; the production of the framework for subsequent critique and development of the area; and for the revitalisation of a debate perceived to be fairly stagnant at the time.

The Modigliani and Miller models thus progressed from a firm-level capital structure irrelevance proposition, through a relevance proposition, reverting again to an irrelevance proposition. It is evident that the question of relevance relies upon the complexity of assumptions employed by the model author. The apparent lack of empirical support for the latter Miller (1977) model must therefore be due to the fact that, though relatively complex, it omitted certain influences, tax or otherwise, which may be necessary to ensure the support of empirical evidence. Taxation influences that require further examination include: the tax advantage to debt in theory and practice; the occurrence of changes in the tax system and the structure of tax rates; and the overall influence of differing tax systems. Sections 2.4 to 2.7 examine these additional influences upon the corporate capital structure in turn.

2.4 The tax advantage to debt in theory and practice

The MM (1963) model proposed a distinct tax advantage to debt over equity which arose from the tax-deductibility of corporate debt interest payments. The model appeared to be supported, generally, by the available evidence, though its apparent advocacy of 99.9 per cent debt capital structures is rarely observed in finance markets. A number of factors, therefore, must work against this effectively limitless tax advantage, to constrain the use of debt to "moderate" levels. The factors might include: the incidence of tax exhaustion (examined later in this chapter); bankruptcy costs and agency costs (examined in chapter 3); uncertainty; and factors related to a specific tax system, industry or firm. As noted in the previous section, the 1963 model only incorporated corporate taxes. With the addition of personal taxes by Miller (1977), the tax advantage to corporate debt is potentially eliminated at the firm level, and thus there is an optimal aggregate debt-equity ratio at the level of the whole market but not for the individual firm. This proposition derived from the interaction of firms and investor leverage clienteles in a model relying upon some very strict assumptions about the structure of tax ratios and implicit assumptions concerning the nature of the tax system itself. Indeed, the Miller model assumed the effective tax rate on equity income to be zero and the model framework was that of a classical tax system, a system not commonly used outside the US. Various authors have found that the Miller (1977) general equilibrium model no longer holds when adapted for different tax systems or when certain assumptions are relaxed. Such criticisms are discussed later. Therefore, it is possible that a distinct tax advantage to debt remains and may vary from country to country, from firm to firm, as different factors influencing the tax advantage to debt are accounted for.

In addition to a tax preference for either debt over equity or vice versa, the tax preference for debt in relation to retained earnings is also studied by many authors. Although this study is concerned primarily with the external funding choice of the firm, where such a tax advantage exists between debt and retained earnings, this is briefly discussed to more comprehensively examine the firm's tax preferences across all of its sources of potential finance.

Firstly, this section discusses the circumstances where the tax advantage to debt may be considerably less than the magnitude suggested by MM (1963). Secondly, the empirical evidence of the authors who have found a positive relationship between the tax advantage to debt and corporate debt-equity ratios is examined. Thirdly, evidence questioning the strength of this relationship is presented. Finally, the overall significance of the tax advantage is discussed, explaining the effects which reduce the tax advantage to debt or even eliminate it completely. Thus, the importance of the tax-deductibility of interest payments on corporate debt is considered in an environment which may effectively offset this tax feature.

The tax advantage may be considerably less than that implied by the MM (1963) model. The model proposed a tax advantage to debt equal to the amount of debt borrowed multiplied by the corporate rate of tax, at least for the US market. Indeed, Franks and Broyles (1979) noted that the tax advantage to corporate debt in the MM formula is different for the UK because of the double taxation of dividends in the US. The US employs a classical tax system whereby dividends are taxed at the corporate level <u>and</u> the personal level, and thus the tax advantage to debt deriving from corporate taxes cannot be replicated by the equity holder by means of "home-made" borrowing. However, in the UK, which employs an imputation tax system, part of this tax advantage <u>can</u> be replicated by the equity holder through home-made borrowing, and therefore, the net tax advantage to debt represents only that part of the tax advantage which cannot be replicated by equity holders. Therefore, the nature of the UK tax system, whereby part of the corporate tax rate is imputed to the equity holder as their payment of personal taxes, reduces the tax advantage to debt to a fraction of the US tax advantage to debt, equal to the difference between the corporate tax rate and the equity holders' marginal personal tax rate, all multiplied by the amount of debt in the firm's capital structure, and then grossed up at the basic rate.

Substituting in the UK rates (correct at 1989) of 0.35 for the corporate tax rate and 0.25 for the average marginal personal tax rate on debt interest <u>and</u> gross dividend income, Ashton (1989) demonstrated that the tax advantage to debt becomes:

$$\text{tax shield value} = \frac{(T - t_s)}{(1 - t_s)}.B = \frac{(0.35 - 0.25)}{(1 - 0.25)}.B = 13.33 \text{ per cent}$$

Equation 2.3

Where:

T = the corporate tax rate
t_s = the personal tax rate on investor income
B = the amount of debt

Therefore, he argued that the tax advantage to debt in the UK was 13 per cent in 1989. However, he further argued that because the gross dividend can be offset against the firm's corporation tax liability under the imputation system, the tax advantage to debt is likely to be reduced from this value. Ashton then argued that in a world with personal taxes, this tax advantage to debt would disappear, particularly because the restrictions on personal tax arbitrage (Auerbach and King (1983), discussed in chapter 3) are an inherent characteristic of the UK system. Ashton thus concluded that the tax advantage to corporate debt was no more than 13 per cent and was therefore much less than the 35-50 per cent (of the face value of debt) often quoted in the US literature.

Mayer and Morris (1982) studied the effect of firm differences in investment activity upon the marginal corporate tax rate of UK firms using the IFS Corporation Tax Model. They found that average present value associated with the tax benefits of different forms of finance was 18 per cent for debt, 7.5 per cent for retentions and -17 per cent for new equity issues.

Cordes and Sheffrin (1983) estimated the marginal effective tax advantage to debt finance, using data from the Treasury 1978 Corporate Master Statistical File and simulations from the Treasury Corporate Tax Model. They found that the average advantage to debt finance, defined as the reduction in corporate tax liabilities divided by the increase in interest deductions causing that reduction, was 0.31 for US corporations as a whole, and also for non-financial corporations. Therefore, Cordes and Sheffrin found the US tax advantage to debt to be far short of the 0.46 often assumed.

In summary, a number of authors found the tax advantage to corporate debt to be very much less than the often assumed nominal tax benefits to debt in the UK and the US. The tax advantage to debt appeared to be reduced because of the nature of the tax system, the structure of tax rates, and the existence of tax exhaustion deriving from insufficient taxable earnings and high investment and other allowances. It remains unclear whether the tax advantage is eliminated by the effect of personal taxes, but it is clear that the tax advantage is less than that proposed by the MM (1963) model.

Though the tax advantage may be significantly less than that proposed by the MM (1963) model, it would still be expected that an increase in any tax advantage present should increase the debt-equity ratios that firms employ. King (1977), Norton (1991), and Rajan and Zingales (1994) found evidence to support this important relationship.

King (1977) created a model similar to the MM (1963) model and tested the relationship between the tax incentives to different forms of finance and the observed pattern of funding in the UK economy. He argues that the optimal financial policy of a firm depends upon the marginal income tax rates of its equity holders. His empirical research thus examines the optimality of different forms of finance, assuming that the personal income tax rate is that applying either to the mean equity holder or the median equity holder. He found that in the period 1947-71 at no time would new equity issues be the optimal source of finance in the UK for the average equity holder and that only in the year 1965 would the median equity holder have a preference for new equity. Furthermore, his tax incentive measures showed that debt would be preferred to new equity issues in every year of the study for the mean and median equity holder. The tax incentive measures that he computed suggested that: retained earnings would predominate in the UK after World War II; new equity issues would be small; and that gearing would increase in importance through time. He found that evidence on the pattern of funding supported these predictions.

King then computed three types of funding ratio: new-share-issues-to-retained-earnings, new-share-issues-to-borrowing, and new-debt-to-retained-earnings, and argued that a positive relationship would be expected between these ratios and the tax incentive measures. He thus regressed the financial ratios: upon the tax incentive measures; upon a multiplicative measure representing the trade-off at the margin between the different sources of finance; and upon the rate of growth of the corporate sector capital stock. The data used were aggregate time series data of UK publicly quoted firms over the period 1950-71, and another independent sample of industrial and commercial firms over the period 1954-71. The tax incentive variable coefficients were found to be predominantly positive, with relationships for the new-share-issues-to-borrowing ratio and new-debt-to-retained-earnings ratio appearing more significant than the new-shares-to-retained-earnings ratio. The coefficients of the multiplicative variables were positive and the coefficients of the growth rate variable were positive and significant. Therefore, King found strong evidence of a positive relationship not only between the debt-equity ratio and the tax advantage to debt, but also between other financial ratios and their respective tax incentive measures. He argued that because this growth rate variable was significant in the financial ratios containing retained earnings, it might be considered as a proxy variable for the need to resort to external finance, as retained earnings are used in preference to debt, which is in turn used in preference to new equity. Thus, the tax incentive to any form of finance, and debt in particular, was found by King to be strongly positively related to its respective financial ratio.

King also created a portfolio adjustment model to explain the behaviour of the debt-equity ratio. He postulated that the target debt-equity ratio (d) would be expected to be negatively related to the tax incentive to issue new equity rather than debt (V_B) and positively related to the tax incentive to issue debt rather than use retained earnings (V_C). Thus:

$$d_t = \alpha_0 + \alpha_1 V_B + \alpha_2 V_C + \alpha_3 d_{t-1} \qquad \text{Equation 2.4}$$

This model was then estimated for UK industrial and commercial firms over the period 1955-71, using a mixed autoregressive and moving average error structure equation. He found that V_B was significantly negatively related to the debt-equity ratio for both the mean and median marginal equity holder tax rates, but that V_C had the incorrect sign and was insignificant for the median tax rate and just significant for the average tax rate. Thus, he included a takeover activity variable to adjust for this inconsistency, and found the tax incentive coefficient for V_C to be positive, though still insignificant. The significance of the coefficient of V_B (the tax incentive to issue equity rather than debt) and the insignificance of the V_C coefficient (the tax incentive to issue debt rather than use retained earnings) suggests that the important choice for the UK firm is not between internal and external funding, it is between the forms of external funding. Retained earnings are likely to predominate over each form of external funding.

Thus, evidence from King (1977) supported the MM (1963) tax advantage to debt proposition, implying a unique interior optimum debt-equity ratio for firms. In general, tax incentives to one form of finance over the others appears to influence the actual choice of funding mix. However, UK firms prefer in general to employ retained earnings, resorting only to external funding when these are exhausted. The tax advantage to debt apparent in the UK appears to strongly influence the choice of debt to new equity issues.

Norton (1991), in his 1984 factor analysis of US Fortune 500 firms, found that tax deductions and tax losses may affect capital structure choice. Thus, this evidence, based on the survey replies of firms, showed that firms perceived there to be a tax advantage to debt, and that tax exhaustion might reduce such a tax advantage.

Rajan and Zingales (1994) studied the capital structures of firms in the G7 countries. They found a positive relationship between the tax advantage to debt and pre-tax earnings flowing to debt in Japan, Italy , Germany and the UK, in the period 1989-91, though no such relationship existed for the US. Therefore the G7 countries' firms generally responded to an increase in the tax advantage to debt by increasing the amount of debt in their capital structures.

Thus, there is evidence not only of a positive relationship between the tax advantage to debt and the proportion of debt in firm capital structures, but also evidence that firms perceive this advantage to be an important factor in their choice of capital structure.

However, Rutterford (1988) and Mayer (1990) question this positive relationship in their empirical studies of corporate capital structures. Rutterford (1988) derived expressions for the tax advantage to debt in a number of countries, assuming that the tax rates on both dividend and debt to be 30 per cent. She found the tax advantage to debt deriving from her formulae to be greatest for US firms and least for Japanese and German firms, which proved to be the exact opposite of the rankings of gearing ratios from sources such as the Wilson Report and the OECD. She concluded that:

> "A relatively high tax advantage to debt or likely demand for debt in a particular country is not related to a high aggregate leverage ratio."
> (Rutterford (1988), p.206)

Mayer (1990) compared the tax incentive to debt with actual average debt-equity ratios in eight countries over the period 1970 to 1985. He found that, in theory, debt was generally preferred to equity in seven of the eight countries he studied, but that there was a universal preference for equity over debt observed in those countries' capital structures. However, Mayer noted that such a study did not take into consideration cross-border tax incentives, and other features of real finance markets and that the tax incentives refer only to 1983 whereas the actual debt-equity ratios related to a much larger time-span. Even though such shortcomings might weaken the result slightly, he argued that the result was still valid. Thus Mayer found evidence that the tax advantage to debt was not positively related to the actual capital structures of firms observed, and that a negative relationship may even exist. Therefore, the evidence of Rutterford and Mayer strongly questioned the positive relationship between the tax advantage to debt and the proportion of debt in the firm's capital structure.

In summary, the tax advantage to debt proposed by Modigliani and Miller appeared to overstate the tax advantage to debt in real world finance markets, as such factors as the nature of the tax system, the structure of tax rates and tax exhaustion may significantly reduce this incentive. There is evidence that firms do indeed perceive the tax advantage to debt to be a significant determinant of their capital structures, and that increases in this tax advantage increase the proportion of debt employed by the firm. However, considerable evidence also exists to question such a relationship. Therefore, firms may indeed perceive there to be a distinct tax advantage to debt, though evidence on the strength of the relationship across countries between the tax advantage to debt and observed debt-equity ratios is mixed. The important time series evidence of King (1977), however, suggests that such a relationship is readily observed through time, at least for the UK.

2.5 The influence of tax exhaustion on the corporate capital structure

Section 2.4 suggested that the advantage associated with the tax deductibility of corporate debt interest payments may influence the capital structure choice of the firm, though the exact nature of the relationship is uncertain. However, the occurrence of tax exhaustion may limit this tax benefit by "crowding-out" the ability of firms to claim the full, nominal tax advantage to debt. Tax exhaustion occurs where a firm has a surplus of capital (or other) allowances or losses carried forward over taxable profits. Thus firms with relatively high investment (and other allowable) expenditures, low taxable profits, or a combination of both, may find that any tax advantage to debt present is reduced or even eliminated.

To examine the precise influence of tax exhaustion upon the capital structure of the firm, it is necessary to look at the theory and evidence. Firstly, the theory models are examined to more fully explain the concept of tax exhaustion, its relation to former capital structure theories, and its implications for corporate capital structure choice. Secondly, evidence on the extent of tax exhaustion is considered. Thirdly, and related to the second section, evidence of the effect of tax exhaustion upon the tax advantage to debt is discussed. Finally, the overall impact of tax exhaustion on corporate capital structure choice is summarised.

Firstly, the theory of models of DeAngelo and Masulis (1980), Mayer and Morris (1982), Mayer (1984) and Dammon and Senbet (1988) are discussed to provide the theory framework necessary to fully examine the problem of corporate tax exhaustion.

DeAngelo and Masulis (1980) developed a state-preference model of corporate gearing choice to examine the sensitivity of the Miller (1977) model to various tax extensions. They found that the existence of non-debt corporate tax shields was sufficient to overturn the Miller proposition of capital structure irrelevancy. Their model demonstrated that such tax shields implied an optimal degree of gearing for each individual firm, and that such an optimum did not require the incorporation of such offsetting factors as bankruptcy and agency costs. Furthermore, they argued that the net corporate-marginal personal tax benefit is of the same order of magnitude as expected marginal default costs, and that if such costs are incorporated the unique firm optimum still occurs. The model predicts that the level of gearing is negatively related to the level of non-debt tax shields. DeAngelo and Masulis therefore argued that the effect of tax exhaustion is extremely important to the determination of corporate capital structures, to the extent that it overturns Miller's firm-level capital structure irrelevance proposition.

Mayer and Morris (1982) studied the effects of different rates of allowances on the marginal rates of taxation of UK firms, using the IFS model of Corporation Tax. They found that such tax allowances depended upon the asset structure and activity of the firm and also the earnings of the firm, and are thus necessarily firm-specific. They concluded that:

> "There are considerable variations across companies in the value of the tax deductibility of interest payments and the mainstream offset of the imputation system." (Mayer and Morris (1982), p.159-60)

Such a conclusion supports the proposition of DeAngelo and Masulis (1980), that the presence of non-debt tax shields is capable of overturning the Miller irrelevancy proposition and implies firm-level optimal capital structures.

Mayer (1984) extended this study of tax exhaustion by introducing uncertainty about the level of taxable earnings into his stochastic model of company earnings. He found that once such uncertainty was incorporated into his model, the value of tax deductions and allowances becomes dependent on the financial and investment policy of the firm. Extreme gearing positions would no longer be optimal as a result of this, and financial or legal constraints on gearing would not be necessary to achieve an optimum. His analysis suggests that firms would set their debt levels based upon their expectations of the level of future earnings compared to their taxable allowances. He concluded that:

> "Tax exhaustion can, and in very many cases does, occur well before bankruptcy so that tax considerations will come into play even at comparatively modest debt:equity ratios." (Mayer (1984), p.32)

Therefore, not only does tax exhaustion appear to be an important determinant of the corporate capital structure (and vice versa), its effect is felt by the firm well before it may reach a position of financial distress. Thus tax acts upon the capital structure, through tax exhaustion, as an offsetting factor to the benefits of debt, even where firms are relatively buoyant and not experiencing significant bankruptcy or agency costs.

Dammon and Senbet (1988) extended the DeAngelo and Masulis model in a state-preference model which allowed for uncertainty and incorporated investment. They found that increases in allowable investment-related tax shields were not necessarily associated with reductions in gearing, when investment was allowed to adjust optimally in their model. The argued that the effect of an increase in such investment tax shields depends on the extent to which substitution and income effects offset each other. The "substitution effect" (developed by DeAngelo and Masulis) derives from the fact that, ceteris paribus, an increase in investment tax shields reduces the value of the debt interest tax shield. The "income effect" derives from the fact that as firm output increases, debt interest tax shields increase in value. They also conducted a cross-sectional analysis and produced the interesting result that:

> "Firms with higher investment-related tax shields (normalized by expected earnings) need not have lower debt-related tax shields (normalized by expected earnings) if firms employ different production technologies."
> (Dammon and Senbet (1988), p.359)

Thus, in their model, increases in investment tax shields need not reduce debt interest tax shields if this condition holds, but if firms <u>do</u> have the <u>same</u> production technologies then there is a negative relationship between the types of tax shield. Dammon and Senbet (1988), then, modified the DeAngelo and Masulis result of a negative relationship between investment tax shields and gearing, arguing that such a relationship would result only if firms maintained identical production technologies.

The theory models of the effect of tax exhaustion appear to strongly support the proposition that there exists a firm-level optimal capital structure, as the extent of tax exhaustion is specific to the individual firm. The value of non-debt tax allowances appears to depend not only on the level of gearing, but also on the asset structure, expected earnings, and production technology of the firm. As earnings are uncertain from year to year, later models accounted for this uncertainty, but still generally produced the same proposition: that an increase in the amount of non-debt tax shields "crowds out" debt interest tax shields, reducing the effective tax advantage to corporate debt.

There is a large body of evidence concerning the extent of corporate tax exhaustion, only some of which is examined here. Evidence from the IRS (DeAngelo and Masulis, 1980), the UK Government Green Paper on Corporation Tax (1982), and Mayer and Morris (1982) is discussed.

DeAngelo and Masulis (1980) reviewed evidence from the US IRS which found that investment tax shields ($49.5 bn.) were of the same order as debt interest tax shields ($64.3 bn.) in 1975. They also studied Statistics of Income data for the period 1964-1973 and found that, for the US, 27 per cent of US firms paid no taxes at all in a given year period. Therefore, investment tax shields are as significant as debt tax shields, supporting the propositions of DeAngelo and Masulis, and tax exhaustion is a widespread occurrence for US firms.

The UK Government Green Paper on Corporation Tax (1982) noted that,

> "... it is estimated that in any year only about 40 per cent of all companies are currently earning sufficient profits, after all tax reliefs and allowances, to pay mainstream corporation tax." (HMSO (1982), p.9 para. 4.7)

Therefore, this is indirect evidence that tax exhaustion is also significant in the UK.

Mayer and Morris (1982) studied the effects of changes in investment allowances upon the marginal change in corporation tax in the UK. They noted a strong relationship between increases in investment allowances and decreases in the marginal change in corporation tax. They argued that the significant fluctuations in the average level of marginal investment incentives, even in periods when the allowance rates and corporate tax rates remained constant, arose because tax exhausted firms were often unable to claim available incentives in the year of investment. Therefore, using the IFS model, they found evidence that the extent of tax exhaustion varied from year to year in the UK, but was always a significant determinant of the effective corporate tax rate.

To summarise, there is strong evidence that tax exhaustion is a significant problem in the US and the UK, as it reduces the effective corporate tax rate, reducing the tax advantage to debt, and limits the extent of gearing of the firm.

There is another large body of evidence concerning the effect of tax exhaustion on the corporate tax advantage to debt and thus the corporate capital structure. Evidence from DeAngelo and Masulis (1980), Cordes and Sheffrin (1983), Mayer and Morris (1982), Long and Malitz (1983), Kay and Sen (1983), Rutterford (1988), and Mackie-Mason (1990) is reviewed.

DeAngelo and Masulis (1980) sought to test the hypothesis that differential investment tax shields should induce differential optimal leverage ratios for firms. They cited US studies by authors such as Vanik (1978) and Muskie (1976), showing significant variations in investment tax shields across industries, and studies by authors such as Scott and Martin (1975) and Schwartz and Aronson (1967), who found significant differences in gearing ratios across industries but not within industries. They argued that this evidence supported their model, as significant investment tax shield variations across industries should produce significant gearing variations across industries with differing non-debt tax shields relative to earnings (before interest and taxes), whereas intra-industry gearing ratio differences should be less significant. DeAngelo and Masulis also hypothesized that, as many corporate deductions are based on historical costs, inflation increases should increase nominal revenues and decrease the real value of investment tax shields, thus encouraging firms to increase their gearing as they can better utilise debt tax shields. They cited studies by Corcoran (1977) and Zwick (1977) who found the gearing ratios of US firms to increase significantly over the period 1965-74 when the US economy experienced significant increases in the rate of inflation. DeAngelo and Masulis, then, found evidence of a significant impact of tax exhaustion on the tax deductibility of corporate debt interest payments (the tax advantage to debt).

Mayer and Morris (1982) found that in 1976, 36 per cent of the sample studied, using the UK IFS model, received no relief on a unit increment in interest payments. Therefore, a significant number of UK firms are likely to be faced with a zero tax advantage to debt. They also noted that, because the tax system in the UK is complex, the tax advantage to debt for a firm is very sensitive to its specific underlying position, thus reinforcing the proposition that there exist firm-specific optimal capital structures.

Cordes and Sheffrin (1983) found the tax advantage to debt of US firms to be 0.31 (the reduction in corporate tax liabilities divided by the increase in interest deductions), which was considerably less than the corporate tax rate of 0.46 in 1978. They argued that this differential was due to the fact that the use of non-debt tax shields was impaired by debt interest deductions. They also found that the marginal incentives to debt varied significantly by industry and asset size, the former result supporting the DeAngelo and Masulis hypotheses.

Long and Malitz (1983), in their study of 545 US manufacturing firms, found a large positive correlation between a non-debt tax shield and gearing, which contrasts with the negative relationship found by other authors. They argued that DeAngelo and Masulis' study did not take account of advertising and R & D (which, they argued, are greater for US firms than capital spending because such expenditures are immediately allowable against tax rather than being amortised over time). They thus incorporated such expenditures into the tax shield measure, and they found a statistically significant negative relationship between non-debt tax shields and gearing which is consistent with intuition.

Rutterford (1988) estimated the tax advantage to debt in a number of countries. She compared her tax advantage to debt values with estimates of effective average rates of corporation tax on undistributed profits estimated by Kay and Sen (1983), and found that the typical nominal corporate tax rate of 50 per cent was significantly greater than the average effective rates in each of the countries studied. The overstatement of the tax advantage to debt, she argued, was a result of the generosity of allowances in each country, to the extent that, by 1982, UK firms had an estimated £30 billion of unused allowances. Thus, Rutterford found that the generosity of tax allowances significantly reduced the average effective corporate tax rate of firms in a number of countries, thus restricting the value of debt tax shields, thereby discouraging firms from using as much debt at the margin.

Mackie-Mason (1990) employed a discrete choice analysis to model the debt/equity choice of the US firm, based on SEC Registered Offering Statistics and Compustat data. He studied both tax loss carry forwards (TLC's) and investment tax credits (ITC's), as he argued that increases in non-debt tax shields do not necessarily always lead to reductions in gearing. He found that increases in tax loss carry forwards significantly reduced the probability that the firm will issue debt, as carry forwards are very likely to "crowd out" debt interest deductions. However, he found that increases in investment tax credits significantly increased the probability that the firm will issue debt. Such an apparently counter intuitive result is explained by some authors by means of the "moral hazard hypothesis", Mackie-Mason argued, whereby:

> "High tangible asset values should encourage debt issues by lowering the associated moral hazard costs." (Mackie-Mason (1990), p.1482)

However, when he modelled the investment tax credits of firms near tax exhaustion, he found the expected negative coefficient.

Therefore, there is a considerable body of evidence to support DeAngelo and Masulis' (1980) proposition that the greater the level of non-debt tax shields that a firm has, the lower the gearing ratio it will have, as non-debt tax shields "crowd out" debt interest tax shields. There is evidence that the effective tax advantage to corporate debt is significantly reduced by non-debt tax shields, though different tax shields influence the corporate capital structure is different ways. For example, tax loss carry forwards will exert a very significant negative influence on corporate gearing because firms experiencing losses will be far closer to a state of complete tax exhaustion. Studies which incorporate the probability of complete tax exhaustion appear to be more convincing, and the resulting models more robust. Increases in inflation may increase gearing ratios as the value of investment tax shields is reduced. Some authors found marginal investment incentives to vary with firm size and industry, and other important firm-specific factors reinforce this firm-level optimal capital structure result. Thus, the effect of the existence of non-debt tax shields is to reduce the tax advantage to debt, producing an optimal firm-level capital structure which is rather less than the extreme all debt position.

To summarise, the existence of non-debt tax shields is sufficient to produce optimal firm-level capital structures, specific to the firm, as they are determined by the underlying tax position of that individual firm. This tax position is in turn determined by the firm's past, current and future investment and financial decisions. Expansion of one type of tax shield may "crowd out" another, but need not do so if the firm is expanding output and sales, in which case, for example, investment tax credits may not crowd out debt interest tax shields. Thus, although the central proposition of "tax exhaustion theories" is clear, the mechanics of the processes involved may be difficult to understand and model, due to the important effects of tax system complexities and uncertainty.

2.6 The influence of corporate tax reform and changes in tax rates upon the corporate capital structure

This section seeks to examine the effect of corporate tax changes, and more generally, tax code reforms, upon the gearing ratios of firms. Firstly, theory models and propositions concerning the relationship between the corporate tax rate and the corporate gearing ratio are examined. Secondly, evidence to test such a relationship is examined. Thirdly, evidence of the impact of corporate tax reform on the corporate capital structure is discussed. Finally, the overall impact of changes in the corporate tax rate and corporate tax reforms is summarised.

Theory related to the relationship between the corporate tax rate and the gearing ratio of the firm is extensive, and at times complex. However, only the important work of DeAngelo and Masulis (1980) and Litzenberger and Talmor (1989) is discussed here, as more complex theories of the relationship have already been considered in earlier sections.

DeAngelo and Masulis (1980) developed a model of corporate gearing choice which yielded a number of testable hypotheses, one of which was that firms will substitute debt for equity financing as the corporate tax rate is raised. Therefore, their model of optimal capital structure choice, which concentrated upon the effect of tax exhaustion, also predicted that the gearing ratio should increase with the corporate tax rate. It is notable that most theories of optimal capital structure choice would support the nature of this relationship, even if they include other tax and non-tax factors.

However, Litzenberger and Talmor (1989) developed a corporate capital structure model which produced a very different result. Their model proposed that corporate taxes have a neutral effect on the firm's capital structure, the mix of which is therefore of no interest to the firm. This capital structure irrelevancy result, they argued, was analogous to MM (1958) irrelevancy in the respect that:

> "Investors can hedge against changes in corporate decisions that redistribute wealth in the economy, in a manner similar to the ability of homemade leverage to unravel on a personal account any corporate financial leverage." (Litzenberger and Talmor (1989), p.313)

It is clearly demonstrated that the influence of changes in the corporate tax rate depends on the author's theoretical propositions of either the relevancy or irrelevancy of the corporate capital structure, "relevancy" supporting the importance of the corporate tax rate and "irrelevancy" challenging its importance.

It is essential, then, to discuss the evidence examining the relationship between the corporate tax rate and the gearing ratios of firms. Such evidence is provided by Taub (1975), Zwick (1977), and Holland and Myers (1977). Taub (1975) argued that both the traditional and MM models supported a strong relationship between the corporate tax rate and the firm debt-equity ratio. They studied US firm data over the period 1951-70 and found a negative relationship between the two variables, suggesting that increases in the corporate tax rate were associated with decreases in the gearing ratios of US firms over the period. This counter intuitive result was explained by Peles and Sarnat (1977) who argued that the degree of variation in the tax rate over the period (4.8 per cent) was insufficient to support a strong conclusion, a shortcoming which was alluded to by Taub in his paper. Zwick (1977), in his study of the market for US corporate bonds, found evidence to suggest that:

> "The increase in debt ratios from 1960 through 1967 - after fifteen years of change - occurred because of a decrease in asset risk rather than an increase in taxes or inflation." (Zwick (1977), p.34)

Thus, he found little evidence linking the increase in corporate gearing ratios with increases in the corporate tax rate. Holland and Myers (1977) studied the debt-equity ratios of all non-financial US firms over the long period 1929-75. They found evidence that over the period 1940-42, when corporate taxes increased significantly, corporate gearing ratios also rose significantly. Therefore, only in the latter study was evidence found of a strong relationship between the corporate tax rate and the level of corporate gearing. However, such studies require relatively long data time spans to enable observation of a relationship, which is further hindered by the often "sticky" nature of corporate tax rates from year to year.

Further evidence on the effect of corporate tax changes is provided by Peles and Sarnat (1977) and Rajan and Zingales (1994), as both studies examine the effect of tax reforms upon the corporate capital structure. Peles and Sarnat (1977) sought to examine the effect of a significant tax reform, the Finance Act (1965), upon UK corporate capital structures. Amongst other measures, this reform replaced profit and income taxes with a single uniform corporate tax. They studied gearing ratios for the five year period before and after the reform was effected. As the tax reform in effect taxed distributed profits at a higher rate than before, the reform would be expected to increase corporate gearing. They found that the tax reform had a very significant effect on UK corporate capital structures, effectively doubling the average corporate debt-equity ratio. Thus, corporate capital structures are extremely sensitive to radical tax reforms. Rajan and Zingales (1994) argued that if tax mattered, changes in the incentives to employ different funding instruments should result in an increase in those instruments which become most tax advantaged following the reform. They studied tax reforms in G7 countries over the period 1982-90 and found that the instrument becoming most favoured after the reform increased in importance in 6 of the 7 countries and the instrument becoming least favoured decreased in importance in all of the countries. Indeed, a Wilcoxon Rank Test confirmed this effect to be significant at the 1 per cent level. Tax reforms, then, appear to exert a significant impact upon the capital structures of firms, particularly when they radically alter the tax incentives of one form of funding over the others.

To summarise, this section sought to examine the influence of corporate tax reform and changes in tax rates upon the corporate capital structure. As found with respect to the tax advantage to debt, the effect of a change in the corporate tax rate has an uncertain effect on the capital structure. This result derives more from the evidence than the theory. However, tax reforms do appear to have an important impact. The reason for these results is unclear. There are three possible explanations: tax is not an important influence on the corporate capital structure; the corporate capital structure and taxation models are too naive; or, other, non-tax factors are more important.

The first explanation is unsatisfactory, as there is clear evidence of the impact of tax factors such as tax exhaustion and tax reform on the corporate capital structure, in addition to the vast body of literature examining the effect of taxation. Moreover, the corporate finance literature surely would not have been steered by taxation frameworks over the last 30 years unless there were both strong theoretical and empirical reasons for doing so.

The argument that corporate capital structure/taxation models are too naive to adequately represent real world finance markets, and therefore produce useful testable hypotheses, is perhaps a valid one. The sheer complexity of tax systems which have developed over hundreds of years, being subject to numerous incremental adjustments each year, is such that models are necessarily abstract so as to represent only part of the taxation environment. It may be argued that models are only supposed to be simple representations of reality, but the complexity of a given tax system may mean that authors do not even fully appreciate the "reality" to be qualified to model it. Taxation factors may <u>not</u> be considered in isolation, as the taxation environment is a set of complex relationships, governed by: causation uncertainty; differing degrees of understanding of the system by participants; differing perceptions of the influence of taxation; a lack a detailed firm-specific taxation data; interactions of corporate and personal finance markets, the wider corporate environment and the macro economy; continual evolution based on the whims of resident governments; firm expectations of future earnings and the probability of tax exhaustion; and numerous other factors. Thus, the "taxation naivety" argument appears to be a possibility.

Other non-tax factors may indeed be more important than taxation factors, particularly as many firms in the economy are relatively unsophisticated and do not appreciate the full tax implications of their capital structure changes. Such factors are explored in detail in chapter 3.

It therefore appears that taxation is not adequately modelled in the literature to date due to its complexity; or, that other non-tax factors are more important to the capital structure decision of the firm; or that both explanations are valid. Such a statement implies that further work must be undertaken to enable a more precise understanding of taxation and that the effect of the non-tax financial environment must be examined.

2.7 The influence of the tax system upon the corporate capital structure

It has been demonstrated that there is significant evidence of the strong influence of changes in the tax system upon corporate capital structures. However, the tax system in place should also be examined with regard to its influence on the funding choice of firms. Much of the theory of corporate finance is based upon the US classical taxation system and therefore results from such models are not necessarily universal to firms in other countries. Indeed, Ashton (1989) argued that:

> "The UK tax system is sufficiently different from the US system that their (the writings of Modigliani and Miller) relevance to the practice of UK financial management is non-existent." (Ashton (1989), p.207)

Therefore, different tax systems induce different firm behaviour in corporate funding decisions, as the tax incentives to different funding instruments may vary significantly from one system to another. Many authors describe the conditions under which there is a tax advantage to corporate debt using the MM (1963) model, or the conditions necessary to achieve Miller (1977) capital structure irrelevancy.

This section, first of all, describes the main types of tax system in use in modern industrialised economies, along with the overall direction such systems are moving in. Secondly, derivations of the MM models for different tax systems are discussed, paying particular attention to the implications of such adapted models for the economies concerned. Finally, the overall influence of the tax system is summarised, based upon the discussion of the results of the models.

The main tax systems employed by modern industrialised economies may be described as classical, imputation, dual-rate (split-rate), and hybrid systems. Stapleton and Burke (1977), Nobes (1980), and Rutterford (1988) describe these systems, descriptions of which are briefly summarised below.

Nobes (1980) described classical systems in the following manner:

> "Under such systems, company profits are taxed without a deduction for dividends paid; then the dividends are fully taxed as investment income in the hands of the shareholders." (Nobes (1980), p.221)

Stapleton and Burke (1977) described the imputation system:

> "Where the stockholder receives a credit against his personal tax equal to some proportion of the corporate tax paid by the firm."
> (Stapleton and Burke (1977), p.55)

Rutterford (1988) stated that dual rate systems attempt to mitigate, at least partially, the effective double taxation of income inherent in the classical system:

> "By imposing a lower corporate tax rate on distributed profits."
> (Rutterford (1988), p.200)

She further explained that hybrid systems are simply a combination of dual corporate tax rates and an imputation tax system.

There has been a clear movement of tax systems away from the classical tax system towards imputation type systems in the post-war period, as a means of mitigating the effective double taxation of dividends under the former system.

Nobes (1980) argued that the UK's movement away from the classical tax system, for example, was the result of three factors: the desire to bring EEC tax systems closer together; an equity argument, that is, mitigation of the double taxation of equity income, first at the corporate level and second at the personal level; and the desire to encourage effective investment. This latter reason, he argued, was due to the fact that an imputation system reduces the bias against the distribution of profits, in turn, improving the quality of investment. This is because larger dividend payments should result, withdrawing resources from firms of lower profitability and hopefully channelling it towards firms of higher profitability. Therefore, the reasons of tax harmonisation, double taxation mitigation and improved investment should encourage governments to move towards an imputation system, should encourage firms to distribute higher dividends and investors to maximise profits and increasing the quality of investment. Such a movement towards an imputation system should encourage a greater use of equity funding, impacting directly upon the capital structure of the firm.

Rutterford (1988) found that tax reforms in the UK, France, Germany and Japan sought to relieve the effects of double taxation on equity income. She argued that the major reason for such tax reform was the government's desire to influence firms' dividend decisions and that this was particularly evident in tax reforms in Japan and the US, examples which demonstrated an explicit desire to promote the use of debt over equity. Thus, the government exerts a direct influence on the capital structure of the firm through the definition of a particular tax system type, and may also exert a less direct influence upon the firm through various tax reforms.

Stapleton and Burke (1977) studied the Van den Tempel (1969) report to the EEC Commission on tax systems within Europe. The report considered the issue of tax neutrality, which found that the imputation (and dual rate) systems are neutral with respect to dividend policy. Stapleton and Burke defined a neutral tax system as follows:

> "A neutral tax system is then precisely one under which financing and dividend policies have no effect on the market value (of the stock plus the bonds) of the firm." (Stapleton and Burke (1977), p.57)

They basically reasoned that tax neutrality should be pursued for philosophical and allocative efficiency reasons. Philosophically, the tax environment should not be distortionary and should not restrain firms from their business. The tax system should be allocation efficient, in that it should not create a bias for one form of finance over another, or encourage one type of firm over another.

Thus, the movement towards imputation-type tax systems across the modern industrialised economies was based upon reasons of harmonisation, equity, encouragement of investment, allocative efficiency, government control, and greater tax neutrality. The overall effect on corporate capital structures appear to have been a reduction in equity income taxation, thus encouraging the greater use of equity relative to debt. Therefore, the gradual development of the tax system is one method by which governments can directly impact upon the capital structures of firms, by altering their dividend decisions.

Theoretical models which extend the MM models for different tax systems are developed by Franks and Broyles (1979), Pointon (1981), Mayer (1984), Rutterford (1988), and Ashton (1989).

Franks and Broyles (1979) argued that under the US classical tax system, the tax advantage to debt was merely the corporate tax rate multiplied by the amount of debt, using the MM (1963) formulae. However, under the UK imputation system the company is deemed to act as an agent for the tax authorities in collecting the shareholder's tax and thus the corporate tax rate in effect "includes" the shareholder's tax at the standard rate. The tax advantage to debt thus becomes, for one period, the difference between the corporate rate and the shareholder standard rate. They argued that, in the UK, the tax advantage to debt related to the personal tax rate can be replicated in part by the shareholder by means of homemade borrowing and therefore only the difference between the rates is the net advantage to debt. Thus, Franks and Broyles found the tax advantage to be very much less in the UK due to the imputation system and the possibility of homemade borrowing.

Pointon (1981) developed a model to examine the effects of the imputation system on the optimal corporate capital structure. His perfect market tax-free model produced the same results as the MM (1958) model. Pointon extended MM's 1963 work by determining the effect of <u>risky</u> debt interest and incorporated a personal tax framework. While it would be of little use reproducing his model, the main conclusion deriving from the model is of more interest to this section. Pointon concluded that the UK imputation system was characterised by complex tax effects which the MM models did not adequately represent.

Mayer (1984) created a dynamic programming model of the corporate financial and investment decisions, which he extended for the UK imputation system. Under such a system, otherwise independent financial and investment activities become interrelated, as the value of interest tax deductions may decrease as non-debt allowances increase. He found that equality of costs of alternative forms of finance could be achieved without the need for the legal constraints necessary to other models' solutions. The imputation system, then, in conjunction with tax exhaustion effects, produces an internal optimum capital structure solution at firm level, and thus the extent of any tax advantage to debt (the extent to which firms should monitor their funding choice) may differ across tax systems.

Rutterford (1988) produced formulae for the tax advantage to debt under classical, imputation, and hybrid tax systems. She assumed that investor taxes are constant across all firms, thus producing the following formulae. The expressions to follow merely represent the difference in the income streams accruing to stockholders and debt holders between a levered and an unlevered firm, capitalised at the after-tax cost of debt. The tax advantage to debt under the classical tax system is:

$$\text{Tax advantage to debt} = B\left[1 - \frac{(1-T_c)(1-t_{ps})}{(1-t_{pb})}\right] \quad \text{Equation 2.5}$$

Where:

B = the amount of debt in the geared firm

T_c = the corporate tax rate

t_{ps} = the tax rate on investor income from equity investment

t_{pb} = the investor income tax rate on debt income

The tax advantage to debt under the imputation tax system if all profits are paid out as dividends is:

$$\text{Tax advantage to debt} = B\left[1-\frac{(1-T_c)(1-t_{pd})}{(1-t_{pb})(1-t_i)}\right] \qquad \text{Equation 2.6}$$

Where:

t_{pd} = the personal tax rate on dividend income

t_i = imputation rate on gross dividends

Alternatively, if all profits are paid out as capital gains (for example, through share repurchase) under the imputation system the tax advantage to debt is:

$$\text{Tax advantage to debt} = B\left[1-\frac{(1-T_c)(1-t_g)}{(1-t_{pb})}\right] \qquad \text{Equation 2.7}$$

Where:

t_g = the capital gains tax rate

The tax advantage to debt under the hybrid system (which is a combination of an imputation system and the use of dual corporate taxes), if all profits are paid out as dividends, is:

$$\text{Tax advantage to debt} = B\left[1-\frac{(1-T_{cd})(1-t_{pd})}{(1-t_{pb})(1-t_i)}\right] \qquad \text{Equation 2.8}$$

Where:

T_{cd} = the tax rate on distributed profits

Alternatively, the tax advantage to debt under the hybrid system if all profits are paid out as capital gains (for example, through share repurchase) is:

$$\text{Tax advantage to debt} = B\left[1-\frac{(1-T_{cu})(1-t_g)}{(1-t_{pb})}\right] \qquad \text{Equation 2.9}$$

Where T_{cu} = the tax rate on undistributed profits

Given these formulae, Rutterford examined the tax advantage to debt under the different systems, and showed how this changed under different assumptions about equity distributions and tax rates. She found that if zero taxes were assumed on equity returns then the tax advantage to debt may disappear. Employing the Miller assumptions that the equity income tax rate is zero and that the personal tax rate on debt income varies across investors, she found that the classical tax system model produced an aggregate optimal debt-equity ratio at the market level, but no such optimum at firm level. Using the same Miller assumptions she found that debt irrelevance could hold in the US, UK and Japan, whereas debt dominated in France and equity dominated in Germany. However, as noted in section 2.4, she discovered that such results bore little resemblance to observed capital structures in these countries. Therefore, Rutterford adapted the MM tax advantage to debt formula for differing tax systems and found that the Miller (1977) irrelevancy proposition could hold in countries using imputation or hybrid systems. The tax system employed by a country thus has an important impact upon the incentives to firms of utilising one form of finance over another.

Ashton (1989) reworked the Modigliani and Miller formulae under the UK imputation system, as he argued the MM formulae in their standard form were irrelevant to the UK system. He found that, assuming 1989 tax rates (corporate tax rate = 0.35; basic rate of personal tax rate = 0.25), the tax advantage to debt was merely 13 per cent of the debt's market value, which may in turn be reduced by bankruptcy or agency costs. The reduced tax advantage to debt, compared to the often quoted 35-50 per cent of debt value for the US, was due to the fact that, under an imputation system, the gross dividend may be offset against the firm's corporation tax liability. However, when personal taxes were added to his analysis, Ashton argued that, because individuals cannot indulge in personal tax arbitrage, market segmentation occurs with some individuals preferring debt over equity (and vice versa) for tax reasons. This is because a lower bound is placed on debt because personal debt interest is not tax-deductible and an upper bound is placed on debt because short positions on equity and long positions on debt are restricted by UK institutions. The marginal tax rates on debt and equity need not be equal under such investor specialisation, and thus in general equilibrium firms adjust their debt-equity ratios and investors adjust their portfolios until the tax advantage to debt disappears. Therefore, Ashton proposed that the inherent nature of the UK's imputation system is consistent with firm-level capital structure irrelevancy, begging the question as to what non-tax factors may determine the firm capital structure choice.

The theory models of the tax advantage to debt under different tax systems generally reveal a tax advantage to debt under non-classical systems which is very much less than the often quoted 35-50 per cent of debt market value for the US. There are a number of reasons for this. Firstly, outside the US, possibilities for homemade gearing may be greater, reducing the tax advantage to debt from the full corporate rate. Secondly, different tax systems tax different forms of investor returns differently, altering the tax rate structures required for either a distinct tax advantage to debt or firm level irrelevancy. Thirdly, Miller's general equilibrium proposition of firm-level capital structure irrelevancy can hold under differing tax systems, subject both to institutional restrictions and certain strict tax assumptions. This reinforces the proposition that tax may be an important determinant of the corporate capital structure but conditional upon the combination of the tax system, the structure of tax rates, institutional structures, and other factors such as the extent of tax exhaustion.

This section therefore demonstrated the important influence that the tax system exerts across firms in different countries. The tax system in conjunction with the tax rates set in a particular country determine any tax advantage to debt that may exist, though such a tax advantage may be reduced by other indirect influences on the capital structure, such as the generosity of investment allowances. It is intuitive, but necessary, to state that the tax system is capable of contributing to inter-country corporate capital structure differentials, but only departures from tax neutrality should induce intra-country differentials, influencing different types of firms to finance themselves differently. Within a country, tax reforms also alter the incentives to firms in aggregate of choosing one form of finance over another, the degree of tax neutrality again determining any biases between types of firms (for example, if a tax system produces incentives to finance from retained earnings, then this biases against new, fast-growing firms with little retentions and high gearing).

In sum: it is proposed that the overall tax system, the structure of corporate and investor tax rates, institutional structures and constraints, factors such as tax exhaustion, and other factors, must ALL be considered in combination before it may be ascertained what the effect of a change in any one of these factors will have on the corporate capital structure. The lack of consensus in the literature over the precise effect of any tax factor is merely a result of authors holding constant other tax factors whose interrelationship with the variable concerned may not be ignored.

2.8 Summary

Chapter 2 set out with the objective of both determining the relevance of the individual firm capital structure decision and of explaining the important determinants of this decision. If the capital structure decision is relevant then the firm should monitor these determinants and select that capital structure which minimises its weighted average cost of capital, thus maximising its value. Alternatively, if the capital structure decision is not relevant then the firm should ignore the mix of its capital structure, to concentrate solely upon the maximisation of returns from its portfolio of investment projects.

The results from this chapter appear at times conflicting and therefore must be brought together to understand the apparent influence of taxation on the corporate capital structure. The MM (1963) tax advantage to debt model appeared to be more favoured than the Miller (1977) gearing irrelevance model, and the former was more supported by evidence than the other MM models. Many authors developed theory models which proposed a distinct tax advantage to debt and it appears that individual firms perceive such a tax benefit. Theory also suggests that increases in the corporate tax rate, ceteris paribus, should increase the tax advantage to debt, encouraging higher levels of gearing. However, evidence concerning the effect of the corporate tax rate and the tax advantage to debt on gearing levels is mixed, and thus no clear relationship appears to exist in the real world.

Research into the effect of tax exhaustion, however, clearly reveals a reduction of any tax advantage as a result of such tax exhaustion. Other studies reveal a tax advantage to debt in different countries very much less than that proposed by the MM (1963) model. Thus, factors such as tax exhaustion do appear to significantly reduce the effective tax advantage to debt. Theory and evidence reveals that the tax system in place and tax code reforms significantly impact upon corporate gearing.

The existing literature suggests that some of the main factors influencing the magnitude of any tax advantage to debt are known, but computed tax advantage to debt measures are not consistent with observed gearing ratios, even though it is clear that the tax system and changes in the tax system impact upon corporate gearing. The conclusion that must be drawn from these results is that tax certainly is an important influence, as radical changes in the tax system significantly influence corporate capital structures, but isolated individual tax measures are generally incapable of demonstrating a relationship with corporate gearing. This suggests that the tax environment is extremely difficult to model using isolated naive tax variables, and that it would be better to model the whole tax system rather than parts of it to fully understand the influence of taxation on corporate gearing. Additionally, it suggests that other factors, which are held constant in such models and often are not accounted for in empirical testing, may also exert an extremely important influence on corporate capital structures, reducing any tax advantage to debt so that its relationship with gearing levels is no longer easily measurable. Therefore, chapter 3 concentrates on the important non-tax influences upon the corporate capital structure, referring to the tax factors only when such factors must be considered in conjunction with the non-tax factors to fully understand their combined impact.

CHAPTER 3

THE INFLUENCE OF NON-TAXATION FACTORS UPON THE CAPITAL STRUCTURE OF THE FIRM

3.1 Introduction

Chapter 2 examined the various and complex influences of taxation upon the corporate capital structure. Many taxation-based theories of the corporate capital structure hold constant other influences upon the corporate capital structure which are so important that they are, at times, capable of over-turning the propositions of the taxation models. Such factors are examined in chapter 3.

Chapter 2 started from a perfect market framework which enabled the more obvious costs and benefits associated with different financial instruments to be considered. Chapter 3 allows some of the more unrealistic perfect market assumptions to be relaxed to examine how the firm's capital structure choice is affected.

The myriad of capital structure influences examined in this chapter, most of which exert their impact at the level of the firm, would appear to suggest that each firm has a unique optimal capital structure. New benefits and costs related to debt and equity which are identified in this chapter should be considered in conjunction with the costs and benefits, taxation or otherwise, examined in the preceding chapter.

The structure of chapter 3 is as follows. The factors influencing the corporate capital structure may be roughly divided such that section 3.2 considers the macro economic factors and section 3.3 considers the corporate factors. Section 3.2 is much shorter than section 3.3, reflecting the fact that most of the capital structure literature concentrates on corporate rather than macro economic factors. Thus, section 3.2 considers the influence of inflation, capital factors, cyclical effects, and international factors. Section 3.3 considers risk factors, agency influences, the information signalling nature of the capital structure, security costs and the influence of internal funds, firm size and growth, accounting structure factors, production and investment factors, and the influence of industry classification. Finally, section 3.4 summarises the influence of such non-tax factors on the corporate capital structure and, in addition, draws upon the results of the taxation chapter to arrive at a perspective concerning the capital propositions of the literature to date.

3.2 The macro economic factors which influence the corporate capital structure

3.2.1 Introduction

Taxation factors have been demonstrated in chapter 2 to exert an important potential influence upon corporate capital structures. Such factors might be considered on the borderline between the corporation and the macro economic environment and thus could be considered within either perspective, depending on the degree of the firm-specific nature of each tax factor. However, the non-tax macro economic environment may also impact significantly on the corporate capital structure and thus the theory and empirical evidence examining the impact of the macro economic environment must be explored. The macro economic factors to be considered are those pertaining to inflation, capital, the cycle, and the international environment; the overall impact of these is drawn together in a summary at the end of the section.

3.2.2 Inflation

Inflation is one of the most important macro economic indicators in western economies as it affects all real variables when valued in money terms (even when their real value is unchanged). The theory explaining its relationship with the corporate capital structure is first explained, before examining the evidence available to test such theory.

Most authors agree that inflation and the corporate debt-equity ratio are positively related. Zwick (1977) argued that inflation encourages firms to prefer debt to equity if the real cost of borrowing declines. However, it is noted that the extent to which the real cost of borrowing declines depends on how nominal rates of interest react. Corcoran (1977) argued that an increase in inflation causes the real value of net (nominal) debt to decline, making equity holders better off and debt holders worse off. If inflation and interest rates rise equally, he explained, the cost of debt finance will fall by the amount of the increased tax deductions. Franks and Broyles (1979) argued that many firms perceived borrowing to be more worthwhile at times of higher inflation because the firm is essentially repaying "cheaper" pounds to investors. However, there is not necessarily a gain to firms if interest rates fully reflect expectations about the inflation rate. Indeed, if inflation exceeds expectations then the borrower (the firm) gains and if inflation falls below expectations then the borrower loses. DeAngelo and Masulis (1980) predicted, as a testable hypothesis of their famous model:

> "Ceteris paribus, decreases in allowable investment tax shields (eg, depreciation deductions or investment tax credits) due to changes in the corporate tax code or due to changes in inflation which reduce the real value of tax shields will increase the amount of debt that firms employ."
> (DeAngelo and Masulis (1980), p.21)

Modigliani (1982) included inflation in his demand-side capital structure model and found that inflation should increase the value of leverage, that is, the advantage to debt.

While most authors agree that the relationship is positive, Schall (1984) argued that the relationship between inflation and the corporate capital structure is negative. Thus, in inflationary conditions investors sell debt in exchange for equity because the real after-tax return on equity becomes relatively higher than the return on debt, while the net return on both declines.

Kim and Wu (1988) explained the conflicting arguments on the effect of inflation by explaining that inflation decreases the demand for debt if the debt yield becomes relatively lower than the equity yield, but the supply of debt will increase if the tax-deductibility effect related to debt exceeds the tax-deductibility effect related to depreciation. Thus, the net effect of supply and demand factors determines the net effect of inflation.

Many authors have conducted studies of the relationship between inflation and the corporate capital structure. Zwick (1977) found that the higher inflation between 1968 and 1974 caused US firms to significantly increase their debt-equity ratios. Corcoran (1977) studied US non-financial firms and found that the debt-to-debt-plus-equity ratios of such firms increased from 22 per cent to 42 per cent over the 1965-74 period, during which time inflation accelerated. Holland and Myers (1977) also discovered a similar relationship. Rudolph (1978) studied the effect of inflation on the entire balance sheet of 311 US manufacturing firms over the period 1964 to 1974 and found that long-term-debt-to-total-assets increased with increases in the rate of inflation. Kim and Wu (1988) studied 1,092 US firms over the period 1953-80 and found that the coefficients of their regression model suggested that a 1 per cent change in inflation leads to a 0.7 per cent change in the corporate debt rate.

Therefore, the effect of inflation on the corporate capital structure may be a result of complex demand and supply trade-offs. Although the theory is somewhat mixed regarding the effect of inflation upon corporate gearing, the evidence appears to support a positive relationship. Theoretically, whereas anticipated increases in the rate of inflation should be accounted for in the 'price' of debt, unanticipated increases in the rate of inflation may indeed cause increases in the corporate debt-equity ratio.

3.2.3 Capital factors

Constraints on capital in the finance market, and the structure of interest rates, may affect the corporate capital structure in a number of ways.

Auerbach and King (1983), in their "theory of incomplete markets", argued that unless there were constraints on investors or incomplete markets, then the general equilibrium result of the Miller (1977) model could not be obtained. Their model was based on a mean-variance analysis which maximised investor utility, given constraints such as wealth. When constraints on personal borrowing and short selling are introduced, a Lagrangian is formed expressing the investor's utility function, along with multipliers for the above constraints. Short sales need to be constrained in the model to obtain a Miller-type equilibrium, otherwise investors would engage in infinite tax arbitrage, with there being no bounds on the investment of debt. Such bounds are necessary to the creation of investor clienteles and an aggregate equilibrium. Optimisation produces an expression for the market equilibrium interest rate, which is a function of the debt-equity ratio. By means of this interest rate, then, an equilibrium occurs where:

> "The aggregate corporate sector debt-equity ratio will equal the ratio of the wealth of those investors with a tax preference for debt and those with a tax preference for equity." (Auerbach and King (1983), p.594)

Thus, individual investors will hold either debt or equity, depending on their tax preference, and not both within the same portfolio. In their model, then, if capital market constraints did not exist on investor borrowing or short sales of equity, then investors would engage in infinite tax arbitrage, holding both the debt and equity of firms to undo their leverage, resulting in an optimal capital structure for each firm. Therefore, Auerbach and King's model reveals the importance, in theory, of capital constraints at the aggregate level, as such constraints may have the power to render the capital structure decision of the firm irrelevant, suggesting instead that it should concentrate solely on maximising the value of its investments.

Evidence on the importance of capital market constraints is provided by Stonehill et al (1975). Stonehill et al, in their survey of 87 manufacturing firms in five countries over the period 1972-73 found that firm finance managers were more concerned about (financial risk and) the availability of capital than its cost. Capital market conditions and opportunities were ranked highly by firms in Japan, France and Norway. Therefore, there is evidence that capital availability and opportunities influence firms when considering changes to their capital structures. Intuitively, firms may only issue funds when investors are receptive to such funds.

King (1977) regressed the debt-equity ratio upon dummy variables representing periods of capital controls in the UK from the end of World War II until 1958. He found little evidence that the capital controls enforced by the government's Capital Issues Committee had any significant effect on corporate capital structures. Thus, while demand-side capital restrictions do appear to influence the corporate capital structure, government-enforced restrictions do not.

Dempsey (1991) modelled the UK imputation system under a Modigliani and Miller Capital Assets Pricing Model framework, allowing for a spread between borrowing and lending interest rates. Thus in the UK, as in other countries, there is a gap between borrowing and lending rates which, Dempsey argued, is sufficient to eliminate any tax advantage to debt, to the extent that there is a net disadvantage to debt of up to 8 or 9 per cent of the debt's market value. Therefore his model showed that as the structure of interest rates varies depending on the status of the borrower and lender, any tax advantage to debt, as proposed by MM (1963) and other models, may be eliminated. This macro economic factor, then, is not only an influence upon the level of the debt-equity ratio, but may also swing the preferences of investors towards equity.

The supply of capital appears to dictate the environment within which both debt and equity are supplied and is thus capable of significantly influencing preferences for the issue of one instrument over another.

3.2.4 Cyclical factors

As the macro economy is seen to be cyclical in nature, it is likely that the corporate capital structure is affected by such factors as booms and recessions, and stock and bond market peaks and troughs. For example, one might expect to observe a relationship between economic recovery and an increased use of long-term debt, or stock market price rises and issues of equity.

Rudolph (1978) constructed a theoretical model of the effect of the economic environment on balance sheet items, which predicted that as an economy moves from a recession into a recovery period, firms should raise their long-term-debt-to-total-assets ratio (a capital structure measure). However, he found in his empirical analysis of 311

US manufacturing firms, over the period 1964-74, that as the economy recovered, the amount of long-term debt decreased. He rationalised this behaviour by explaining that it may be that firms may be able to finance most of their expansion during recovery by using retained earnings and thus do not need to increase debt financing as rapidly as might be expected. Overall, Rudolph found evidence that firms changed the structure of their balance sheets in response to economic cycles, but did not increase their use of long-term debt in recovery periods. Therefore, the debt-equity ratio of firms is not necessarily heavily influenced by economic cycles.

Martin and Scott (1974) argued that market conditions at the time of issuance influence the marginal debt or equity decision of the firm. Furthermore, they suggested that if management felt that the firm's equity price was currently depressed and that higher earnings were expected in the future then they may decide to issue debt rather than equity, and thus the price-earnings ratios of equity-issuing firms should be greater than those of debt-issuing firms. In their multiple discriminant analysis of 112 firms issuing securities during 1971, they found the price-earnings ratio to be a very significant differentiating factor between debt and equity-issuing firms, and that lower price-earnings ratios were associated with debt-issuing firms. Thus, Martin and Scott found strong evidence of a link between the capital structure decision and capital market conditions.

King (1977) sought to test the hypothesis that a positive relationship exists between new equity issues and the share price index because, he argued, firms prefer to issue equity when share prices are high, relative to recent performance. The relationship was inferred from evidence from the Royal Commission on the Distribution of Income and Wealth (1975). However, when King tested this relationship on a sample of UK companies over the period 1950-71, he found that the relationship was insignificant.

Thus, though firms perceive a benefit of issuing equity when the stock market is buoyant, he found no evidence to support such a relationship.

Marsh (1982) also argued that the level of equity and debt issues is related to the performance of the equity and bond markets. He suggested that managers would be more likely to issue equity after periods of strong stock market performance and would be more likely to issue debt when interest rates were low or were expected to rise. He conducted a logit analysis of the choice between equity and long-term debt for 748 security issues by UK companies during the period 1959-70, and found that market conditions and the past history of security prices were very strong determinants of the debt-equity choice of the firm.

Thus, the cyclical nature of the economy in aggregate appears to have little empirical support as a factor acting on the corporate capital structure decision, although stock and bond market conditions do appear to be significantly related to the firm's choice of capital structure.

3.2.5 International factors

It has been demonstrated that capital factors significantly influence corporate capital structures, and that certain cyclical factors may significantly influence corporate capital structures, within a particular country. However, there are also influences which should explain inter-country differences in capital structures, and these are referred to by authors as international or cultural factors.

Stonehill et al (1975) studied, by means of a survey over the period 1972-73, the influence of international factors on the corporate capital structures of five western economies. They explained that such factors might include governmental incentives to raise funds abroad, hedging strategies, and capital repatriation. They found such factors to rank highly in France, the US and the Netherlands as determinants of firm capital structures.

Stonehill et al also noted that cultural factors may be important determinants, as firms may feel obliged to maintain the debt-equity ratios of their subsidiaries similar to the norms of the host country. Thus, the corporate culture of the host country might dictate the firm capital structure. Also, it is likely, they argued, that non-US firms will depart from the shareholder-oriented goals prevalent in the US, and may thus maintain different capital structures, based upon such cultural factors as societal values about income distribution, the state of development of equity markets, tax and accounting systems, and so on. Therefore, different countries may induce differing corporate capital structures due to the influence of different norms, institutions and goals.

Sekely and Collins (1987) studied 677 firms in 9 industries in a total of 23 different countries, seeking to establish the influence of cultural factors on the debt structure. They grouped countries into "cultural realms", which Broek and Webb (1973) defined as groups that have:

> "Fundamental unity of composition, arrangement and integration of significant traits which distinguish them from other realms." (Broek and Webb (1973))

Sekely and Collins employed the Kruskal-Wallis test to examine patterns within the data. They found some limited evidence of a positive relationship between the degree of development and a country's aggregate corporate capital structure. They also found evidence of significant differences between cultural realms but not within them. Therefore, cultural influences may, at least in part, explain some of the country effects on capital structures, Within groups of countries, cultural patterns may affect the development of financial institutions and affect attitudes towards debt and risk.

Thus, international factors and cultural factors may be a cause of differences in corporate capital structures between countries, and countries of similar culture may have similar debt-equity ratios.

3.2.6 Summary

Many authors suggest that the macro economic environment significantly impacts upon the choice of capital structure of the firm. There is significant evidence supporting a positive relationship between inflation and the corporate capital structure. Investor capital market restrictions do appear to affect firm gearing, although government capital restrictions do not. The interest rate gap between lenders and borrowers of debt may reduce the tax advantage to debt, and may even eliminate this tax benefit in the UK. There is little evidence of the significance of economy-wide cycles influencing corporate capital structures, although market conditions, particularly stock and bond prices, do appear to significantly influence the capital structure choice. However, international factors, particularly cultural factors, appear to impact significantly upon corporate capital structures and are capable, at least in part, of explaining inter-country aggregate gearing ratio differences. To summarise, though only a few macro economic influences on the corporate capital structure have been examined in this section, it is clear that the macro economic environment significantly influences the firm's choice of capital structure. Thus, the macro economy sets the framework within which individual firms conduct their financial operations, and it is intuitive that alterations in this framework will impact upon such operations. However, corporate financial decisions are more immediately influenced by the corporate environment, and it is this corporate environment which enables firm-specific capital structure solutions. Therefore, the corporate factors influencing firm capital structures are examined next.

3.3 The corporate factors which influence the corporate capital structure

3.3.1 Introduction

In addition to the corporate environment which has been shown to exert a significant influence on the firm's choice of capital structure, there are many factors influencing the capital structure which occur at firm-level. As a complex and varied number of influences impact upon the capital structure choice, this may mean that the firm arrives at a capital structure which is optimal for its own environment, which is in turn governed by taxation, macro economic, and corporate factors. Aside from the taxation factors already examined, the firm-level or corporate factors may strongly impact upon the firm's capital structure choice, as the corporate environment is that which is more readily understood by the firm in making both short-term and long-term funding decisions. Each group of corporate factors is thus examined in turn.

3.3.2 The influence of risk factors on the corporate capital structure

3.3.2.1 Introduction

Risk is defined in the Oxford Dictionary as, "exposure to mischance". In the corporate setting, such exposure may be the result of high debt levels, high earnings variability, or other factors. However, the main incidence of corporate risk is related to bankruptcy and earnings and thus the discussion concentrates on these factors.

3.3.2.2 The influence of bankruptcy costs on the corporate capital structure

Following the MM (1958, 1963) models, many authors sought to determine the effect of introducing the possibility of bankruptcy into the MM perfect market models. Some authors argued that its inclusion radically changed the conclusions of the MM models, whereas others argued that either such costs were insignificant in magnitude or had no effect on the capital structure irrelevance debate. The literature in this area is very large and thus is only summarised here, drawing out some of the more important theoretical and empirical results. Firstly, the concept of bankruptcy is described. Secondly, models which suggest that the presence of bankruptcy costs is capable of producing an optimal capital structure solution are discussed, followed by those models which suggest that the influence of bankruptcy is insignificant. Thirdly, evidence on the magnitude of bankruptcy costs is reviewed, as well as evidence on the empirical relationship between such costs and the debt-equity ratio. Finally, the theory and evidence are summarised, to arrive at a balanced perspective on the effect of bankruptcy costs on the corporate capital structure.

The absence of bankruptcy costs from the MM models is perhaps their greatest shortcoming. The firm is forced into bankruptcy on the demands of debt holders when it can no longer meet the capital or interest payments due on debt. When bankruptcy occurs, the assets of the firm are sold and the funds are distributed to the debt holders, and if any funds are left over then these are distributed to the firm's equity holders. Within a perfect market, no financial loss results from bankruptcy as all assets are sold for their economic value. In the real world, however, the costs of bankruptcy <u>may</u> be significant, and the magnitude of such costs has become a key factor in many of the bankruptcy papers of the last few decades.

Warner (1977) suggested that bankruptcy costs are either direct or indirect. Direct costs would include lawyers' and accountants' fees, the fees of other professionals, and the opportunity cost of managerial time spent in administering the bankruptcy, whereas indirect costs might include lost sales and profits and the increased difficulty (and costs) of raising new finance and credit.

Thus, the expected value of bankruptcy costs may indeed be assumed to be insignificant in the perfect market, but may be considerable in the real world.

Many authors have suggested that an optimal firm-level capital structure may be reached where the marginal benefit of the debt tax deduction equals the marginal costs associated with the risk of bankruptcy. Earlier writers recognised this trade-off, which was later formalised in state preference models of corporate capital structure.

Robichek and Myers (1966) argued that there was a trade-off between the present value of the tax rebate associated with increased debt and the present value of the marginal cost of the "disadvantages" of debt. Baxter (1967) argued that the risk of ruin (bankruptcy) became very real as leverage increases and cannot be eliminated by arbitrage as the geared firm will always be less desirable than the ungeared firm. Thus he suggested that up to some degree of gearing, the market value of the firm increases with debt, but at high levels of gearing, extra debt reduces firm value due to the rising expectation of the costs associated with bankruptcy. Hirshleifer (1970) studied mainly personal bankruptcies, but proposed that:

> "Even within complete capital markets, allowing for considerations such as taxes and bankruptcy penalties would presumably permit the determination of an optimal debt-equity mix for the firm." (Hirshleifer (1970), p.264)

Even writers such as Stiglitz (1970), who assumed no bankruptcy costs in his multiperiod model, noted that this restrictive assumption was a serious limitation of his model. He argued that the price of a bond with the risk of bankruptcy and a bond without this risk would not be equal, resulting in a change in the opportunity set facing the investor and thus affecting firm value.

Though many authors proposed this intuitive trade-off between the tax advantage to debt and the costs associated with bankruptcy, only a few of the central papers are discussed here. Stiglitz (1972) demonstrated in his model that if the nominal rate of debt interest rises as the firm borrows more, an internal optimal debt-equity ratio results from this bankruptcy cost, counterbalancing the tax benefits to debt. Kraus and Litzenberger (1973) produced a formal state preference model of corporate capital structure, including bankruptcy costs, and found that:

> "The market value of a levered firm is shown to equal the unlevered market value, plus the corporate tax rate times the market value of the firm's debt, less the complement of the corporate tax rate times the present value of bankruptcy costs." (Kraus and Litzenberger (1973), p.918)

Thus, an optimal capital structure may exist. Scott (1976) developed a multiperiod model of firm valuation which proposed a unique optimal capital structure, whereby firm value was a function of the liquidating value of its assets in addition to expected future earnings. DeAngelo and Masulis (1980) found that, in their model, the tax advantage to debt is of the same magnitude as expected marginal default costs, whether such default costs are large or small, and that such costs were capable of producing a unique optimum capital structure, regardless of the presence of other counterbalancing factors such as non-debt tax shields. Therefore, the consensus of academic opinion was that a trade-off was indeed possible between the tax advantage to debt and the costs associated with bankruptcy.

Other authors have argued that capital structure irrelevance (market value invariance) still holds, even if bankruptcy costs are incorporated into their models. Stiglitz (1969) found the market value of the firm to be unrelated to its capital structure when there is a positive probability of bankruptcy, but only when the transactions costs associated with bankruptcy are zero, which is surely an unrealistic assumption. Miller (1977) addressed the issue of bankruptcy costs whilst constructing his famous capital structure irrelevancy model. His main argument for assuming zero bankruptcy costs was that the expected value of such costs were very small relative to the tax advantages they were suppose to balance. Indeed, he argued that:

> "The supposed trade-off between the tax gains and bankruptcy costs looks suspiciously like the recipe for the fabled horse-and-rabbit stew - one horse and one rabbit." (Miller (1977), p.264)

However, DeAngelo and Masulis (1980) criticised Miller's "horse-and-rabbit stew" argument, as they hypothesized that the expected net tax advantage to debt is endogenously determined by the interaction of supply and demand to be of the same order of magnitude as the marginal default costs.

Haugen and Senbet (1978), in their model, argued that bankruptcy costs are an insignificant (or even non-existent) determinant of corporate capital structure in a well functioning market. This proposition arose from the argument that the liquidation decision is distinct from the event of bankruptcy; the costs associated with the latter are limited to the costs of informal capital structure reorganisation prior to default; and, that actual liquidation would only occur if the present value of such liquidation was greater than the value of the firm if allowed to continue. They extended their model in 1984, this time arguing that, with rational behaviour and unhindered arbitrage, bankruptcy costs would not exceed the lower of financial markets transactions costs and court system costs.

Therefore, models which question the impact of bankruptcy-associated costs on the corporate capital structure mainly question the ability of such costs to trade-off against the tax advantage to debt, as the magnitude of the former is argued to be much less than the latter. Thus, evidence on the magnitude of bankruptcy costs must be discussed.

Evidence on the magnitude of bankruptcy costs is provided by authors such as: Van Horne (1976), Sharpe (1981), Baxter (1967), and Warner (1977).

Van Horne (1976) found the costs of bankruptcy to be significant, as assets sold realised only 30-70 per cent of their going-concern value and administrative expenses were found to add another 20 per cent to this value, suggesting a total bankruptcy cost of greater than 50 per cent of the firm's before-bankruptcy value. Baxter (1967) studied personal bankruptcies and found that in 1965, 19.9 per cent of large US bankruptcy realisation values went to administrative expenses, and further proposed that for corporate cases this percentage would be smaller but far from insignificant. He also noted that the indirect costs probably have a far more important impact on firm value (and thus on the capital structure). Miller (1977) criticised Baxter's study arguing that direct corporate bankruptcy costs have no relation to personal bankruptcy costs and that Baxter's study examined only those individuals undergoing liquidation and did not consider reorganisation.

Perhaps more convincing evidence was provided by Warner (1977) who studied the direct bankruptcy costs of 11 US railroad firms over the period 1930-55. Warner found that bankruptcy costs represented on average only 1 per cent of the value of the firm 7 years prior to bankruptcy. He further argued that it was the expected costs of bankruptcy that influenced the corporate capital structure, and thus such costs were likely to be very much less than 1 per cent, rendering them negligible and thus irrelevant to the firm's choice of debt-equity ratios. Miller (1977) argued that this evidence supported a key assumption of his model, but that Warner considered only the direct costs of bankruptcy. The indirect costs, such as the reluctance of customers and suppliers to deal with the firm and the opportunity cost of management time, he argued, were likely to be large. However, Miller suggested that the lack of use of income bonds in the US, which have all the tax advantages of debt with none of the bankruptcy cost disadvantages, suggested that the combined costs of bankruptcy cannot be very large.

Therefore, the authors who found evidence that direct bankruptcy costs were significant appeared to study personal bankruptcies, whereas the study of corporate bankruptcies revealed direct costs to be very small. It may not be conclusively argued, however, whether bankruptcy costs are large or small, as there is little evidence of the extent of indirect costs which are arguably much larger than direct costs.

Stonehill et al (1975), Marsh (1982) and Mackie-Mason (1990) included measures of bankruptcy risk in their capital structure empirical studies. Stonehill et al (1975) studied the determinants of the corporate capital structure in their 1972-73 survey of 87 firms in five countries. They found that financial risk ranked the most important determinant to firms in three of the five countries. Marsh (1982), in his study of UK companies between 1959 and 1974, found that bankruptcy risk (a coverage ratio measure) was a significant capital structure determinant and that those firms with greater bankruptcy risk were more likely to issue equity than debt. Mackie-Mason (1990) studied 1,747 US issues since 1977 and found that financial distress variables were significantly negatively related to the probability of issuing debt. Thus, there is strong evidence that bankruptcy risk measures significantly influence the corporate capital structure.

To summarise, many authors suggested that the tax advantage to debt may be counterbalanced by bankruptcy-related costs. Indeed, many authors extended such ideas and formalised them in state-preference models which produced internal optimal capital structure results. Models which found the inclusion of bankruptcy to be an insignificant factor often did so by using a combination of restrictive, unrealistic perfect-market assumptions. There is little evidence of the significance of <u>direct</u> corporate bankruptcy costs, and <u>indirect</u> bankruptcy costs have been found to be extremely difficult to estimate. However, bankruptcy cost variables were found to be significant determinants of the discrete choice between new debt and equity issues. Therefore, much of the theory proposed a counterbalancing effect between the tax advantage and bankruptcy risk disadvantage to debt, though very little evidence is available to either support or refute this proposition. Evidence clearly shows, however, that firms perceive bankruptcy costs to be a determinant of their capital structure choice and therefore a counterbalancing effect is entirely possible, as well as being intuitively appealing.

3.3.2.3 The influence of earnings risk on the corporate capital structure

Bankruptcy risk was seen to be an important determinant of the corporate capital structure. However, there are other types of risk which must be considered by the firm, prior to its capital structure decision. Various measures of earnings risk are thus briefly discussed.

Toy et al (1974) conducted regression tests to discover the performance variables which determined the corporate debt ratios of 816 manufacturing firms in four industries in five countries. They hypothesized that firms with high earnings rate variability were likely to employ less debt due to institutional constraints and bankruptcy risk. The earnings risk measure was found to be highly significantly related to debt ratios in three of the five countries, but that the relationship was positive, and thus, counter intuitively at first glance, higher earnings risk appeared to be associated with higher debt ratios. Taub (1975) modelled the choice of new funding for 89 US firms between 1960 and 1969, including testing for the significance of an "uncertainty of future earnings" variable. He expected to find that the greater the uncertainty of such earnings was, the lower the desired debt-equity ratio would be. After depreciation was excluded from earnings, he found that the future earnings uncertainty variable was significantly negatively related to the debt ratio. Titman and Wessels (1988) employed a factor analytic approach to study 469 US firms over the period 1974-82. He included an indicator of volatility, the standard deviation of the percentage change in operating income, but found it not to be a significant determinant. Finally, Zwick (1977) conducted an empirical study of the influence of asset risk on the corporate capital structure. He defined asset risk as:

> " The amount of uncertainty or expected variability of their (corporations') earnings before interest and taxes." (Zwick (1977), p.32)

He proposed that an increase in asset risk should cause firms to reduce their gearing to reduce the risk of bankruptcy. He observed increases in debt ratios in the US between

1960 and 1967, and argued that such increases were due to a decrease in asset risk. Therefore, evidence on the significance of earnings risk may suggest a positive relationship, although the evidence is mixed.

3.3.2.4 Summary

Following the MM (1963) tax advantage to debt proposition which appeared to advocate an extreme corporate gearing position, many authors explored the risk of bankruptcy as a limiting factor on gearing. Though little evidence is available on bankruptcy risk, most authors suggested that such risk counterbalanced the tax advantage to debt, thus implying a unique capital structure for each firm. Evidence suggests that firms take into account bankruptcy risk, however, before determining their gearing levels. Firms with high earnings variability should limit their gearing, as such high variability adds to the financial risk associated with debt. However, there is only weak evidence to support the significance of earnings risk as a capital structure determinant.

3.3.3 Agency influences on the corporate capital structure

3.3.3.1 Introduction

The firm is described by Jensen and Meckling (1976) as a nexus for the set of contracting relationships among interested parties. As each of these interested party consists of rational economic agents, they are driven by self-interest to pursue their own goals, as much as they are able. The relationship between the owners (equity holders) and managers of the firm may be described as an agency relationship. Jensen and Meckling defined the agency relationship as:

> "A contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent."
> (Jensen and Meckling (1976), p.308)

The firm manager who owns less than 100 per cent of residual claims on the firm will pursue to some extent his own goals such as maximising the level of perquisites or minimising his effort searching for new profitable projects, rather than pursuing the equity holders' goal of profit maximisation with full vigour. The divergence between the owner-manager's goals and the equity holders' goals increase as the proportion of outside equity increases. Realising this, equity holders set up monitoring procedures and safeguards to minimise the divergence. If the equity holders anticipate the divergence and the costs of monitoring then they will reduce the price they are willing to pay for the equity. The wealth effects of the equity holders' actions are borne entirely by the owner-manager, representing an agency cost of equity.

With respect to debt, agency costs may also arise between debt holders and the manager acting on the behalf of equity holders in the firm. Suppose the manager has the opportunity to take up either a low risk or high risk project. The manager may borrow from debt holders on the pretence that the funds are intended for the less risky project, but, after the funds are raised, the manager may choose the more risky project. In so doing, the manager has essentially transferred business risk from the equity holders to the debt holders because the latter invested funds at a lower rate than they should have for the riskier project. Equity holders thus gain and debt holders lose from such a phenomenon. Again, debt holders may incur monitoring costs to prevent business risk transformation, or any other action by the manager which reduces the value of their claim, costs which are ultimately borne by the firm in the form of reduced income from debt issues.

There may, then, be agency costs associated with both equity and debt as the monitoring costs of claim holders are simply passed on to the firm. In addition, firm managers may even incur "bonding costs" as a result of their own decision to ensure that their actions are in the interests of claim holders.

Firstly, the theories describing the agency relationship between equity holders and managers are described. Secondly, theories describing the agency relationship between equity holders and debt holders are examined. Thirdly, evidence relating to the significance of agency costs to corporate capital structure determination is reviewed. Finally, the trading-off of the agency costs of debt and equity to produce an optimal capital structure is considered.

3.3.3.2 The agency relationship between equity holders and managers

Jensen and Meckling (1976) were probably the first authors to coherently analyse the agency relationships present within the firm. They argued that where the owner-manager has issued some outside equity, so that he/she no longer owns 100 per cent of the equity, the costs of any activities to promote profit-maximisation are borne by the manager whereas he/she does not capture the entire gains of the activities. Conversely, if the manager decides to increase his/her level of perquisites, then he/she receives the entire benefits of the increase but pays only partly for the costs. Thus, as the proportion of outside equity increases, the degree of efficiency of the firm may decrease. However, ceteris paribus, introducing or increasing debt in the capital structure essentially increases the proportion of equity owned by the manager, reducing the loss from monitoring costs imposed by outside equity holders. Therefore, in this sense, debt produces an agency benefit which helps to reduce the agency costs of equity.

Jensen (1986) extended the agency advantage to debt concept into a "control hypothesis" for debt creation. He argued that managers of firms with substantial free cash flow might invest it at below the cost of capital or waste it on organisational inefficiencies rather than paying it out. However, debt creation allows managers to bond their promise to pay out future cash flows, by issuing debt in exchange for equity. In this respect, Jensen suggested that debt was an effective substitute for dividends, as the firm is forced to pay out future cash flows as interest by law (in the bankruptcy court if necessary).

> "Thus, debt reduces the agency costs of the free cash flow by reducing the cash flow available for spending at the discretion of managers."
> (Jensen (1986), p.324)

Therefore, both Jensen and Meckling (1976) and Jensen (1986) suggested that there are potential agency benefits associated with debt.

Harris and Raviv (1990) argued that managers will always want to continue operating even if investors want to liquidate. Debt may resolve this problem, however, as debt holders may force liquidation if the firm defaults, and as debt increases, so does the probability of default. Thus, debt improves the liquidation decision and the benefits of this are traded off against the costs of investigation to make an efficient liquidation decision. Thus, greater use of debt reduces the agency problem between managers and investors which arises from the decision to liquidate or continue the firm.

Stultz (1990) assumed, in a similar manner to Jensen (1986), that even if it would be better to pay out free cash flow to investors, managers would always rather invest such cash flows. He argued that there is a counterbalancing effect between the benefits and costs of debt. The benefits arise from preventing the manager from investing in value decreasing projects as increased debt payments reduce the free cash flow, whereas the costs of debt arise from the debt payments preventing value increasing projects. Thus, the agency costs and benefits are traded off to produce an optimal level of debt for the firm.

Therefore, where a conflict arises between managers and investors, concerning the level of perquisites, investment in value-decreasing projects, or the decision to liquidate, debt may be employed to reduce or even eliminate such conflict by encouraging managers towards more efficient actions.

3.3.3.3 The agency relationship between equity holders and debt holders

Jensen and Meckling (1976) argued that debt encourages equity holders to invest suboptimally. This is because if an investment is successful and yields returns greater than the value of debt, equity holders receive most of the gains whereas if the investment fails debt holders lose. Thus, equity holders will invest in risky projects even if they decrease firm value, as such a decrease is offset by the gain at the expense of debt holders. However, if debt holders anticipate this behaviour they will increase the returns they demand, passing the costs on to the equity holder. This is an "asset substitution effect" and represents an agency cost of debt.

Myers (1977) argued that firms have both assets-in-place and future investment opportunities. Outstanding debt will cause under-investment in such future opportunities as the number of projects are reduced because the returns from projects must be able to cover not only the investment outlay but also the outstanding debt servicing costs (principal + interest). Therefore, future investment opportunities may be passed up, even though they make a positive contribution to firm value, and thus the present market value of the firm is reduced. Firms with few assets-in-place and many future investment opportunities should, Myers argued, employ less debt.

Hirshleifer and Thakor (1989) argued that managers may pursue safe projects as they are concerned about their reputations. If the manager has the option of pursuing two projects, where one project is higher risk than the other, but has a higher return if successful, the manager may choose the lower-risk-lower-return project to avoid failure and thus a loss of reputation. However, equity holders would have preferred the higher expected return project. This effect reduces the agency costs of debt observed in earlier models.

Diamond (1989) argued that firms choose investment projects which assure debt repayment. A firm can build a reputation for investing in safe projects by not defaulting on debt, thus enabling it to benefit from cheaper debt. Thus, reputation of non-default on debt causes firms to refrain from indulging in asset-substitution, again reducing the agency cost of debt (an agency benefit of debt).

Therefore, use of debt may cause firms to indulge in asset substitution, producing gains to equity holders at the expense of debt holders, and may also cause the firm to engage in sub-optimal investment policies. However, the firm's reputation for non-default and the manager's reputation for success both work against these agency costs, and may produce some optimal level of debt.

3.3.3.4 Empirical evidence on the influence of agency effects on the corporate capital structure

As the agency relationship is very often fairly intangible, empirical studies of the importance of agency costs to the corporate capital structure necessarily concentrate on testing the implications of such theories.

Smith and Warner (1979) studied the bond covenants of firms to attempt to discover the significance of agency costs.

> "A bond covenant is a provision, such as a limitation on the payment of dividends, which restricts the firm from engaging in specified actions after the bonds are sold." (Smith and Warner (1979), p.117)

They studied 87 US public issues of debt over the period 1974-75 and found that 90.8 per cent of bond covenants contained restrictions on the issuance of additional debt; 39.1 per cent restricted merger activities; 35.6 per cent constrained the firm's disposals of assets; and 23 per cent contained restrictions on dividend payments. These restrictions imply that agency conflicts between debt holders and firms must be significant. Smith and Warner suggested that variation in debt contracts across firms supports their "Costly Contracting Hypothesis", which suggests that if agency costs are significant, then bond covenants should contain a large range of carefully chosen clauses.

Marsh (1982), in his empirical study of UK firms over the period 1959-70, argued that a firm with a higher proportion of assets-in-place should employ more long term debt. He conducted a logit analysis of funding issues over the period, modelling the choice between debt and equity, and found that the higher the ratio of fixed-to-total-assets, the higher the probability of debt issue. Thus, this supports Myers' (1977) assets-in-place agency theory.

Rutterford (1988) found that taxes did not explain cross-sectional differences in gearing across countries, and thus studied the impact of agency costs as a possible determinant instead. She compared the relationships between firms and their creditors in the US, the UK, France, Germany and Japan. Close links between lenders and firms were in place in the last three of these countries, such as banks holding significant equity holdings in firms, banks holding positions on the Boards of firms, banks employing industrial specialists to monitor the firm, and so on. She argued that such close links should reduce the agency costs of debt in such countries, leading to higher gearing. Observation of debt-to-total-asset ratios from the OECD for 1982, listed by Rutterford, reveals that this was indeed the case. Higher corporate debt countries were those with closer bank-to-firm links.

Mackie-Mason (1990) studied the influence of moral hazard costs on the debt-equity choice of firms since 1977. He calculated three measures to test the significance of agency costs: the ratio of plant and equipment to total assets to proxy for Myers' (1977) assets-in-place; research and advertising expenditures to proxy for Myers' future investment opportunities; and a cash flow deficit variable to proxy for Jensen's (1986) free cash flow. He found all three measures to be related to a higher probability of debt issue. This generally supports the importance of agency costs to the capital structure decision of the firm, although the second measure should be related to a greater probability of issuing equity as debt should cause under investment in future opportunities.

Finally, Norton (1991), in his factor analysis of US Fortune 500 firms during 1986, found that agency cost factors were of little, if any, concern to the firms responding to his survey.

Therefore, there is generally both observational and empirical evidence that agency costs significantly influence the firm's choice of capital structure.

3.3.3.5 Summary

By abstracting the concept of the firm to a nexus of contracting relationships, the conflicts between various interested parties may be discussed. Such conflicts impose costs and benefits on the firm such as monitoring and bonding costs, losses in value through sub-optimal investment decisions, and so on. The effect of debt on the firm is complex, as it may both create such costs or reduce such costs, depending on the situation of the firm. The evidence supports the importance of agency costs to the firm, as implications of agency relationships are inherent in the accounts of firms and surveys show that firms do indeed perceive such agency conflicts, otherwise elaborate and complex bond contracts would not exist. Thus, as a result of the agency costs and agency benefits associated with both debt and equity, an optimal capital structure may result where these costs and benefits are traded off, regardless of other factors such as taxation or bankruptcy costs.

3.3.4 The information signalling nature of the corporate capital structure

3.3.4.1 Introduction

Information asymmetry theories assume that firm managers have access to information about the firm which investors do not. This information asymmetry may cause the firm to maintain a preferred "pecking order" with respect to its capital structure. The firm's capital structure decision may also send signals of inside information to investors. Theories relating to these statements are discussed in turn, and evidence supporting their validity is examined in some detail.

3.3.4.2 Pecking order theories of corporate capital structure

Probably the seminal papers on the "pecking order" capital structure preferences of firms are those written by Myers (1984) and Myers and Majluf (1984).

Myers (1984) extended the work of authors such as Donaldson (1961), who observed that:

> "Management strongly favoured internal generation as a source of new funds even to the exclusion of external funds, except for unavoidable 'bulges' in the need for funds." (Donaldson (1961), p.67)

Myers proposed, then, that firms would prefer to fund new investment by internal rather than external funds, but if external funds were to be used then low-risk debt would be used first and equity would only be used as a last resort.

In their model, Myers and Majluf (1984) proposed that a firm could be of two types: one firm type with high valued current assets and another firm type with lower valued current assets, and furthermore, that investors do not know which type the firm is initially. The firm manager has the opportunity to invest in a new project, and must finance by equity issue if he or she decides to go ahead. The firm with the higher valued current assets would decide to issue no equity and would not invest in the project whereas the firm with the lower valued current assets would accept and issue equity to fund the investment. This is because the manager of the firm with the higher valued current assets would anticipate that an issue of equity would be mispriced because of the information asymmetry, which might result in new investors benefiting from more than the NPV of the new project, and thus existing equity holders losing as a result. Thus, such information asymmetry causes under-investment by the firm with the higher valued current assets. The firm that issues equity signals to investors that it has lower valued current assets. Such firms would not imitate firms with higher valued current assets as current shareholders would have to pass up the positive net present value (hereafter referred to as NPV) project and would receive no gain in the valuation of their assets. Firms with higher valued current assets would not imitate firms with lower valued current assets, as the equity issued would be underpriced and current shareholders would lose their existing assets plus the value of the new project. Thus, Myers and Majluf argued that firms would attempt to avoid the dilemma of passing up positive NPV investments or issuing underpriced stock; would set target dividend payout ratios to ensure that most investment could be financed internally; that firms may still issue debt as long as it is low risk; and that if internal funds and risk-free debt does become exhausted, risky debt and convertibles would be issued before common stock. Therefore, their model suggests a pecking order of finance, rather than an optimal capital structure, and that what is observed in finance markets is the cumulative requirement for external financing.

Thus, Myers (1984) and Myers and Majluf (1984) propose a distinct pecking order of finance such that rather than firms seeking to attain an optimal capital structure mix, they instead merely prefer retained earnings to debt to outside equity.

However, Brennan and Kraus (1987) and Constantinides and Grundy (1989) argued that such a pecking order for finance does not exist as there is a far wider set of funding options available to firms, such as combinations of issues and repurchases, resolving the under-investment problem of the Myers and Majluf (1984) model.

Brennan and Kraus (1987) created a model in which two types of firm exist: firm H with high valued current assets and firm L with lower valued current assets, and each firm has outstanding debt. An equilibrium will exist whereby L issues sufficient equity to just fund the new project, whereas H issues sufficient equity to finance the new project AND to retire its outstanding debt at face value. Investors correctly infer the firm type. As H's debt is riskless, the firm receives a commensurate price on the equity issued as well as the debt that is repurchased. H-type firms would never imitate L-type firms as this would lead to their equity being overpriced. As L-type firms' debt is risky, they will not imitate H-type firms because repurchase of L's debt at face value would be an overpayment, and this would outweigh the gains from their overpriced equity issue. Therefore, neither firms will issue debt, in equilibrium, but will issue equity and will take on positive NPV projects, and the under-investment suggested by Myers and Majluf (1984) will not longer exist. With respect to signalling, a negative signal would be produced by issuing equity alone, but if this were accompanied by a simultaneous repurchasing of debt, the signal would be positive. Brennan and Kraus thus obtain a result which directly contrasts to Myers and Majluf's result - that equity is preferred to debt to finance new investment.

In Constantinides and Grundy's (1989) model, managers are assumed to hold some of the firm's equity and are allowed to issue any type of security as well as to repurchase existing equity. In equilibrium, all firms undertake positive NPV projects financed by the issue of securities (such as convertible debt) which are neither pure equity nor debt. The hybrid security is issued to fund both the new investment and the repurchase of some of the firm's equity. This repurchase means that firms find it costly to overstate their true value (by emulating the behaviour of a higher valued firm), and the new hybrid security, which is sensitive to the value of the firm, makes it costly to understate firm value. There is no longer a need for the firm to finance the investment internally, or use riskless debt and neither Myers and Majluf's under-investment nor their pecking order theories apply.

Therefore, theory is divided over the existence of a "pecking order" for corporate funding. There is also a potential under-investment problem in the Myers and Majluf (1984) and Myers (1984) models, which is resolved in the models of Brennan and Kraus (1987) and Constantinides and Grundy (1989) because, they argued, firms have access to a broader range of financial instruments than pure debt and equity. These pecking order theories, then, do not propose the existence of an optimal capital structure, but merely suggest the rationale for preferences of one form of finance over another. The interaction of the finance and investment decisions, as discussed in the case of tax exhaustion, may mean that investment is a determinant of the capital structure decision, or indeed, vice versa.

3.3.4.3 The signalling nature of the corporate capital structure

If perfect markets are assumed, as in the MM models, there is perfect dissemination of information about firms to investors, enabling investors to efficiently price the securities of firms. However, a number of authors have argued that such perfect dissemination does not occur, and that the capital structure itself sends signals to investors concerning, in particular, the investment policy of the firm.

Ross (1977) argued that, if the nature of the firm's investment policy is signalled to the market through its capital structure decision and if the compensation that a manager receives is related to the accuracy of the capital structure signal, then the capital structure may indeed be relevant, implying a unique optimal debt-equity ratio for the firm. Therefore, the degree of gearing may be used by management to signal to investors the value of the firm. To support this, he argued that low valued firms will not have high debt-equity ratios, due to the risk of insolvency, and thus firm value will be positively related to the gearing ratio.

Leland and Pyle (1977) argued that managers of firms which wish to expand, will often invest a large part of the required equity themselves. This produces a signal of business confidence to investors, increasing the amount they are willing to lend, and thus the debt-equity ratio of the firm will increase as a result. Thus, the degree to which managers take up equity in their own firms sends a signal of the quality of investment projects to investors, and the greater the fraction of total equity taken up by managers, the greater the value of the firm. In turn, as the value of the firm increases, so will its debt capacity, and, in general, the amount of debt issued to fund investment will increase. This positive relationship between firm value and debt is a similar conclusion to the MM (1963) model, but in a tax-free environment.

The theories describing the information signalling nature of the corporate capital structure suggest that firm value is positively related to gearing in a world of imperfect information dissemination. The degree of gearing thus conveys information about the degree of business confidence and the quality of the firm's investment projects. This suggests that managers will not only set the level of debt in the firm's capital structure for reasons of taxation, financial distress risk, and so on, but will also be influenced by the type of signal which a capital structure change may send to investors about the "health" of the firm.

3.3.4.4 Evidence on the information signalling nature of the corporate capital structure

Breaking down the assumption of perfect information in finance markets led to theories which suggest that the capital structure signals firm value to investors, but at the same time this may lead to distortions in corporate investment. Empirical research has concentrated mainly on testing the validity of the Myers and Majluf (1984) model, but such evidence may be employed more generally as a measure of the importance of the information signalling nature of the corporate capital structure.

Evidence supporting the information signalling theories is provided by Myers (1984) and Remolona (1990). In addition Mackie-Mason (1990) produced mixed results in his empirical work.

Myers (1984) computed figures from the evidence of Brealey and Myers (1984) for US firm data over the period 1973-82. He found that 62 per cent, on average, of capital expenditures were financed internally, with the majority of external funding coming from debt and only 6 per cent of external financing coming from new equity issues. He suggested that such an observation may provide some prima facie evidence in support of a pecking order for corporate funds.

Remolona (1990) studied Global Vantage data for a number of major countries over the period 1983-88 and found that:

> "Firms manage their long-term debt to achieve an optimal capital structure while they adjust short-term debt to accommodate cash-flow shocks." (Remolona (1990), p.36)

Thus, there is a pecking order effect, particularly for short-term debt. He also argued that if the pecking order hypothesis holds, firms will exhaust their cash flow (internal funds) before issuing debt and thus strong cash flows relative to investment should lead to a decline in leverage. The evidence from his test reveals that relatively strong cash flows in aggregate do indeed appear to be related to decreases in leverage. Furthermore, he found evidence, on a disaggregated basis, that firms were acting as if external funds were far more costly than internal funds by regressing the change in total debt upon a measure or predicted external financing needs. Therefore, Remolona found strong evidence to support the pecking order hypothesis.

Mackie-Mason (1990), in his study of US public offerings since 1977, examined the importance of various signalling costs variables on the firm's choice of debt or equity. He noted that authors such as John and Williams (1985) assumed that dividends are employed by firms as a costly signal of earnings, and that Bagnoli and Khanna (1987) assumed the prior year percentage change on the firm's share price would be an important signalling proxy. He found that 'investing in dividends' makes a debt issue more likely and that firms are more likely to issue equity when the share price has recently risen. Therefore, signalling variables do impact upon the choice of corporate capital structure but signals which should support equity issues are not necessarily followed by such issues. Mackie-Mason's evidence is thus mixed on the significance of the signalling nature of the corporate capital structure.

Evidence questioning the significance of information signalling effects is provided by Mayer (1990) and Norton (1991). Mayer (1990) examined OECD data and company accounts data for eight major countries, to test various hypotheses concerning capital markets. His initial observations provided some support for information theories, as retentions were found to be the dominant source of finance in all countries, with external finance representing only a small proportion of funding in each country. However, he also noted that the pecking order proposed by Myers and Majluf (1984) may not exist as the sale of equity to external investors is not allowed in many countries. He argued that Myers' (1984) prediction that equity finance is employed at high levels of gearing when debt becomes risky finds little support in the evidence, as in countries such as Japan which have high gearing levels, there is little evidence of new equity finance.

Mayer found that bond finance was more significant in countries which contained large numbers of bond-rated firms, which suggests that use of debt finance is promoted by the action of pure information-gathering institutions. Therefore information asymmetry must be a problem in these countries, otherwise such institutions would not exist. Finally, he observed that banks are the dominant source of external finance in the countries studied. However, information theory cannot explain this preference if it is possible to establish institutions that perform a pure information-gathering role (such as bond-rating agencies). Mayer concluded that:

> "Information deficiencies do not provide a convincing explanation for observed international patterns of corporate finance on their own."
> (Mayer (1990), p.323)

Norton (1991), in his 1986 survey of US Fortune 500 firms, conducted a factor analysis upon the firm responses and found that firms did not perceive debt to send a positive signal, nor equity a negative signal, questioning the pecking order theory of Myers and Majluf (1984). Another factor in his analysis indicated that signalling either does not happen or is not considered important by firms when deciding on their capital structure mix.

Therefore, evidence from Mayer (1990) and Norton (1991) questions the significance of any information signalling characteristic of the corporate capital structure.

In summary, there is mixed evidence on the validity of information theories of capital structure. It is not clear whether a pecking order exists for the choice of financial instruments or whether this may lead to distortions in investment (such as under-investment).

3.3.4.5 Summary

Both the theory and evidence suggesting a distinct pecking order to corporate financial instruments is mixed. However, it is clear that firms do prefer to finance using internal funds rather than external funds, even if the pecking order within external funds is unclear. A pecking order for corporate funding may be consistent with capital structure irrelevancy, and implies little about the existence of a unique optimal capital structure. Therefore, the information signalling nature of the capital structure, if indeed capital structure changes do send signals to investors, is unclear both in theory and is not clearly supported or refuted by the available evidence.

3.3.5 The influence of security costs and internal funds on the corporate capital structure

3.3.5.1 Introduction

The direct costs associated with issuing and servicing securities, as well as the level of internally generated funds, should impact upon the firm's choice of capital structure. Firstly, the influence of transactions costs is considered, a discussion which includes consideration of the influence of retentions. Secondly, the costs of servicing equity in the form of the payout ratio, are discussed to determine its influence on the corporate capital structure. Finally, the theory and evidence are brought together to summarise the effect that the direct costs associated with firm securities have upon the corporate capital structure.

3.3.5.2 The influence of transactions costs on the corporate capital structure

It is often assumed in the theoretical models of the literature, particularly in the MM models, that the firm exists within a perfect market where transactions costs are zero. However, in the real world, such transactions costs may be considerable, and will thus affect the firm's capital structure decision. Consideration of the effect of such costs would be incomplete if the level of retentions was not also discussed.

Titman and Wessels (1988), in their factor analysis of 469 US firms over the period 1974-82, found that transactions costs were an important determinant of the capital structure choice. They observed that smaller firms relied far more on short-term debt than larger firms owing to economies of issue costs. They also found that there was a negative relationship between various profitability measures and current debt to the market value of equity ratios, which may imply that the increased transactions costs related to higher debt levels may reduce profitability.

Mayer (1990) found little evidence of the significance of transactions costs to the corporate capital structure choice. He found that although the US and UK had the most complex and efficient financial systems in the world, other countries raised considerably more external finance than firms in these countries. In addition, although US and UK firms' equity markets contained considerably more quoted companies than other countries, they appeared to raise roughly similar amounts of new finance to countries such as France and Japan. In bond markets, he observed that direct costs of issues over the period 1982-83 represented 1.7 per cent for Canada and only 1.1 per cent for the UK, whereas comparatively little was raised by European firms on the Eurobond market and a considerably greater amount was raised by North American firms using domestic bonds (OECD, 1989). To confirm that such results did not merely reflect differences in investment demand across countries, he revealed that high growth electronics and pharmaceutical industries had the highest proportion of retentions of all industries. Therefore, Mayer found no evidence of transactions costs significantly impacting upon the capital structure of firms.

In the same study, Mayer (1990) noted that if transactions costs are introduced to any examination of the capital structure decision of the firm, then a preference for retentions over external finance will result. Indeed, he observed that retentions were the dominant source of finance in all the countries he studied. This result implies both that transactions costs may be a significant determinant of the corporate capital structure, which is in turn entirely dominated by the firm's use of internally generated finance. However, in addition to transactions costs, risk may also be an important cause of the popularity of internal finance over debt finance.

Firms employ internal finance for investment (retentions) up to the point where such funds no longer cover outlays, and at this point the decision about the form of external finance is made. Marsh (1982) conducted a logit analysis based on a sample of 748 issues of equity and debt made by UK companies over the period 1959-70. He hypothesized that a company's stream of retentions will result in a steady reduction in the book value debt ratio over time and thus it might be expected that firms with high retentions will be more willing to issue debt. He included, then, a retentions ratio variable, defined as the level of retentions as the percentage of capital employed in the firm, as a proxy for the expected level of retentions. Marsh found that increases in the retentions ratio were in fact more likely to lead to equity issues in a univariate model, rejecting his hypothesis. Thus, contrary to theory, the higher the level of retentions, the greater is the likelihood of firms issuing equity securities at the margin.

Therefore, theory suggests that in an imperfect world, transactions costs would cause the firm to prefer retentions to external finance, a hypothesis which is strongly supported by evidence. This supports, to some extent, a pecking order theory, but only of a preference for internal over external finance. However, it is unclear what effect transactions costs have upon the external finance mix of firms, as the evidence is mixed, and what effect the level of retentions has upon the choice of debt over equity, as the theory conflicts with the available evidence.

3.3.5.3 The relationship between the payout ratio and the corporate capital structure

Martin and Scott (1974) defined the dividend payout ratio as cash dividends divided by net earnings per share available to the common shareholders, thus expressing it as a measure of the relative level of dividends. They argued that an increase in the payout ratio should lead to an increase in leverage usage, at least in bookkeeping terms, and that it might be expected that firms issuing new equity have lower payouts than firms issuing new debt. Their study of 112 US firms that issued securities during 1971 revealed the dividend payout ratio to be a significant variable at the 5 per cent level as a discriminating variable between debt and equity in a univariate model, thus supporting their hypothesis. Therefore, increases in the payout ratio appear to be related to an increased likelihood of issuing debt rather than equity at the margin.

Marsh (1982), in his logit analysis of the issue decision of UK firms over the period 1959-70, found increases in the payout ratio to increase the likelihood of an issue of debt, at least on a univariate basis.

Rozeff (1986) argued that existing literature suggested that new long-term debt has a negative influence on the amount of dividends paid. It is notable that this relationship is opposite in sign from the other studies, but the direction of causation is also opposite, that is, he looked at the determinants of the payout ratio rather than the converse. He conducted a multiple regression analysis to model the target dividend ratio of 1,000 US firms over the period 1974-80, using beta as a surrogate measure for financial leverage (and operating leverage), and found evidence of a negative relationship. He interpreted this result as showing that firms viewed dividend payments as "quasi-fixed" charges and that firms with higher fixed charges (related to higher debt) will pay lower dividends to reduce the total costs of external financing. Thus, Rozeff hypothesized, and found evidence of, a negative relationship between the payout ratio and the degree of gearing, but, notably in a model with the payout ratio as dependent.

As the study of Rozeff (1986) examined the relationship between the payout ratio and the degree of gearing whilst employing the payout ratio as dependent, its negative relationship result is not capable of questioning the implied positive relationships found by Martin and Scott (1974) and Marsh (1982). Thus, an increase in the payout ratio of the firm increases the likelihood that the firm will increase the proportion of debt in its capital structure.

3.3.5.4 Summary

The costs associated with the issue and servicing of financial securities, then, have a varied effect on the corporate capital structure. Clearly, firms will endeavour to fund internally if they have not exhausted such funds due to the transactions costs associated with external finance in the real world, and there is strong evidence that firms do finance predominantly from retentions. However, the exact influence, if any, of transactions costs on the extent and mix of external financing is unclear. Increases in the servicing cost of equity, the dividend payout, appear to favour debt rather equity issues at the margin, although the sign of the relationship depends on the direction of causation.

3.3.6 The influence of firm size and growth upon the corporate capital structure

3.3.6.1 Introduction

Many authors have suggested that firm size and growth are strong determinants of the corporate capital structure. They argue that scale influences market conditions, financial risk, management perceptions, and so on, to such an extent as to cause large firms to finance differently from smaller firms. Firms experiencing growth, particularly fast growth, may finance differently from firms which are static, as demands for external finance may be greater and pecking order effects may arise. The theory relating to the influence of size and growth factors is considered in turn, along with empirical evidence to support such theory.

3.3.6.2 The influence of size on the corporate capital structure

Most authors would agree that size is positively related to the degree of gearing employed by the firm, and thus theory and evidence supporting this hypothesis is examined first. However, other authors hypothesize a negative relationship, which is also examined in turn. The apparent conflict is then discussed to arrive at a more precise understanding of the influence of firm size on capital structure.

Martin and Scott (1974) argued that larger firms in the US were located in mature industries and enjoyed a wider range of financing options than smaller firms. They thus hypothesized a positive relationship between debt issues and firm size at the margin. In their multiple discriminant analysis of 112 US firm issues during 1971, they found size to be the most important discriminator of all the variables they studied, and that, as hypothesized, larger firms were more likely to issue debt than equity.

Taub (1975) hypothesized a positive relationship between the debt-equity ratio and the size of the firm, because larger firms have larger assets to fall back on if a variation in earnings risks results in debt interest default. He found evidence consistent with this hypothesis in a model of the US firm's choice of new financing based on 89 firms over the period 1960-69.

Marsh (1982) proposed a positive relationship between size and the debt-equity ratio, because, he argued, there existed size-related differences in long-term debt flotation costs and asset composition. He found evidence to support this proposition in a logit analysis of 748 US firm security issues over the period 1959-70. Thus, larger firms appear to offer greater security for debt and experience lower flotation costs than smaller firms.

Rajan and Zingales (1994) noted that larger firms tended to be more diversified and fail less often than smaller firms, and so size may be an inverse proxy for the probability of bankruptcy. They also noted that size may also be a proxy for the information which outside investors have about the firm, which should increase their preference for equity relative to debt. However, they do not explain why this latter information effect should not also increase demand for potential debt holders, thus weakening their argument. In a cross-sectional analysis of leverage in US firms during 1991, they constructed a Tobit model which revealed the relationship to be positive and highly significant.

Therefore, the theory and evidence discussed above supports the hypothesis that corporate gearing increases with firm size. However, Remmers et al (1974) hypothesized a positive relationship, again arguing that size was a proxy for risk, but found no evidence of significant differences between the debt ratios of small, medium and large firms for a number of countries for the years 1966 and 1970. They noted, however, that the firms studied were the largest firms within each country and thus possibly did not represent enough variation in scale for differences to become significant.

The research of authors who found evidence of a negative relationship between firm size and gearing is discussed next.

Gupta (1969) hypothesized that a negative relationship exists between debt and firm size because, he argued, smaller firms would find outside equity issues very costly and would be reluctant to share ownership with new equity owners, thus encouraging the use of debt more than for larger firms. In his study of 173,000 US manufacturing firms over the period 1961-62, he found evidence of such a negative relationship, supporting his hypothesis. However, he did note that much of the debt was short-term debt, as similar constraints existed for long-term debt as those for outside equity.

Titman and Wessels (1988) hypothesized that small firms would be more highly levered than large firms, though most of the leverage would be short-term debt such as bank loans. Indeed, they found in a factor analysis of 469 firms over the period 1974-82, that size was negatively related to short-term debt ratios.

Remolona (1990) observed that large firms were much less leveraged than small firms in his Global Vantage data study of firms in four major countries in the 1980's.

Therefore, a number of authors found a negative relationship between firm size and leverage. However, this relationship is mainly explained by the fact that such authors generally studied short-term rather than long-term debt. Short-term debt would obviously be used by smaller firms to a far greater extent than larger firms, as such firms may have only a limited access to long-term funds, whether debt or equity generated.

On balance, then, there is a positive relationship between firm size and long-term debt arising from the reduced risk, larger securable assets, lower flotation costs, greater diversification, and so on, of larger firms than smaller firms. However, there is also evidence of a negative relationship between short-term debt and firm size, as smaller firms find long-term outside funding more costly and are probably more averse to the owner-manager dilution than larger firms.

3.3.6.3 The influence of growth on the corporate capital structure

It has been observed already that firm size is positively related to the proportion of long-term debt in the corporate capital structure. Firm growth, the change in firm size, should also have an influence on the capital structure. Most of the literature suggests a positive relationship, the theory and evidence of which is considered below.

Gupta (1969) found in his study of 173,000 US manufacturing firms over the period 1961-62 that growth firms tended to have high debt to total assets ratios. He argued that this positive relationship was due to the fact that growth firms required greater flexibility, and also that debt was easier to acquire and to liquidate.

Toy et al (1974) hypothesized that high growth rate firms, ceteris paribus, would have higher debt-equity ratios, at least until firms' retained earnings caught up with their market opportunities. They found evidence to support this hypothesis over the period 1966-72 for firms in the US, Japan, Norway and Holland, but found a negative relationship for French firms. Thus, high growth firms may require large amounts of long-term debt relative to equity until their internal cash-flows start to benefit from the growth of sales and profits.

Martin and Scott (1974) argued that firms experiencing a rapid growth in sales would be more willing to accept higher financial risk funding, and thus more debt, than non-growth firms. They found evidence to support this proposition in their analysis of 112 US firm issues during 1971.

King (1977) found evidence in his time-series regression analysis of UK firms over the period 1950-71 that the growth of the corporate sector capital stock was significantly positively related to the ratio of equity-to-retentions as well as to the ratio of debt-to-retentions. He argued that such growth might be considered as a proxy for the need to finance externally. Thus, growth firms need external finance to a greater extent than non-growth firms. Alternatively, it may be argued that those firms which issue relatively large amounts of external finance become growth firms by definition, and thus the direction causation is uncertain here.

Finally, Titman and Wessels (1988) argued that there might be either a positive or a negative relationship between growth and the long-term debt ratio. They suggested that equity-dominated firms may invest sub-optimally to transfer wealth away from the debt holders and that the costs of this agency relationship would be higher for firms in growing industries which have more flexibility in their choice of future projects. This would lead to a negative relationship between future growth and long-term debt. However, Myers (1984) argued that this problem may be mitigated if short-term debt is used instead of long-term debt, implying a positive relationship between short-term debt and growth rates. In their factor analysis of 469 US firms over the period 1974-82, they found that there is actually <u>no</u> effect of expected future growth on debt ratios.

Therefore, it appears that firm growth is generally positively related to the proportion of debt in the corporate capital structure, because growth firms require greater flexibility, exhaust retained earnings more easily, and would be more receptive to higher financial risk funding than non-growth firms. More generally, growing firms are more likely to use a greater proportion of external funding to total funding than non-growth firms, as there may be a significant lag between investment and increased cash flows.

3.3.6.4 Summary

There appears to be a positive relationship between firm size and long-term debt, but a negative relationship between firm size and short-term debt. Factors which influence such relationships include financial risk, asset structure, manager-ownership-dilution, and flotation costs. Growing firms appear to require greater external funding than non-growth firms, and when they issue long-term external funds they appear to prefer debt to equity financing for reasons of flexibility and reduced risk aversion. Thus, the scale of the firm, and the change in the scale of its operations, impact significantly on its choice of capital structure.

3.3.7 The influence of accounting structure factors on the corporate capital structure

3.3.7.1 Introduction

The accounting structure of the firm is basically the relationship between variables in its financial accounts. Ratios are constructed by expressing accounts items relative to other items such as total assets, sales, market value, and so on, to enable comparison across firms of different size. Management of firms will often use such ratios to monitor the progress of the firm, often comparing them with the ratios of other firms in the same industry. Therefore, it is likely that managers will make their capital structure decisions after considering, amongst other factors, these accounting ratios. Such accounting ratios (or accounting structure factors) as profitability, tangibility, and liquidity may, then, be determinants, to some extent, of the corporate capital structure.

3.3.7.2 The influence of profitability on the corporate capital structure

Profitability is widely suggested to impact significantly on the level of debt that firms employ in their capital structures. Drury and Bougen (1980) suggested that the relationship between profitability and the gearing level might be either positive or negative. Higher profitability firms might prefer higher gearing (a greater proportion of cheaper debt capital) to maximise the earnings per share of ordinary shareholders.

Alternatively, they argued, lower profitability firms may find it difficult to obtain debt capital, at least at an "affordable" price, thus resulting in a preference for equity capital. These two arguments support a positive relationship. However, highly profitable firms are likely to have substantial retained earnings and would find it relatively easy to raise equity capital, producing a negative relationship between profitability and gearing. Alternatively, lower profitability firms, which have meagre retentions, may find it difficult to attract equity funds and would have to raise funds from fixed interest debt, again supporting a negative relationship. Thus, Drury and Bougen demonstrate that the relationship between profitability and gearing is theoretically unclear, and thus it is necessary to discuss the evidence, as well as the supporting theory, of a wider range of authors.

Toy et al (1974) hypothesized that high earnings rate firms, ceteris paribus, would maintain relatively lower debt because of their ability to fund themselves internally. They conducted a regression analysis of the debt ratio of 816 firms in 5 countries upon profitability, the average earnings rate over 7 years. They found that profitability was significantly negatively related to the debt ratio in four of the five countries studied, and was in fact the most important differentiating factor among the countries.

Martin and Scott (1974) argued that profitability may be either positively or negatively related to the probability of a debt over an equity issue. Greater profitability creates a higher cash flow which should support more fixed-interest debt than equity. Alternatively, highly geared firms may experience higher rates of return on equity-contributed funds and may thus seek to reduce their gearing by issuing equity. They found profitability to be a very significant discriminator, at the 5 per cent level, between debt and equity, such that more profitable firms would more likely issue equity than debt, but did not find profitability to be a significant discriminator in their multivariate analysis.

Drury and Bougen (1980), whose theoretical explanations for the relationship between gearing and profitability have already been discussed, conducted a study of the gearing determinants of 700 UK firms over the period 1968-77. Their cross-tabulation exercise revealed that high profitability firms are more likely to employ low gearing ratios, confirming the negative relationship found by other authors.

Marsh (1982) conducted an analysis of variance of 748 security issues made by UK firms over the period 1959-70, and found that highly profitable firms were more likely to issue equity at the margin, thus producing a negative relationship.

Titman and Wessels (1988) argued that profitability should be an important determinant of the debt-equity ratio as a result of the pecking order theories of Myers (1984) and Myers and Majluf (1984). In their factor analysis of 469 US firms over the period 1974-82 they found significant evidence of a negative relationship between measures of past profitability and current debt levels scaled by the market value of equity.

Rajan and Zingales (1994) also noted that the relationship between profitability and gearing may be theoretically either positive or negative. They argued that the Myers and Majluf (1984) theorem, already discussed, should lead to a negative relationship. Also, managers may prefer to issue equity rather than debt to avoid the disciplinary role of debt. This disciplinary role of debt, as proposed by Jensen (1986), predicts a positive relationship if the market is effective and it forces firms to pay-out cash through higher gearing. In their study of US firms using a Tobit model, they found a very significant negative relationship between profitability and book-value-leverage, market-value-leverage, and also flow-leverage. Furthermore, they found evidence that the negative relationship between leverage and profitability occurs in all of the G7 countries over the period 1987-91.

To summarise, there is a very strong negative relationship between profitability and the proportion of debt in the corporate capital structure. This may be because more profitable firms find it easier to issue equity due to the higher earnings of their equity holders, do not need to resort to debt finance as they have substantial internal funds, supporting Myers and Majluf's (1984) theorem, or, that firms may wish to avoid the disciplinary role of debt as described by Jensen (1986). Thus, more profitable firms appear to prefer to finance internally, but if they do require external finance they prefer to extend their equity ownership.

3.3.7.3 The influence of asset structure upon the corporate capital structure

The assets of the firm may be divided into fixed assets and current assets. The ratio of fixed-to-total assets plus the ratio of current-to-total assets sums to unity, with the former measure often being referred to as the tangibility of the firm and the latter referred to as the liquidity of the firm. The nature of any relationship between these accounting ratios and corporate gearing is examined below.

Marsh (1982) argued that firms with a higher proportion of assets-in-place should employ higher long-term debt, citing Myers' (1977) theory that debt may cause firms to pass up some investment projects due to the extra servicing costs of the outstanding debt. Indeed, Marsh found evidence that the fixed asset ratio was a significant determinant in his logit analysis of 748 issues made by UK companies over the period 1959-70. Thus, the fixed asset ratios of UK firms (tangibility) were found to be positively related to their gearing ratios.

Rajan and Zingales (1994) argued that a firm with a large proportion of tangible assets has collateral sufficient to reduce the agency costs of debt to the lender, such as the costs related to the transformation of business risk. He also argued that firms with a greater proportion of tangible assets will retain more value in the event of liquidation. Therefore, the greater the fixed asset ratio, the more willing lenders should be to lend to the firm, and the greater the degree of gearing should be. In their Tobit analysis of US firms for 1991 data, they found tangibility to have a significant positive influence on gearing. They also found such a relationship for Japan, Germany and Canada, though not for the remaining G7 countries over the period 1987-91.

Thus, both theory and evidence supports a positive relationship between the tangibility of a firm's assets and the degree of gearing that the firm employs.

Martin and Scott (1974) sought to test Van Horne's (1974) statement that the greater the firm's projected liquidity posture, including its cash flow generating capacity, the greater is its debt capacity. They extended this argument to the incremental issue decision of the firm, arguing that higher liquidity firms should be more likely to issue debt rather than equity. They studied a sample of 112 US firms that issued either debt or equity during 1971, and conducted a multiple discriminant analysis of the data, finding that higher firm liquidity (the ratio of the firm's current assets divided by total assets to that of the industry norm) was associated with equity rather than debt-issuing firms. They explained this apparently counter intuitive result by arguing that the higher liquidity of equity issuers implied a lower than industry-average operating leverage, and as they noted that equity-issuers had higher gearing than debt-issuers:

> "Their low degree of operating leverage might indicate a trade-off between financial and operating leverage as a conscious part of management policy." (Martin and Scott (1974), p.77)

Therefore, firms with high liquidity ratios appear to favour equity rather than debt issues at the margin.

Stonehill et al (1975), in their survey of 87 manufacturing firms in France, Japan, the Netherlands, Norway and the US over the period 1972-73, found that liquidity ranked highly in Norway alone as a perceived debt ratio determinant. The reasoning for this, they argued, was that Norwegian financial executives were more concerned with the impact of liquidity on financial risk than on any desire to produce a similar liquidity ratio to other firms within their industry. Thus, evidence confirms a positive relationship between liquidity and the gearing ratio in the perceptions of Norwegian corporate managers, but, markedly, not for firms in the other countries in the study.

Thus, although theory would generally suggest that firms with greater liquidity could support more debt, the evidence is mixed and generally questions the significance of liquidity as a determinant at all.

Therefore, while the theory and evidence strongly supports a positive relationship between the tangibility of a firm's assets and the degree of gearing that it employs, there is little evidence of a clear relationship between gearing and liquidity, even though the theory supporting a positive relationship is intuitively plausible.

3.3.7.4 Summary

The accounting structure of the firm appears to influence the gearing ratio chosen by that firm, in that profitability and tangibility are positively related to gearing. Though the theory supporting a positive relationship between liquidity and gearing is intuitive, the evidence supporting such a relationship is very weak. It may be, then, that firms in general maintain their liquidity ratios to industry-norms, for example, and that not enough variation exists across such ratios to be able to establish a statistically significant relationship with gearing. However, both profitability and tangibility (collateral) do appear to significantly influence the firm's choice of capital structure, as such factors are far better measures of a given firm's ability to support current and future debt than liquidity.

3.3.8 The influence of production and investment factors upon the corporate capital structure

3.3.8.1 Introduction

Myers (1977) argued from an agency perspective that firms with a greater proportion of assets-in-place, and lower intangible future investment opportunities, are likely to supply a higher proportion of debt. Thus, a link has already been established, in the literature reviewed so far, between the financial and investment decisions of the firm. Other less direct influences on the capital structure, such as tax exhaustion due to excess non-debt allowances, have also been discussed in some detail. However, many authors (such as Modigliani and Miller) assumed the two decisions to be entirely separate, and assume one decision to be given whilst examining the other. Only in the last decade or so has this restrictive assumption been relaxed, leading to theories of the corporate capital structure which also incorporate production and investment factors. These capital structure-investment theories are discussed first, and then production factors are examined as they broaden consideration of a firm's projects to the markets in which goods are sold, the type of product, the level of output and the technology of production.

3.3.8.2 The influence of investment factors upon the corporate capital structure

Myers' (1977) assets-in-place agency theorem has already been discussed in some detail. Myers (1986) broadened discussion of this concept, arguing that the costs of possible financial distress were most important for risky firms and for firms whose value depends on intangible assets. Debt contracts may be costly for the firm and monitoring costs may be expensive for creditors if the firm has a high proportion of intangible assets, and these costs may cause the firm to pass up positive NPV investments. Myers argued that the tendency of such firms to under-invest may explain, for example, the low debt ratios observed in the US pharmaceutical industry, where firm value depends on the continued success of research and development. Thus, the type of investment may influence the firm's choice of capital structure.

Long and Malitz (1986) also argued that the type of investment opportunities facing the firm determines, at least in part, its ability to support debt. They hypothesized that firms with relatively high levels of intangible investment, such as research and development expenditure and advertising expenditure, should use less debt financing. Conversely, firms investing predominantly in tangible assets, such as plant and equipment, should employ higher debt levels. They explained this hypothesis by arguing that in the event of financial distress a firm will find it difficult to cash in on intangible firm-specific assets, particularly assets which have value only as part of a going-concern. If bankruptcy occurs, the loss in value will be much higher for firms with intangible assets than for firms with tangible assets such as capital equipment. Investors realise this and insist on more stringent firm monitoring, increasing the level of monitoring and bonding costs. Such costs will directly impact on the premium demanded by investors, making the debt a more expensive financing option. Thus firms which invest a large proportion of funds raised in research and development and advertising expenditures (intangible investments) should employ lower debt levels than those with more tangible investments. Long and Malitz studied the data of 545 firms from 39 US industries and found, in a regression analysis, that leverage was negatively related to advertising and research and development expenditure and positively related to the amount of plant, thus supporting their hypothesis.

Therefore, the type of investment undertaken by the firm may significantly influence its capital structure decision. Firms which invest more in research and development and advertising, and less in plant and machinery, should employ less debt relative to equity than firms with more tangible investments. Not only may the level of investment be potentially reduced by debt finance, but the type of investment may also influence the degree of gearing that the firm employs.

3.3.8.3 The influence of production factors on the corporate capital structure

Various characteristics of production may impact upon the corporate capital structure, such as competitive factors, product characteristics, and technology. The effect of each of these is discussed in turn, along with any evidence available to support each theory.

Spence (1985) hypothesized that firms under competitive pressure in their product markets might optimise their capital structures more carefully than firms that are sheltered from competition. He observed that the US firms which experienced sheltered markets appeared to have widely divergent capital structures, whereas firms operating in very competitive markets appeared to have much less variable capital structures. He studied data from 1,183 US firms over the period 1970-74 and found that deviations of actual from calculated optimal (average) capital structures were not related to competitive conditions. However, he did find that actual capital structures were positively related to the degree of diversification, and negatively related to the degree of labour intensity. Thus, while the greater spread of debt-use for sheltered market firms may not be explained by competitive conditions, actual capital structures appear to be strongly related to the degree of diversification and labour intensity.

Brander and Lewis (1986) produced a model which suggested that gearing creates an incentive to increase output. They started with the assumption, as explained by Jensen and Meckling (1976), that increases in gearing cause holders of equity to choose riskier investments. Brander and Lewis, by means of a Cournot model, argued that oligopolist firms gear themselves to pursue a more aggressive strategy. Harris and Raviv (1990) created a simple model to explain the Brander and Lewis results. Two firms simultaneously gear themselves and then simultaneously choose their output levels. One firm's profits (and marginal profits) are negatively related to the other firm's profits and increase with random shocks. When shocks are large, in good states, the marginal profit of output is large and the firm will choose a higher output than if the marginal profit is low. However, before this marginal profit is known, the firm must choose its output level. Due to limited liability, equity holders assume that the marginal profit cannot be low, and as a result gearing creates an incentive to increase output. Thus, this encourages firms to produce larger outputs, since this means that their rivals must produce less. The Brander and Lewis model, then, proposed a positive relationship between gearing and the level of output in an oligopolistic market.

Therefore, the Spence, and Brander and Lewis models suggest that the level of gearing that a firm employs is significantly related to the production factors: the degree of diversification, the degree of labour intensity, and the level of output. Such relationships arise from the competitive nature of product markets.

Titman (1984) argued that firms which produce unique goods, durable goods, and/or goods which require after-sale servicing and parts will employ less debt in their capital structures. This is because the costs suffered by customers are higher in the event of liquidation for these types of goods than for "normal" goods (non-unique, non-durable, "service-free"). The costs are ultimately passed on to equity holders who should (for an optimal solution) liquidate only if these costs are exceeded by the gains to liquidation. However, as equity holders ignore these costs in the event of a liquidation decision, the capital structure may be used to force them to make the optimal liquidation decision described above. Thus, equity holders should never liquidate, debt holders will always want to liquidate, and the firm compares customer costs to the gains from liquidation before it makes a decision to default. Thus, the more unique, durable, and/or service-intensive a good is, the less debt the firm producing that good will employ in its capital structure.

Titman and Wessels (1988) extended the concept of uniqueness and tested whether such uniqueness was negatively related to the degree of firm gearing. Again, they argued that customers, workers, and suppliers of firms producing unique products should bear relatively high costs if the firm liquidates. In their factor analytic study of

469 US firms over the period 1974-82, they found that firms with relatively high research and development expenditures, high selling expenses and low employee turnovers (quit rates), have low debt ratios, thus confirming that uniqueness is negatively related to gearing.

Maksimovic and Titman (1991) argued that consumers cannot distinguish the quality of the good until consumed, but that firms will endeavour to produce high quality goods to build a reputation for doing so. In the event of bankruptcy the firm's reputation would be destroyed and firms would no longer want to produce quality goods. The tendency to produce higher quality goods is reduced by debt finance. Therefore the firms likely to have less debt are those which can reduce quality with relative ease, as equity holders would want to reduce the risk of bankruptcy, and ultimate loss of reputation, by restricting gearing in the firm.

The more unique, durable, and service-intensive a firm's goods are and the easier it is to adjust the quality of those goods, the less debt will be employed by the firm in its capital structure.

Authors such as Stonehill et al (1975), Anderson (1990), and Maksimovic and Zechner (1991), all sought to determine the influence that firm technology has on corporate capital structures.

Stonehill et al (1975) conducted a survey of 87 firms from five countries over the period 1972-73 and found that the technology of the industry was perceived by Norwegian firms to impact significantly on the corporate capital structure, but was not rated as an influence by the other countries studied.

Anderson (1990) conducted a Tobit regression of 4,917 Canadian firms for the year 1982 to determine whether technology was related to the capital structure. He found that industrial classification, firm legal status and location, all influence the amount of long-term debt raised by firms. Long-term debt was also found to be positively related to repairs and maintenance costs and negatively related to employee costs. Thus, Anderson found that the positioning (industrial, legal, locational) of the firm significantly influences its capital structure choice and that the extent of long-term debt should increase as capital inputs increase and labour inputs decrease (the latter measures relative to total revenue).

Maksimovic and Zechner (1991) developed a model which suggests a link between technology choice and financial structure. Indeed, they found that:

> "Within an industry, firms that adopt the technology chosen by the majority of firms generate higher expected earnings before interest and taxes and are less levered than firms that deviate and adopt a technology which is only chosen by a few firms." (Maksimovic and Zechner (1991), p.1635)

Thus, firms using a different technology from that used by most firms in the industry tend to employ more debt than firms using a more common technology, as internal funds will be less for "technology-deviates" and greater external funds are required to fund investments.

Therefore, technology has an important influence on the corporate capital structure, with factors such as the labour-to-capital ratio having a negative influence on the gearing ratio.

To summarise, various production factors <u>do</u> appear to exert a significant influence on the corporate capital structure, questioning the assumption made in most of the central capital structure literature that real and financial decisions are separate. The competitiveness of markets may cause firms to optimise their capital structures more carefully and the extent of debt may even cause firms to produce more output than they otherwise would have done due to such competitive pressures. Firms with more durable, unique, or service-intensive goods should use less debt, and the technological development has a significant impact on the debt-equity ratio, particularly the degree of capital intensity which exerts a positive influence.

3.3.8.2 Summary

Various capital structure theories examining the influence of investment and production factors on corporate capital structures sought to suggest a link between the financial and real decisions of the firm. The "investment" theories suggest that debt may not only cause firms to pass up valuable investment opportunities but suggest also that firms with less tangible investment expenditure, on research and development expenses and selling expenses, should employ less debt. The "production" theories suggest more sophisticated real to financial interactions than merely the relationship between capital structure and the type of investment. The degree of competition, the type of product and the type of technology all influence the degree of debt funding. Important capital structure influences thus arise from investment, production and marketing pressures on the firm. Thus, the firm's finance manager must not only bear in mind the financial accounts factors, but must also consult other managers within the firm, such as the production manager and the marketing manager, before making a decision to significantly adjust the capital structure mix.

3.3.9 The influence of industry classification on the corporate capital structure

3.3.9.1 Introduction

Many authors have argued that the industry to which a firm belongs should impact significantly upon an individual firm's capital structure. Furthermore, they argued that each firm may target the average debt-equity ratio of their industry, and, in this sense, strive towards an optimal debt-equity ratio. Indeed, Ang (1976) argued that:

> "The existence of an optimum leverage ratio implies the existence of a target ratio, but not necessarily vice versa. However, the existence of the target ratio will raise some hard questions concerning whether there is an optimum leverage ratio." (Ang (1976), p.555)

Thus, if it can be shown that firms target the debt-equity ratios of their industry, this suggests, though does not prove, that individual firm optimal debt-equity ratios exist.

The next issue to be addressed is why firms would target their capital structures on the average of the industry to which they belong. Scott and Martin (1975) argued that the finance manager of the firm lacks a valuation formula to determine the best capital structure for his/her individual firm, relying instead on analysis and judgement. They suggested that judgement may be improved by examining the funding mixes of other firms in the same industry. Indeed, Drury and Bougen (1980) noted that any deviation from industry norms is viewed by both lenders and investors with some suspicion, further encouraging a strong industry convergence effect. Scott (1972), however, rationalised this targeting behaviour by arguing that firms choose capital structures which suit their particular business risk. As firms within the same industry should have a similar degree of business risk, a range of leverage will exist which firms will seek to locate within. Remmers et al (1974) argued that firms in the same industry face the same environmental and economic conditions which should produce clustering of earnings and sales. With respect to the relationship between target ratios and business risk, they argued that:

> "If it can be shown that debt ratios vary significantly by industry, it will be proved that financial decision makers have found different optimal financial structures that are a function of their business risk."
> (Remmers et al (1974), p.24-25)

Therefore, the theory suggests that if firms target their capital structures upon the "norm" for their industry then optimal firm-level capital structures may indeed exist. The reason that firms target in this way is owing to the fact that finance managers often look for guidance from similar firms on financial structure decisions, as they recognise that similar firms will be exposed to similar environmental factors, especially business risk, and they realise that significant departure from published industry norms will be viewed with some suspicion.

Evidence supporting an industry effect on the capital structure will be discussed first, followed by evidence questioning such an effect. It will be quickly recognised that evidence in support of target capital structures based on industry norms far outweighs the evidence refuting such targets. Finally, the theory and evidence are brought together to summarise the impact of industry classification upon the individual firm's capital structure.

3.3.9.2 Evidence supporting the existence of target capital structures based on industry norms

The evidence presented here concentrates mainly on providing support for the hypothesis that debt-equity ratios (or other capital structure variants) vary more between industries than they do within industries. However, evidence using other techniques is also discussed.

Schwartz and Aronson (1967) studied the common stock equity ratios for four US industry classes for the years 1928 and 1961. They compared the sample means using an F-ratio to test that the means of the different industry equity ratios were statistically equivalent. They found that the differences between industries were significant whereas the differences within the industries were not and could be explained by random variability. They also studied the period 1923-62 and found that structural differences between the industries were remarkably stable.

Lev (1969) employed least squares regressions to estimate partial adjustment models to examine the periodic adjustment of financial ratios to industry means. The models allowed for the assumption that at any particular time only a fraction of the desired adjustment to the target may be accomplished. They examined data for 245 US firms from 18 industries over the period 1947-66, studying a variety of financial ratio measures. Although only some of the adjustment coefficients were significant, they found the coefficients to lie between zero and unity, finding generally that firms did indeed adjust their financial ratios to industry-wide averages in a partial adjustment manner.

Scott (1972) argued that if an industry effect was significant then this supported the existence of an optimum financial structure for the firm, and that testing for such an effect was in fact a surrogate for testing the effect of leverage on the cost of capital. He studied 12 US industries containing 77 firms over the period 1959-68, using a one-way analysis of variance and found that the financial structures of firms in various industry classes were significantly different at the 1 per cent level for each of the ten years studied. He also conducted a multiple comparison test which confirmed that the differences were not the result of one strongly deviant industry.

Scott and Martin (1975) conducted a Kruskal-Wallis one-way analysis of variance by ranks to determine if samples from different industries came from different populations. They applied the test to book value common equity to total assets data from up to 277 US firms from 12 industries over the period 1967-72 and found industry class to be a significant determinant of financial structure. Furthermore, they conducted an analysis of covariance to discover whether the differences were merely the result of differing firm sizes within industries, but found that the test still supported a significant industry effect on capital structure.

Briscoe and Hawke (1976) conducted a one-way analysis of variance test for 120 UK firms for the periods 1965-69 and 1970-74 and found evidence of significant industry differences in gearing at the 5 per cent and 1 per cent levels, respectively.

Ang (1976) constructed a list of models, from naive target models through to complex partial adjustment models, which may explain how firms target their capital structures. He then estimated each model on a data set of 133 US firms and sought to discover which model was the most significant. The best performing models were found to be those listed below:

A simple partial adjustment model with constant payout ratio:

$$D_t - D_{t-1} = \lambda(\gamma TA - D_{t-1}) + e_t \qquad \text{Equation 3.1}$$

Where:

$D_t - D_{t-1}$ = the change in the debt level

λ = the speed of adjustment

γ = the target leverage ratio

TA = total assets

D_{t-1} = last period's debt level

e_t = disturbance

A first order Markov process model:

$$L_t = a + bL_{t-1} + e_t \qquad \text{Equation 3.2}$$

Where:

L_t = the leverage ratio

L_{t-1} = last period's leverage ratio

b = the drift parameter

e_t = disturbance

A historical average leverage model:

$$\Delta L_t = L_{H,t-1} - L_{t-1} + e_t \qquad \text{Equation 3.3}$$

Where:

ΔL_t = the change in the firm's leverage

$L_{H,t-1}$ = last period's industry average leverage

L_{t-1} = last period's firm leverage

e_t = disturbance

The power of these models, Ang concluded, suggested that firms do indeed operate in a manner consistent with a concept of a target leverage ratio, whether firms move in a partial adjustment process towards the target, whether they merely drift around their own concept of a target, or whether they target their capital structure on the historical average of their industry.

Marsh (1982) conducted a logit analysis of 748 debt and equity issues made by UK companies over the period 1959-70. He assumed that a company's choice of debt or equity was a function of the difference between current and target debt ratios, and that the target ratio was only observed through its determinants such as size, risk, and asset composition. As he found these determinants to be significant, he concluded that firms did choose to issue either debt or equity as though they strived towards target long-term debt ratios.

Cordes and Sheffrin (1983) used the UK Treasury Corporate Tax Model to examine data associated with 1978 corporate returns. They found that the marginal incentives to use debt varied significantly across industries, suggesting that observed differences between industry debt-equity ratios occurred partly because the tax advantage to debt varied across industries. Thus, industry differences in capital structures may not merely be a result of differing business risk, but may be for taxation reasons.

Titman and Wessels (1988) estimated a factor analytic model of the corporate capital structure choice, using data from 469 US firms over the period 1974-82. They incorporated into their model a dummy for manufacturing firms as opposed to non-manufacturing firms and found that the former employed significantly less debt than the latter. Thus, "industry-type" appeared, in their study, to influence the corporate capital structure.

In summary, there is considerable evidence to support the concept that firms target their capital structures with respect to the norms of their particular industry, evidence which derives from various empirical techniques. Some authors suggest that firms are only partially adjusted towards their target at a given time. Cordes and Sheffrin (1983) even suggested that an industry effect may in fact be owing to variations in financial instrument tax incentives across industries. However, whether this behaviour may be explained by taxation, business risk, or other factors as yet unrecognised, it is clear that the industry to which a firm belongs may significantly influence the capital structure which that firm chooses. In addition, it may be that such targeting in turn goes towards support for a firm-level optimisation of the capital structure.

3.3.9.3 Evidence questioning the existence of target capital structures based on industry norms

The theory and evidence in this area both point towards the existence of firm-level optimal capital structures, as firms adjust their capital structures towards the norm for their particular industry. Alternatively, the evidence may merely suggest that the capital structure ratio is irrelevant but firms lack the confidence to deviate from the norm for their industry. However, there is evidence which questions such firm behaviour, evidence which shall be discussed in this section.

Remmers et al (1974) conducted a one-way analysis of variance of the book-value total debt to total assets ratio of Fortune 500 firms from nine industries for the years 1966, 1970, and 1971, but found no evidence of an industry effect. They then conducted a similar analysis of variance test for four manufacturing industries in five countries. They found that industry was a significant determinant of corporate debt ratios in France and Japan, but not in the Netherlands, Norway and the US. On balance, then, they concluded that the industry influence on the firm capital structure is very weak, which may be because industry category is not a good proxy for business risk.

Stonehill et al (1975), in their survey of 87 firms from France, Japan, the Netherlands, Norway, and the US, over the period 1972-73, found that firms did not perceive industry norm to be an important debt ratio determinant in any of these countries.

Drury and Bougen (1980) analysed 700 UK firms in 45 industries over the period 1968-77. They constructed gearing distributions for each industry but observed no evidence of clustering of firms within each distribution around a norm. They concluded that if an industry optimal capital structure does exist then it must be spread over a very wide range, thus questioning the significance of any industry effect on corporate capital structures.

Sekely and Collins (1988) conducted a Kruskal-Wallis test upon a sample of 677 firms in 9 industries in 23 countries for the period 1979-80. They found that the differences in median rank between industries were not significant even at the 10 per cent level, and thus the industry effect appeared to be insignificant. They argued that the industry effect was insignificant owing to a reduction in the distinction between industries, a significant increase in the use of debt across the sample, and the highly imperfect and incomplete markets that exist outside the US. However, their study did examine multinational corporations, which would be expected to complicate the results, rendering minimal any industry effect.

In summary, the evidence questioning the existence of firm target debt-equity ratios based on industry norms is weak compared to that lending support to the target debt-equity ratio concept. Even though Stonehill et al (1975) found that firms may not perceive such targeting to be important, it may be either that firms are subconsciously practising such behaviour or even that they would not want to admit "following the leader" as such an admission might be embarrassing. Some authors, such as Sekely and Collins (1988), criticised those papers supporting the industry-target concept on the grounds that the data distributions tested were often non-parametric and thus the standard analysis of variance tests could not be validly used. However, authors both supporting and questioning the industry-target concept have used such methods, and thus the conclusions are not biased one way or another as a result of this problem.

3.3.9.4 Summary

The evidence available strongly supports the proposition that individual firms target their capital structures on the norm for the industry to which they belong. This may result from the fact that firms within an industry are subject to similar business risk, tax incentives, or other factors. There is some evidence that firms are generally in a state of partial adjustment towards a target at any given moment in time, as the adjustment process is lumpy for transactions costs and time reasons. Firms may refuse to admit such behaviour as it makes finance managers appear as if 'sheep following a shepherd'. Alternatively, it may be that finance managers are simply not aware that they are conforming to industry norms, but are guided to do so by institutional lenders and private investors who would frown upon very significant capital structure deviations from other firms in a particular industry. Thus, evidence of the targeting of the firm's capital structure with respect to its industry norm suggests that by so doing firms are engaging in the equivalent of capital structure optimising behaviour. Industry effects, then, impact significantly upon the corporate capital structure, implying firm-level optimal capital structures.

3.4 Summary

Chapter 3 sought to determine the nature and significance of macro economic and corporate factors to the firm's capital structure choice. Many of these factors were not considered by the pivotal papers which shaped early capital structure theory. However, these factors exert such an important influence on the firm's capital structure choice that no literature review of the theory and evidence would be complete without considering their influence.

The previous chapter concluded that it was difficult to isolate individual taxation measures which are significantly related to gearing, even though it was clear that the taxation environment as a whole significantly impacted upon the corporate capital structure. In particular, it was difficult to relate computed tax advantage to debt figures to actual gearing levels. The proposed reason for this was that tax exhaustion may reduce any tax advantage to debt and that the computed tax advantage to debt outside the US classical system was very much reduced anyway. Another possible explanation for the apparent lack of relationship between computed tax incentives to debt and observed gearing ratios was the possibility that non-tax factors introduced costs and benefits related to different forms of finance which might to some extent counterbalance any tax advantage to debt.

Macro economic factors provide the framework within which firms can operate, affecting both the operational and strategic decisions of the firm. On an operational level, the macro economic environment affects the day-to-day success of the firm, setting the parameters of internal firm operations as well as the external environment of the firm's competitors, customers and investors. On a strategic level, the macro economy influences the firm's long-term financial and investment plans. The firm may only adjust its capital structure, then, to the extent which the institutions, legal frameworks, market conditions, international trading conditions, and culture of a particular country will allow. The macro economic environment, then, defines the boundaries of the taxation and corporate environments. In addition, changes in various macro economic variables may, at times, cause significant shifts in the corporate capital structure which the finance manager distinguishes from the overall macro economic environment, such as a sharp increase in inflation, which may encourage him/her to issue more debt.

The finance manager, then, understands the constraints of the macro economic environment, and after taking account of these constraints, he/she may examine the taxation and corporate influences on the capital structure decision in order of their importance. Such factors may be classed as primary, secondary and tertiary factors, with the primary factors representing the priority influences on the finance decision.

The primary factors include tax incentives, the extent of tax exhaustion, investor premiums and transactions costs. Of these factors, the finance manager is likely to consider the influence of any tax advantage to debt first of all, as there is evidence that firms perceive the tax characteristics of debt to be of great importance. A forward-thinking manager will also consider the extent to which any tax advantage to debt may be utilised by considering the amount of non-debt tax shields the firm has, as well as the average taxable profits that the firm has earned in recent years. The premiums that potential debt and equity holders demand also directly impacts on the capital structure choice. Transactions costs of issuing funds may be an important influence, particularly for smaller firms. Thus, these primary factors are the easily observable direct costs of finance decisions which are likely to be foremost in the minds of finance managers.

The secondary factors include risk, ability to service funds, collateral, and industry-norm targeting. The finance manager will only raise new external funds, particularly debt, if the risk of insufficient earnings and ultimately financial distress are relatively low. Firm profitability and liquidity ratios serve as a guide to the individual manager of the "health" of the firm and may serve as measures of debt capacity. Intuitively, the greater the debt the firm already has relative to equity finance, the less willing the manager will be to issue more debt at the margin, unless the firm has less debt than it requires to achieve its target capital structure. Whilst considering all of these factors, the firm will also be mindful of any deviation of its capital structure from the capital structures of similar firms within its industry as such industry capital structure norms should guide the firm to finance in a similar manner to firms with similar degrees of business risk. The manager should recognise that any significant deviation from an industry norm capital structure may be viewed by private investors and institutional lenders with some suspicion and may result in higher premiums demanded. The firm's collateral, in the form of fixed assets, may also influence the premium demanded by investors, particularly potential debt holders, as the higher the level of fixed assets, the higher is the liquidation value of the firm. The level of dividends paid to investors may also influence the firm's capital structure choice because, although the dividend paid out does not represent a mandatory cost of equity, dividend reduction or passing-up altogether is viewed as "bad news" by the market, resulting in "sticky" dividends which are regarded as quasi-fixed servicing commitments. Thus, the secondary factors, though not considered first by the manager, impose direct costs and represent real influences on the manager's choice between debt and equity external finance.

The tertiary factors include size and growth, production and investment factors, agency costs and benefits, and the information signalling nature of financing decisions. There are important influences on the capital structure related to the scale of the firm. Larger firms may find it easier to issue long-term debt due to their greater collateral value, reduced risk, and economies with respect to the direct and indirect costs of debt. In faster growing firms, the finance manager may rely greatly on external funds as internally-generated funds become exhausted, and may prefer debt to equity as he/she is willing to bear the greater risk as higher expected future earnings should easily cover debt costs. Thus, the size of the firm and the rate of growth may alter the manager's degree of risk aversion, and thus scale and changes in scale will alter the manager's willingness to take on more debt. Managers will also be aware that the nature of their investment projects as well as their current operations and markets has an impact on their capital structure. The marketing strategy of the firm may require that the firm decides to grow as quickly as possible, and thus the scaling factors discussed above become important. Firms producing durable or unique goods will be inclined to moderate their debt as they realise that product prices will greatly reduce if it is believed that there is a chance of the firm arriving at a position of financial distress. If the manager has a large proportion of projects which are marginally worthwhile then debt financing may severely reduce this portfolio of projects, causing the firm to under-invest. Managers in this position may prefer to fund using equity. Thus, production and investment factors do appear to influence the manager's capital structure decision, though in an indirect manner. There may be agency costs and benefits related to different financial instruments, which the finance manager is less likely to consider at the time of the capital structure decision, but which nonetheless may result in extra costs and benefits arising from that decision. Bonding costs and monitoring costs may later increase the costs of such financial instruments in the form of independent auditing costs and bond covenant costs. The choice of funding at the margin may send signals to the market about the value of the firm, and managers may find that this effect restricts their choice to some extent. Firms may even maintain a pecking order of financing which they follow to finance investment, which further influences their choice of investment, particularly with respect to external financing. However, many of these tertiary factors are less intuitive to the finance manager as some of the implicit costs and benefits related to each form of finance are often unobservable and, at times, fairly abstract.

To conclude, given the macro economic environment, the finance manager makes his/her choice of the financial instrument to be used to raise new funds by prioritising influences on this choice in a similar manner to the ordering of the primary, secondary and tertiary factors discussed above. Different firms may prioritise differently due to differences in risk, scale, industry, length of establishment, sophistication, and so on. It may be that some managers only ever consider the more direct primary factors and that others always meticulously examine all of the influences: primary, secondary and tertiary. However, what becomes clear from this synthesis of macro economic, taxation and corporate influences, is that the myriad of influencing factors should be different for each individual firm, and thus each firm may choose its capital structure by trading-off the influences in an optimising manner. As each firm's objective function for this optimisation is different, in any economy there occur optimal capital structures at the level of the firm. The analysis of this report seeks to determine which of the factors, discussed in the literature review, determines the capital structure of the European firm. The objective for the rest of the report, then, is to firstly test hypotheses deriving from the literature which were largely produced from the experience and evidence from US firms and, less frequently, UK firms, and were rarely tested for a wider range of countries. Secondly, new hypotheses deriving from the body of the research are developed and tested. Finally, a synthesis model of the many competing determinants of the European corporate capital structure is developed, deriving from tests of the hypotheses, from new empirical capital models, and from new ideas which attempt to explain the nature of firm-level capital structure determination. The literature suggests the existence of firm-level optimal capital structure solutions, and it is thus the purpose of this report to determine whether this proposition holds for European firms.

CHAPTER 4

A STATEMENT OF RESEARCH HYPOTHESES AND PRELIMINARY TESTING

4.1 Introduction

The main purpose of chapter 4 is to introduce the hypotheses to be tested throughout the report, as well as the methodology employed for the empirical work. Section 4.2 lists the central, supporting and subsidiary hypotheses to be tested, and discusses some of the methods used, as well as problems and issues that may arise in the testing process. Section 4.3 examines the methodology used throughout the empirical research. Section 4.4 describes the five European data sets upon which the empirical analyses are to be conducted. Section 4.5 defines and discusses the two main capital structure measures used throughout the report: the stock debt-to-debt-plus-equity ratio measure and the flow funding issue measure. Section 4.6 provides a perspective on corporate capital structures across Europe by examining DDE ratios, and their relationship with tax factors. In addition, the section conducts a test of Miller's (1977) financial leverage clientele hypothesis as a means of further testing the central hypothesis. Section 4.7 examines the corporate environment of the European firm and describes tests of the effect of location (country) and tax system upon the stock capital structure, the marginal funding choice, and accounting structures generally. Finally, section 4.8 draws together the results of the analyses to determine what progress has been made towards addressing the central and supporting hypotheses.

4.2 The hypotheses to be tested in the empirical research

On balance, the existing body of literature reviewed supports the existence of firm-level unique capital structures, as macro economic, taxation and corporate factors drive each firm to pursue the unique mix of external funds which best suits its environment. It is impossible to test this proposition of firm-level capital structure optimality directly, and thus a less direct approach is used. It is proposed that if macro economic, taxation and corporate factors are all found to impact significantly on the corporate capital structure, then capital structures are responsive to those stimuli and may well reflect some unique optimum value. Whilst macro economic factors may only impact on capital structures within a country or economic unit, taxation and corporate factors are capable of producing unique capital structures at the firm level. Optimality is thus affected at the aggregate level and then at the disaggregated level, and thus the firm may optimise its capital structure given the influences of the country within which it operates, and also given those factors which impact in different ways on different firms.

The hypotheses listed consist of a central hypothesis, three supporting hypotheses, and 20 subsidiary hypotheses. If evidence is found supporting the relationships detailed in the subsidiary hypotheses, then this provides a test of the supporting hypotheses. If the supporting hypotheses suggest that macro economic, taxation and corporate factors significantly impact upon the corporate capital structure then the central hypothesis is supported. The hypotheses are addressed in this manner because the issue of firm-level capital structure optimality is complex and may not be answered by merely conducting one or two tests of surrogate optimality measures. Some of the hypotheses, however, are concerned with such optimality tests, such as H24, and to some extent H6, but the results of testing these hypotheses must be interpreted in conjunction with results of the complete set of hypotheses.

It is recognised that not all of the hypotheses which might be drawn from the literature are tested in the new empirical research, as some theories do not lend themselves to easily testable propositions whilst others add little to the hypotheses already listed. However, it is argued that the hypotheses to be tested should enable comprehensive testing of a wide variety of capital structure determinants, thus providing the justification for addressing the central hypothesis. This justification is further strengthened by the statement and testing of additional hypotheses, deriving from the new analyses of this research, in addition to the bivariate and multivariate modelling exercises undertaken to study the interaction of the capital structure with its potential determinants.

The hypotheses listed are not hypotheses in the strict statistical sense, whereby each one is matched to a specific empirical test, but are better considered general hypotheses, each one of which may be tested using a number of separate methods. Whether an individual hypothesis is accepted or rejected, then, depends on the overall results of a variety of supporting tests.

The listed hypotheses are tested throughout the empirical research, but are not necessarily addressed in the order presented here as hypothesis testing is often better ordered by empirical method rather than determinant type. However, the results are drawn together once the analyses are completed, to enable examination of the European evidence in the hypothesis order given in this section. By utilising different empirical methods, hypotheses may be addressed within cross-sectional, marginal, dynamic time-series, and long-term time-series perspectives. Not only does this allow a more comprehensive testing of the hypotheses, but often highlights important differences in capital structure-determinant interactions which cannot be captured in a single method alone. Additionally, some hypotheses are tested using descriptive statistics, some using bivariate techniques, and some using multivariate techniques, again producing some interesting results deriving merely from different perspectives.

It may be noted that the nature of the relationship described in each hypothesis is dictated by the theory and evidence of the literature reviewed, thus prescribing a positive or negative relationship, for example. Where reviewed evidence is weak or mixed, the form of relationship generally proposed by the theory is the one which guides the hypothesis.

Where hypotheses are supported by the empirical tests, that theory which appears most supported by the evidence may be discussed and expanded upon. Conversely, where hypotheses are questioned by the empirical tests, an attempt to explain such divergence is made. Results which question hypotheses may occur because much of the literature review was developed from the theoretical framework and empirical evidence of US (and to a lesser extent, UK) firms, which may not have universal application. The questioning of certain hypotheses may, then, be anticipated.

Many of the tests do not imply any direction of causation, even though much of the theory does. Indeed, it may be, in certain circumstances, that the corporate capital structure is itself a determinant of other factors, rather than being determined with the causation flowing from the non-capital structure variables. For example, it is noted that the bankruptcy risk hypothesis, H15, implies a different causation from the other hypotheses to be tested. Whilst most factors related to the capital structure are hypothesized, at least initially, to be determinants of the capital structure, the capital structure measure is more accurately expressed as a determinant of bankruptcy risk. However, as the empirical research progresses, the direction of causation with respect to bankruptcy risk may change, and where such a change is anticipated, or indeed imposed, this is discussed in the relevant section. The potential problem of causation uncertainty is also separately addressed in the time-series analyses of later chapters.

Finally, the results of the hypothesis testing and the results deriving from empirical models of the corporate capital structure are all drawn together in the conclusion in chapter 8, where the question of capital structure optimality is ultimately answered. The implications of the central hypothesis for the individual firm are then discussed within a theoretical model of the corporate capital structure.

Table 4.1
The central hypothesis, and the supporting and subsidiary hypotheses

Central hypothesis:

H1: There exist firm-level optimal capital structures.

Supporting hypotheses:

H2: Taxation factors significantly influence the corporate capital structure.
H3: Macro economic factors significantly influence the corporate capital structure.
H4: Corporate factors significantly influence the corporate capital structure.

Subsidiary hypotheses:

Taxation hypotheses:

H5: Corporate debt-equity ratios distributions are bimodal in shape.
H6: The corporate debt-equity increases as the tax advantage to debt increases.
H7: The corporate debt-equity ratio is determined by the degree of the firm's tax exhaustion.
H8: The corporate debt-equity ratio increases with the corporate tax rate.
H9: Corporate debt-equity ratios vary significantly across tax systems.

Macro economic hypotheses:

H10: The corporate debt-equity ratio increases with increases in the inflation rate.
H11: Corporate debt-equity ratios vary significantly across countries.
H12: The corporate debt-equity ratio is negatively related to stock market performance.
H13: The corporate debt-equity ratio increases as debt interest rates decrease.
H14: The average corporate debt-equity ratio of a country is related to the cultural realm to which the country belongs.

Corporate hypotheses:

H15: The degree of bankruptcy risk increases as the corporate debt-equity ratio increases.
H16: Retentions are the main source of investment finance.

Table 4.1 (cont.)
The central hypothesis, and the supporting and subsidiary hypotheses

Corporate hypotheses (cont.):	
H17:	The corporate debt-equity ratio increases as the payout ratio increases.
H18:	The long-term corporate debt-equity ratio increases with firm size.
H19:	The short-term debt-equity ratio increases as firm size decreases.
H20:	The corporate debt-equity ratio increases with the rate of firm growth.
H21:	The corporate debt-equity ratio increases with the degree of liquidity.
H22:	The corporate debt-equity ratio increases as firm profitability decreases.
H23:	The corporate debt-equity ratio increases as the tangibility of the firm's assets increases.
H24:	Individual firms target their debt-equity ratios on the norm for the industry to which they belong.

4.3 Methodology

This section briefly introduces the empirical research methodology employed throughout the report. The main objective of the project is to establish whether firm-level optimal capital structures exist by testing hypotheses from the existing literature, testing new hypotheses arising from the analysis, and by studying the interaction of the corporate capital structure and factors influencing it within empirical models. This section merely seeks to introduce the nature of the empirical work. More detailed descriptions of methods used are given when required throughout the report.

The central, supporting and subsidiary hypotheses have already been detailed in section 4.2. Existing hypotheses are restated and tested throughout the report. New hypotheses, deriving from the analysis are stated, discussed to explain why they are proposed, and tested in turn. The expected signs of the variable coefficients of the models are also hypothesized before estimation.

Various data sets are collected to enable the testing of hypotheses and the estimation of models of the capital structure decision of the European firm, and these will be described in section 4.4, along with the data preparation techniques used to render the data sets ready for analysis.

The methodology of this report includes the following: descriptive statistics, distribution analysis, univariate and multivariate analysis of variance, bivariate correlation tests, Granger causality tests, bivariate regression models, multivariate logistic regression models, unit root and cointegration tests, autoregressive distributed lag models, bivariate error correction models, and Johansen procedure multivariate error correction models. The broad spectrum of methods utilised reflects the diversity of hypotheses to be tested, and should provide stronger confirmation of rejection of hypotheses where different methods produce similar results. However, where the results of different methods apparently conflict, a closer examination of such circumstances may reveal new processes and interrelationships hitherto not discussed in the existing literature.

The level of significance employed in statistical tests for critical values is the generally accepted five per cent level, but this is varied when the nature of the data set or method used demands.

The remainder of chapter 4 describes: analyses of capital structure ratios and other accounting ratios across Europe; the ranking of capital structure ratios by tax system type and the corporate tax rate; a test for the existence of bimodal corporate capital structure distributions across Europe as a means of testing the Miller (1977) investor clientele hypothesis; and a multivariate analysis of variance to determine the importance of differences between accounting ratios, debt and equity issuing firms, as well as differences within countries, tax systems, and so on. This chapter thus provides a comprehensive perspective of the structure of the modern European firm and its capital structure, as well as determining the general influence of tax factors, country factors, and the differences between firms more likely to issue one form of external finance over another.

4.4 The European data sets

The main source of the information used in the empirical analyses is the Datastream on-line financial database. This database contains information which includes company accounts items, macro economic variables, equity and bond market prices and conditions, amongst many other variables and series. The system is mainly used by brokers, though it is also often employed in academic research projects where large samples of accurate data are required. The data are available for current variables and their historical values, enabling reasonable length time-series studies for firms in certain countries.

There are five main data sets used throughout the empirics of this report. Different data sets are required to capture average, marginal and time-series effects, as well as to enable tests for the significance of industry classification and tax exhaustion. A brief description of the data sets is given in table 4.2.

Table 4.2
The data sets of the European corporate capital structure research

Data set 1
Cross-sectional capital structure data set
Countries analysed: Belgium (63 firms), Denmark (46 firms), Eire (14 firms), France (346 firms), Germany (201 firms), Italy (92 firms), the Netherlands (59 firms), Spain (47 firms), Sweden (119 firms), Switzerland (142 firms), the UK (1,497 firms).
Number of observations: 2,626 firms.
Period: year ending October 1992.
Data type: Corporate capital structure ratios and firm characteristic variables.

Data set 2
Marginal capital structure data set
Countries analysed: Germany (66 firms), Belgium (8 firms), Denmark (12 firms), Spain (2 firms), France (63 firms), Eire (6 firms), Italy (19 firms), the Netherlands (24 firms), Switzerland (23 firms), the UK (172 firms).
Number of observations: 395 firms.
Period: capital structure issues: year ending March 1991.
accounting ratios: year ending March 1990.
Data type: Corporate capital structure issues and accounting ratios.

Table 4.2 (cont.)
The data sets of the European corporate capital structure research

Data set 3
Time-series capital structure data set
Countries analysed: the UK (up to 314 firms, 1968-93)
the Netherlands (up to 56 firms, 1978-92)
Germany (up to 204 firms, 1981-92)
France (up to 354 firms, 1983-92).
Number of observations: up to 928 per annum, up to 26 years.
Period: November 1968 to November 1993.
Data type: Corporate capital structure ratios, accounting ratios, macro economic variables, and other measures.

Data set 4
Industry-effect capital structure data set
Countries analysed: the UK only.
Number of observations: 486 firms from 12 industries.
Period: year ending February 1993.
Data type: Corporate capital structure ratios and industry classifications for firms in industries containing greater than or equal to 20 firms.

Data set 5
Tax exhaustion capital structure data set
Countries analysed: Belgium (40 firms), Denmark (38 firms), Eire (13 firms), France (292 firms), Germany (1 firm), Italy (56 firms), the Netherlands (9 firms), Spain (37 firms), Sweden (0 firms), Switzerland (131 firms), the UK (1,460 firms).
Number of observations: 2,077 firms.
Period: year ending March 1993.
Data type: Corporate capital structure ratios and corporation tax-paid measures.

As can be readily observed, the main data sets are the first three, as data sets 4 and 5 are merely those used to test subsidiary hypotheses. Indeed, the first three data sets are those which enable the majority of the hypotheses to be tested as well as enabling the empirical models to be estimated.

Once the raw data are collected from Datastream, unwanted information is removed within a word-processing or spreadsheet package. Each row then represents a case (an individual firm) and each column represents a separate variable. The data are then imported into the SPSS statistics package Version 5.02 (1993), within which accounting ratios and various other measures are computed. SPSS is used to conduct all of the cross-sectional and marginal analyses. However, other packages such as PCGIVE Version 7.0 (1992) and MICROFIT 3.0 (1991) are utilised to analyse the time-series data.

Problems encountered with the data include: unavailable data; missing observations; significant variations in the number of quoted companies across countries; and comparability of accounting measures across countries. Difficulties were encountered when seeking certain data types across the European sample, particularly those variables related to taxation. Where precisely comparable measures are unavailable, approximately comparable measures are used instead, but in such circumstances attention is drawn to this substitution. Missing observations constitute a fairly general problem with Datastream data. For example, when a multivariate model is to be estimated, if the data for just one of the independent variables is missing then all of the data for that particular firm will be omitted from the model estimation process, reducing the sample size and the validity of the model. Various instrumental variable and averaging "missing observations rectification" techniques were found to have an insignificant effect on the problematic data sets and thus were not used. Some countries have relatively few quoted companies compared to countries such as the UK, and therefore valid models may be produced for firms in these countries only with some difficulty. Thus, in some of the analyses, only a subset of countries is used as hypothesis tests or models would be meaningless for very small samples. Finally, authors such as Rutterford (1988) and Rajan and Zingales (1994) noted that inter-country comparisons of accounting measures are plagued by problems such as differences in cost conventions, the degree of consolidation of accounts, debt composition, assets composition, the presentation of leasing finance, institutional structures, and differences in the treatment of provisions and pensions in the accounts. Other differences which limit inter-country comparability are noted as the report progresses. In summary, data restrictions are seen to limit the ability to test certain hypotheses and estimate models on the corporate data from certain countries, thereby reducing, in some cases, the broadness of the results presented. However, it is asserted that by studying the five different data sets with their differing perspectives, a reasonably comprehensive coverage of European firms is achieved.

Therefore, hypotheses are tested and models estimated using the five data sets described, to enable consideration of the central optimality hypothesis of the existence of firm-level optimal capital structures and the processes by which that hypothesis comes about.

4.5 The capital structure measure

There is no capital structure measure which is common to the literature. Authors have argued from different theoretical standpoints as to why certain measures should be preferred to others, though often restrict their choice of measure when faced with the constraints imposed by the data available. Probably the most popular measure employed is the straight long-term debt to equity measure.

Marsh (1982) argued that the theory suggests that debt ratios should be measured in market value terms, even though most of the finance textbooks prescribe the use of book value ratios. Stonehill et al (1975) found that corporate treasurers generally worked in book values rather than market values. Support for book value measures is also provided by Myers (1977), as he argued that such measures were strongly related to a firm's "assets-in-place". However, Marsh employed both market value and book value debt ratios in his study, mainly due to the difficulties involved in calculating the market value of a firm's debt. Incidentally, he found the results of using both measures to be very similar in his analysis.

Titman and Wessels (1988) studied long term debt, short term debt and convertible debt-to-equity ratios, measuring equity in book and market values. They used book values for debt and they argued that they did not suspect the cross-sectional differences between the market values and book values of debt to be correlated with any of the capital structure determinants in their study, suggesting that the use of either book value or market value equity was acceptable. Furthermore, they cited Bowman (1980), who demonstrated that the cross-sectional correlation between the book value and market value of debt was very large, which should minimise any misspecification arising from using book value debt measures.

Harris and Raviv (1990) used a book value debt to equity (the latter in book or market value) measure, and also used debt to market value equity plus book value debt. Rajan and Zingales (1994) also used a total debt to total debt plus equity ratio, expressing equity in market value terms. However, this ratio may be biased, they argued, as firms in different countries employed differing levels of trade credit. They considered and criticised three other measures of the corporate capital structure: the long term debt to long term debt plus equity ratio, the non-equity liabilities to total assets ratio, and the ratio of earnings before interest, taxes and depreciation to interest payments. They criticised the first measure as it ignores short term debt, which represents a very significant proportion of debt in some countries, especially Japan where it is automatically rolled over and thus acts very much like long term debt. The second measure may be considered too broad a measure of leverage as it even includes claims such as pension liabilities in some countries. The third measure is criticised because continental European firms tend to under-report profits due to "conservative" accounting, in effect inflating leverage in this measure.

The literature clearly demonstrates the broad range of measures used to gauge the mix of the firm's finances. However, most authors suggest a debt to equity type ratio, measuring debt in book value and equity in market value, the former due to data constraints. The research of this report employs a slight variation on this measure: the long term debt to long term debt plus equity ratio, consistent with authors such as Harris and Raviv (1990) and Rajan and Zingales (1994), consisting of book value debt and market value equity, and is referred to throughout this research as the DDE ratio.

The DDE ratio was chosen as the main measure of the corporate capital structure for a number of reasons, both theoretical and practical. Firstly, as most of the literature discusses the effect of various determinants on a stock capital structure ratio, a stock measure was used in preference to a flow measure. Secondly, the DDE ratio was chosen in preference to debt to equity ratios because it is the proportion of total funds (debt plus equity) represented by debt that concerns the firm finance manager. By considering the percentage of total funds, the finance manager quickly gauges the degree of gearing, whereas the debt-equity ratio is a more abstract measure. Thirdly, a ratio containing long term debt is required, as this research seeks to determine the long term external funding behaviour of European firms. Furthermore, it is the strategic external funding choice which is of interest here, whereas including short term debt in the capital structure measure may force the examination of short term, operational funding which is not of central importance. However, debt structure is considered separately within this research. Finally, it is extremely difficult to ascertain the market value for a firm's debt, whereas the market value of equity is readily available. This necessitates examination of a quasi-market value capital structure measure. Thus, the long-term-debt (book value)-to-debt-plus-market-value-equity ratio fulfils all of these criterion and is readily computed from the data available.

A potential difficulty with the DDE ratio, however, is that because the equity component of the denominator is measured in market value terms, then the DDE ratio may be negatively related to variables which are measured in nominal values through time merely because of its definition. This may produce a negative bias on the coefficients of models of the DDE ratio which contain time series variables measured in nominal terms. Where such models are discussed later, this potential problem is again discussed.

The debt constituent of the ratio is defined as Datastream item code 321, total loan capital, which comprises all loans repayable in more than one year, including debentures, convertible loans, promissory notes and commercial paper repayable in more than one year, leasing finance and HP, and other loans repayable in more than one year. The equity constituent is defined as Datastream item code MV, the market value of equity by issue (or HMV, the historical market value of equity, in the time-series analyses).

Another important capital structure measure, used in the marginal capital structure choice models, is a dichotomous, "zero/one" variable. "Zero" represents predominantly equity issuing firms, where equity represents at least 75 per cent of the total funds issued in a given year, and "one" represents predominantly debt issuing firms, where debt represents at least 75 per cent of the total funds issued in a given year. The amount of equity issued is defined as Datastream item code 406, total equity issued, and is defined as equity issued for cash, equity issued for acquisition, plus any share premium. The amount of debt issued is defined as Datastream item code 418, the change in loan capital, and is defined as loans issued for cash and loans issued for acquisition, less loans redeemed.

In summary, the two main measures used throughout this research are the long-term-debt-to-debt-plus-equity ratio (known generally as the debt-equity ratio, though more specifically as the DDE ratio), and the dichotomous "zero/one" marginal issue variable, which classifies firms by predominant issue type.

4.6 Observational evidence of European corporate capital structure patterns

4.6.1 Introduction

This section provides evidence produced from observation of European corporate capital structures. Firstly, mean DDE ratios are computed and ranked to determine the spread across Europe, and standard deviations are calculated to observe the spread within each country. Secondly, the ranking of mean DDE ratios within Europe is considered in conjunction with the tax system and corporate tax rate applicable in each country during the study period. Thirdly, the distributions of corporate capital structures are plotted as part of an indirect test of Miller's (1977) general equilibrium model. Finally, the results of this observational evidence are drawn together and summarised.

4.6.2 The pattern of corporate capital structures within Europe

Computing corporate DDE ratios across Europe enables the testing of hypotheses H11 and H14, which propose that DDE ratios vary significantly across countries, and that DDE ratios are related to the cultural realm to which a country belongs, respectively.

Summary statistics of corporate capital structure ratios across Europe are given in table 4.3, where countries are ranked by the mean DDE ratio of their constituent firms. Perusal of the ranking of DDE ratios supports hypothesis H11 as the variation in European corporate capital structures is indeed wide, ranging from 20 per cent to 55 per cent long-term debt as a proportion of total external funds. If short-term debt were included in the ratio, it would be expected that the degree of gearing would be much larger. Swiss firms have the highest proportion of long-term debt in their capital structures, which may be a result of the highly developed system of banking intermediaries, the banking culture and the large influx of foreign deposit funds into Switzerland. The latter may reduce the cost of debt within the country, which, when coupled with the extremely efficient banking system, means that debt finance may be cheaper both in terms of the direct and indirect costs of borrowing to Swiss firms, encouraging them to employ relatively high gearing levels. Conversely, UK firms have the lowest proportion of long-term debt in their capital structures. This may be owing to the fact that the UK is considered a world centre of equity institutions, providing efficient financial intermediaries, buoyant investor markets and many specialised secondary markets for the efficient allocation of funds. It may be, then, that UK firms have a cost advantage over the other European firms with respect to the ease of access to equity markets or lower transactions costs, or simply that UK firms have more of an equity culture than other European firms. This result is consistent with the research of Rutterford (1988), who explained this apparent equity culture, arguing that the UK has a well developed equity market:

> "With efficient information dissemination, stringent auditing and monitoring procedures and low issue costs, which keep the agency costs of equity to a minimum." (Rutterford (1988), p.206)

Thus, institutional factors may explain the hierarchy of debt-preference across Europe.

Table 4.3
European firm DDE ratios and summary statistics ordered by mean DDE ratio

rank	country	mean DDE ratio	standard deviation	minimum value	maximum value	number of observs.
1	Switzerland	0.55	0.28	0.00	1.00	142
2	Belgium	0.51	0.35	0.00	0.99	63
3	Italy	0.45	0.34	0.00	1.00	92
4	Eire	0.40	0.22	0.00	0.74	14
5	Denmark	0.34	0.29	0.00	0.92	46
6	France	0.34	0.28	0.00	1.00	346
7	Germany	0.30	0.29	0.00	0.98	201
8	Sweden	0.27	0.28	0.00	0.98	119
9	Netherlands	0.26	0.26	0.00	0.99	59
10	Spain	0.25	0.26	0.00	0.80	47
11	UK	0.20	0.24	0.00	1.00	1497

The standard deviations all fall within a fairly narrow range, indicating a fairly similar spread of DDE ratios within each country. The maximum of 1.00 or thereabouts in most of the countries reveals that some firms indulge in almost 100 per cent gearing, issuing only small amounts of equity to conform to legal obligations.

Hypothesis H14 proposed that the mean DDE ratio of a country is related to the "cultural realm" (Broek and Webb, 1973) to which a country belongs, following a study of Sekely and Collins (1988) who found weak evidence of this. Table 4.4 shows, however, that countries within cultural realms do not have similar DDE ratios, as each group contains both high and low ranking DDE ratios. The cultural diversity within Europe does not appear to enable the grouping of countries into cultural realms, at least with respect to corporate capital structures.

Table 4.4
Cultural realm grouping and mean DDE ratios across Europe

cultural realm	country	DDE ratio	rank	standard deviation
Anglo-American	Eire	0.40	4	0.22
	UK	0.20	11	0.24
Western Central Europe	Switzerland	0.55	1	0.28
	Belgium	0.51	2	0.35
	Germany	0.30	7	0.29
	Netherlands	0.26	9	0.26
Mediterranean Europe	Italy	0.45	3	0.34
	France	0.34	5	0.28
	Spain	0.25	10	0.26
Scandinavia	Denmark	0.34	5	0.29
	Sweden	0.27	8	0.28

In summary, then, there are very wide corporate capital structure differentials across Europe, supporting hypothesis H11, which may be explained, at least in part, by differences in institutional factors across countries, particularly the state of development of debt and equity markets. Countries of similar cultures (cultural realms) do not have similar firm DDE ratios, questioning hypothesis H14, as the countries are too diverse to be grouped in such a naive manner.

4.6.3 The effect of tax system and the corporate tax rate on mean DDE ratio rankings across Europe

Table 4.5 again shows the ranking of mean DDE ratios across Europe, but in addition shows the type of tax system and the corporate tax rate employed by each country during the study period. The table thus provides some preliminary evidence to test hypothesis H9, that corporate DDE ratios vary significantly across tax systems, and H8, that the corporate DDE ratio increases with the corporate tax rate.

Table 4.5
The ranking of European countries by the corporate DDE ratios and showing taxation system types and the corporate tax rates

Rank	Country	DDE ratio	Tax system	Corporate tax rate %
1	Switzerland	0.55	Classical	10 to 27
2	Belgium	0.51	Imputation/Tax Credit	39
3	Italy	0.45	Imputation/Tax Credit	36
4	Eire	0.40	Imputation/Tax Credit	40
5	Denmark	0.34	Imputation/Tax Credit	38
5	France	0.34	Imputation/Tax Credit	34
6	Germany	0.30	Imputation/Tax Credit	50
7	Sweden	0.27	Imputation/Tax Credit	30
8	Netherlands	0.26	Classical	35
9	Spain	0.25	Classical	35
10	UK	0.20	Imputation/Tax Credit	33

Apart from the two extremes, Switzerland and the UK, the countries with the highest mean DDE ratios employ imputation/tax credit tax systems and the countries with the lowest ratios employ classical tax systems. This is interesting because, apart from the two extremes, the result is counter intuitive because the classical tax system effectively taxes the returns on equity twice, first at the corporate level and then at the personal level, thus discriminating against equity returns. One thus might expect countries with classical tax systems to use more debt in their corporate capital structures than countries of non-classical tax systems. However, the result is supported by Rutterford (1988) who found in her international study of corporate capital structures that:

> "Despite the reductions in the tax advantage of debt as Japan, France, Germany, and the UK moved towards an imputation tax system during the 1960's and 1970's ... leverage ratios appear in most cases to have increased over time." (Rutterford (1988), p.202)

The result appears to lead to one of two possible explanations: either the tax system type does not significantly affect the corporate DDE ratio within a country, at least to an extent observable in a cross-sectional study, or the tax incentives produced by different tax systems are not clearly captured and modelled in the existing literature. However, the counter intuitive result holds only for the majority of the country mean DDE ratios, and not for the countries with the highest and lowest DDE ratios, and therefore it is a very tentative result, suggesting only weak support for hypothesis H9.

The table also lists the corporate tax rate applicable at the date of data collection, though it is clear that the corporate DDE ratio bears no relation to the corporate tax rate. Therefore, hypothesis H8 is not supported by cross-sectional European firm evidence. This may imply that, even if higher corporate tax rates increase the tax incentive to corporate debt, this has little cross-sectional impact, as other factors within a particular country may counterbalance or dominate this effect.

Therefore, corporate capital structures do vary with the tax system chosen by a country, supporting hypothesis H9 to some extent, although there is some weak evidence questioning the relationship proposed by the literature of the double taxation of equity returns under the classical system. The corporate tax rate exerts no clear impact on corporate DDE ratios across the countries studied, questioning hypothesis H8, as other factors appear to counterbalance or dominate this effect.

4.6.4 An analysis of European corporate capital structure distributions

Kim, Lewellen and McConnell (1979) argued that, if Miller's (1977) capital structure irrelevance theory held, then the distribution of capital structures within a country should be bimodal if investor leverage clienteles exist. They argued that investors would specialise their equity holdings in those firms whose capital structures satisfy their personal tax requirements because they would gain higher returns, after tax, for a given amount of gearing and a given amount of investment, by specialising in such a manner. Low tax bracket investors would buy the equity of highly geared firms, whereas high tax bracket investors would buy the equity of firms with low gearing or no gearing at all, thus obtaining the gearing they require through personal borrowing. They inferred from this that low tax bracket investors demand the equity of firms with low gearing policies and high tax bracket investors demand the equity of firms with high gearing policies. Thus, firms accommodate investors by employing either no debt or high debt relative to overall funding. A bimodal capital structure distribution will thus arise, whereby low (high) tax bracket investors will hold the equity of firms in the higher (lower) model.

The Kim, Lewellen and McConnell argument therefore gives rise to a testable implication of the Miller capital structure theory. Hypothesis H5 of this research states that corporate debt-equity ratio distributions are bimodal in shape. If the hypothesis is not supported then this provides some evidence questioning the presence of investor leverage clienteles and questioning, although indirectly, the Miller capital structure irrelevancy proposition.

To test hypothesis H5 DDE ratios are plotted for each European country to determine whether this implication of Miller's leverage clientele hypothesis, which is central to his 1977 model, holds. Figures 4.1 to 4.11 show the separate DDE ratio distributions for each country, and table 4.6 summarises the results. The table shows that such bimodal distributions can only be said to exist in Belgium, Italy and Spain, where even then the distributions are only roughly bimodal, and that most distributions are of an exponential decay shape. Hypothesis H5 is therefore not supported by evidence from European corporate capital structures, thus questioning firm-level capital structure irrelevancy and providing indirect support for the central hypothesis, H1, of the existence of firm-level optimal capital structures. Miller's theoretical model cannot hold without investor leverage clienteles, and it is clear that these do not generally occur across Europe.

Table 4.6
Summary of European firm debt to debt plus equity ratio distribution types

Country	Debt to debt plus equity distribution shape	Bimodal Distribution (Yes/No)
Belgium	bimodal	Yes
Denmark	exponential decay	No
Eire	flat	No
France	exponential decay	No
Germany	exponential decay	No
Italy	bimodal	Yes
Netherlands	exponential decay	No
Spain	bimodal	Yes
Sweden	exponential decay	No
Switzerland	flat/unimodal	No
UK	exponential decay	No

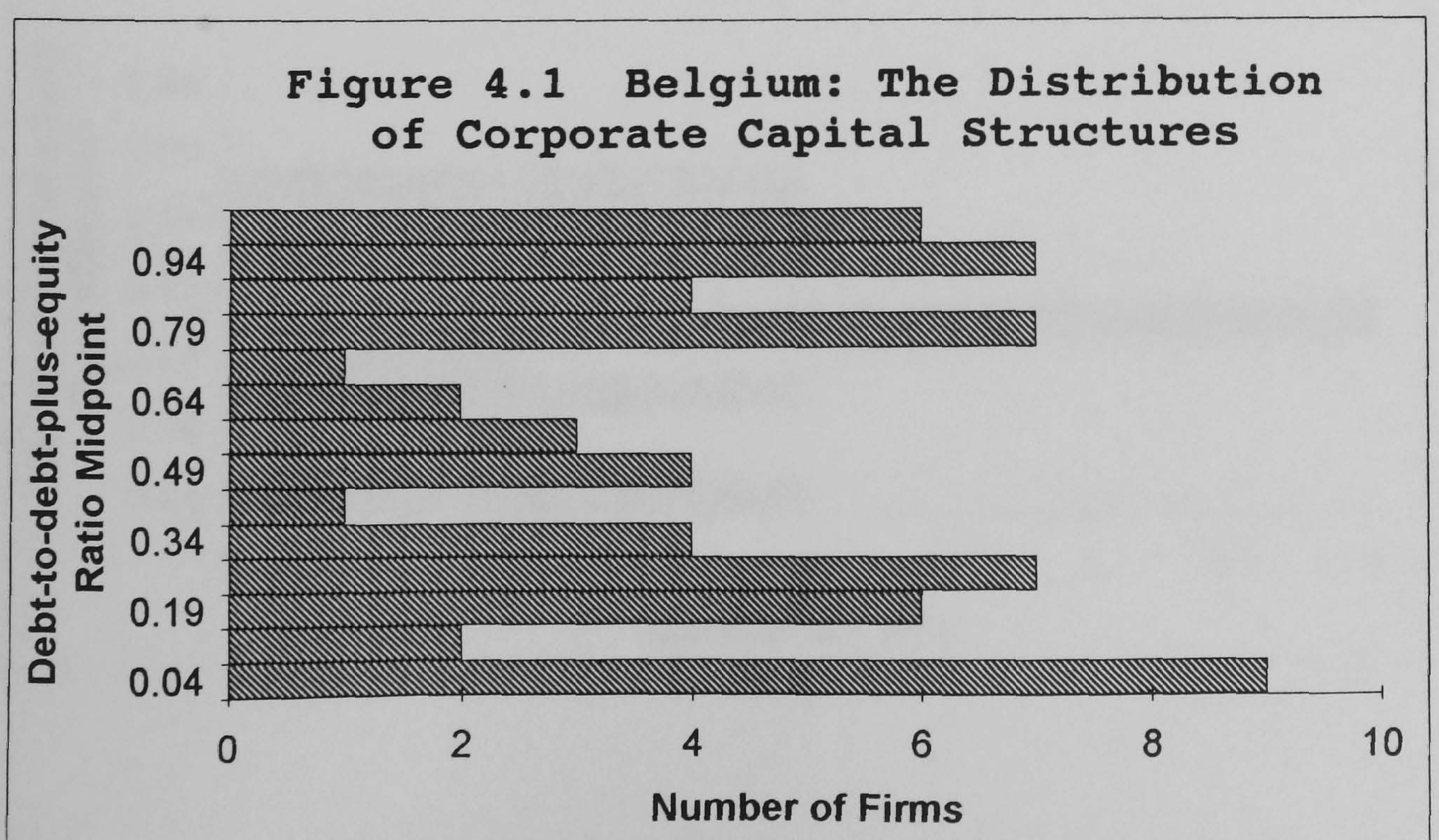


Figure 4.2 Denmark: The Distribution of Corporate Capital Structures

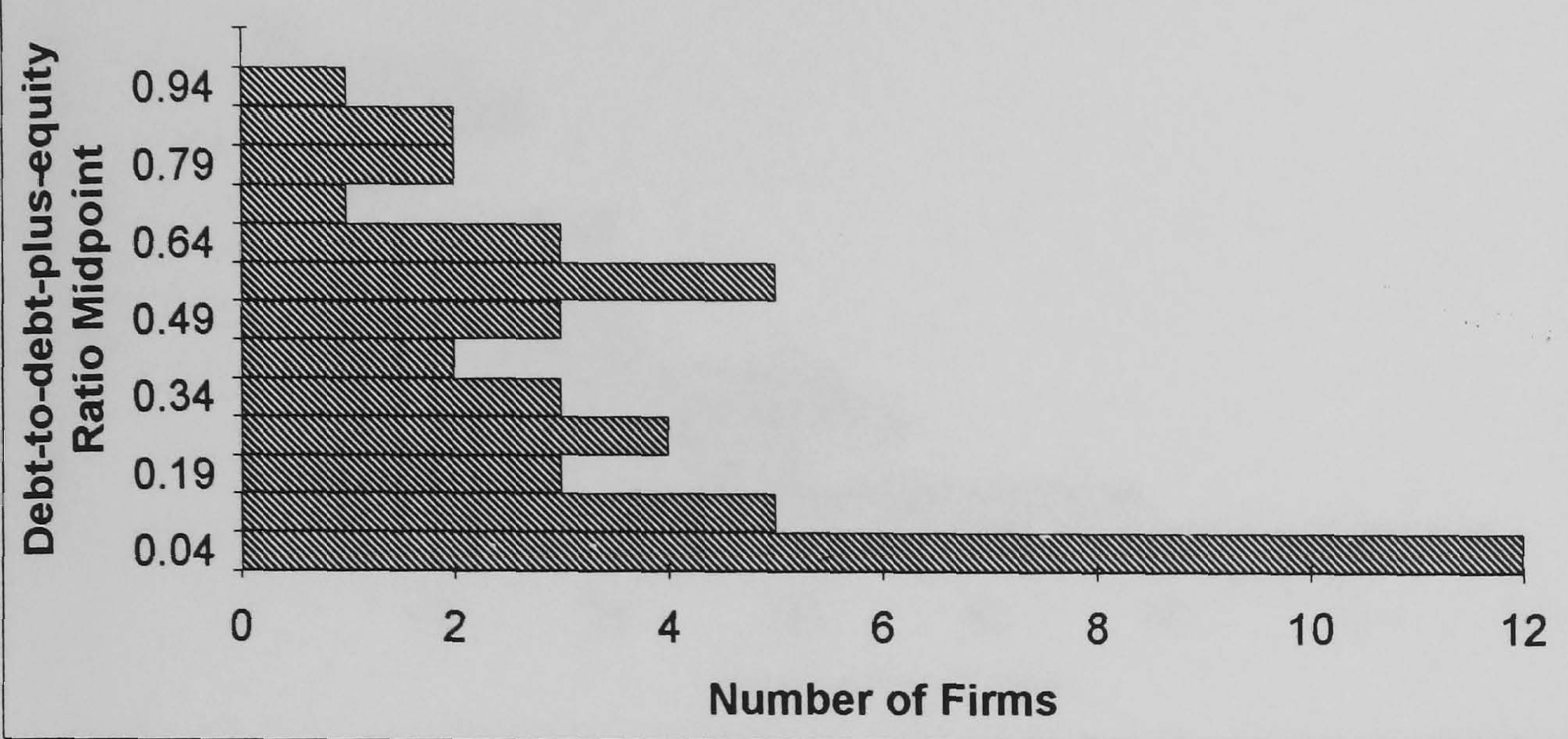


Figure 4.3 Eire: The Distribution of Corporate Capital Structures

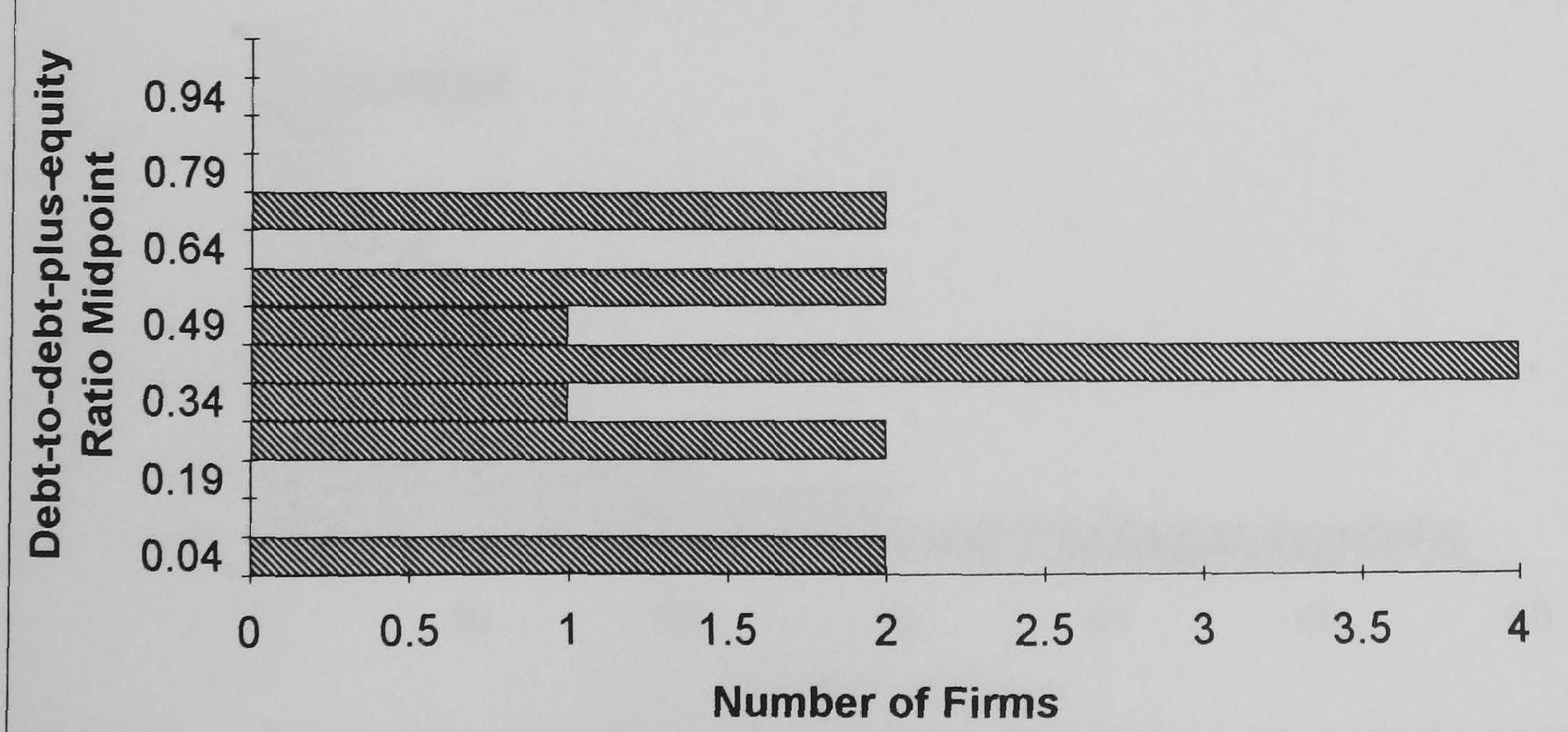


Figure 4.4 France: The Distribution of Corporate Capital Structures

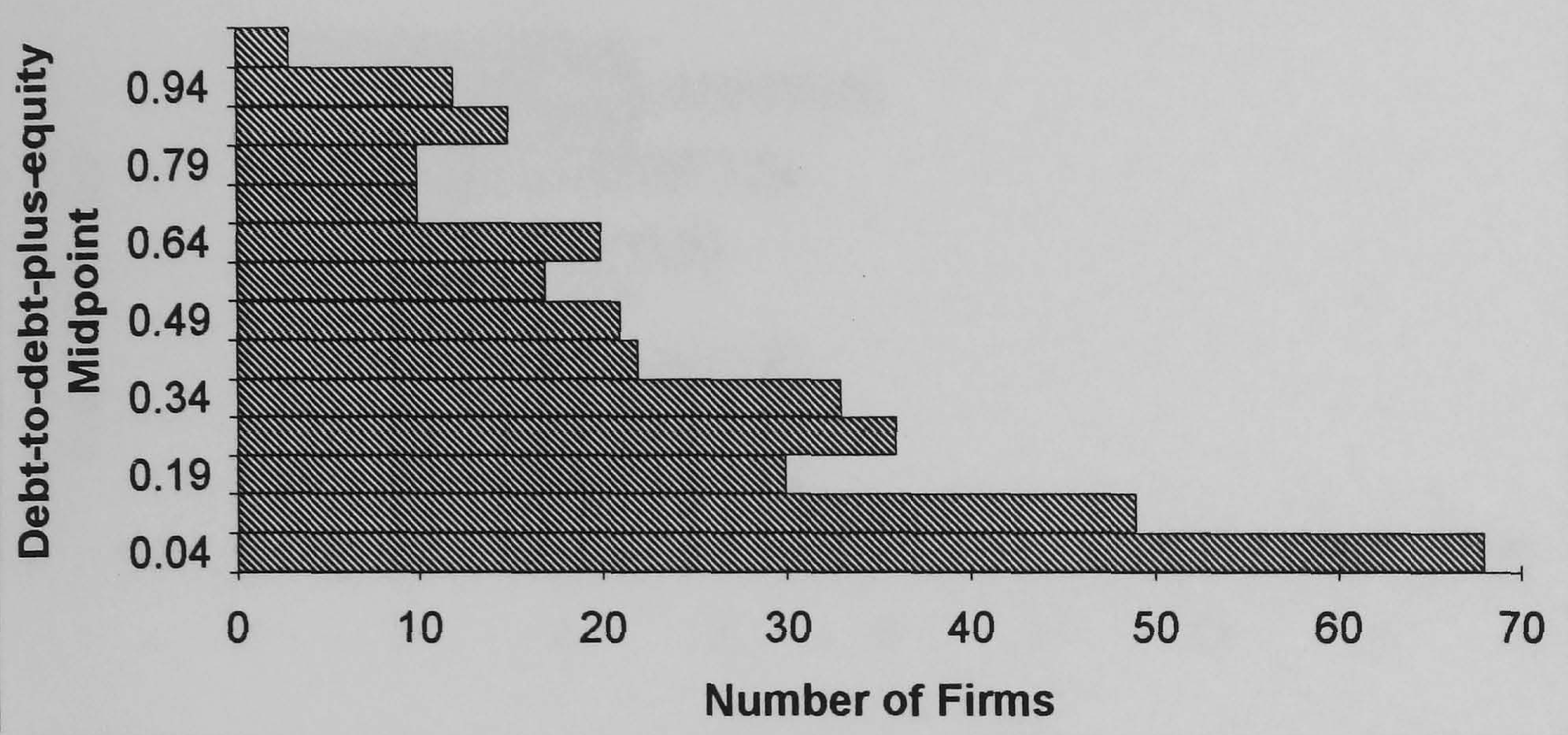


Figure 4.5. Germany: The Distribution of Corporate Capital Structures

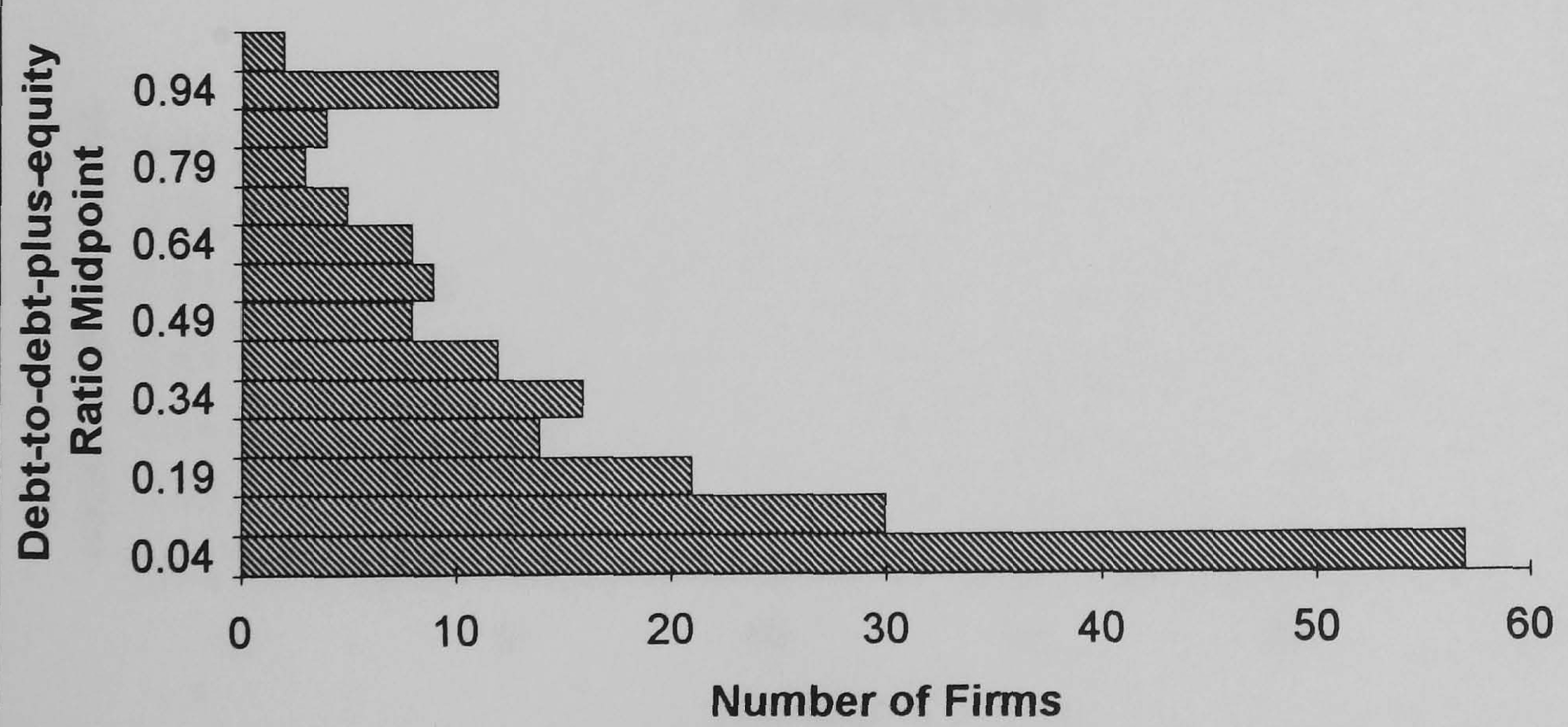


Figure 4.6 Italy: The Distribution of Corporate Capital Structures

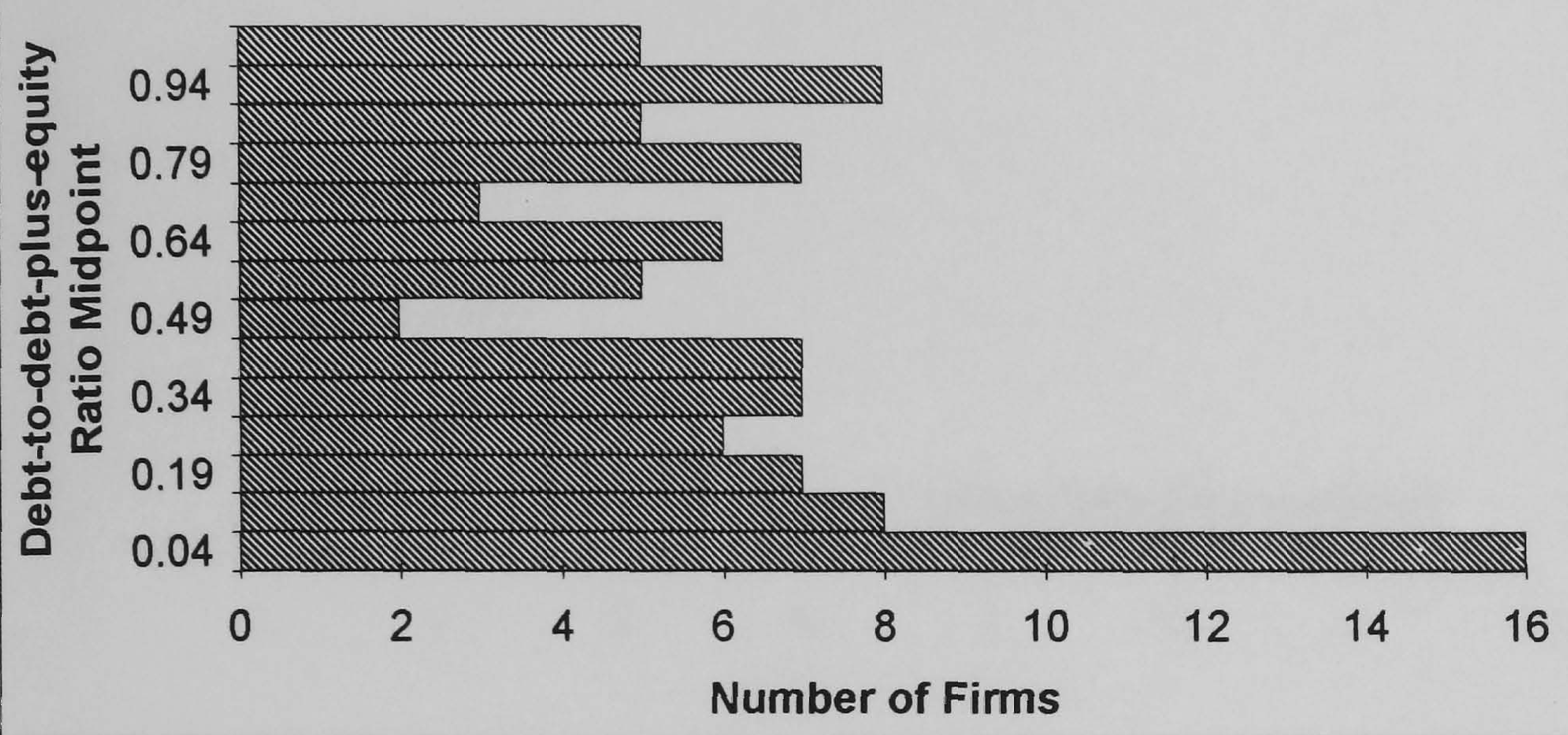


Figure 4.7 The Netherlands: The Distribution of Corporate Capital Structures

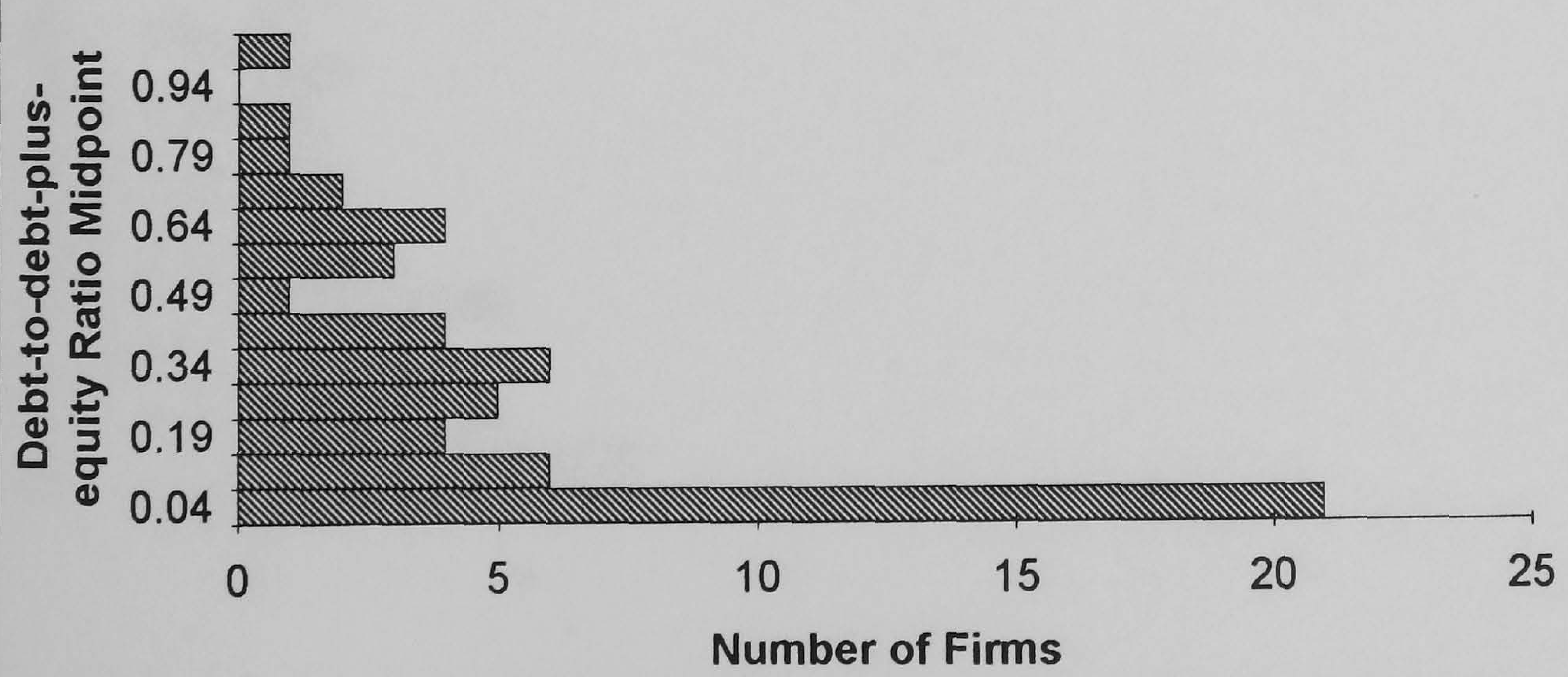


Figure 4.8 Spain: The Distribution of Corporate Capital Structures

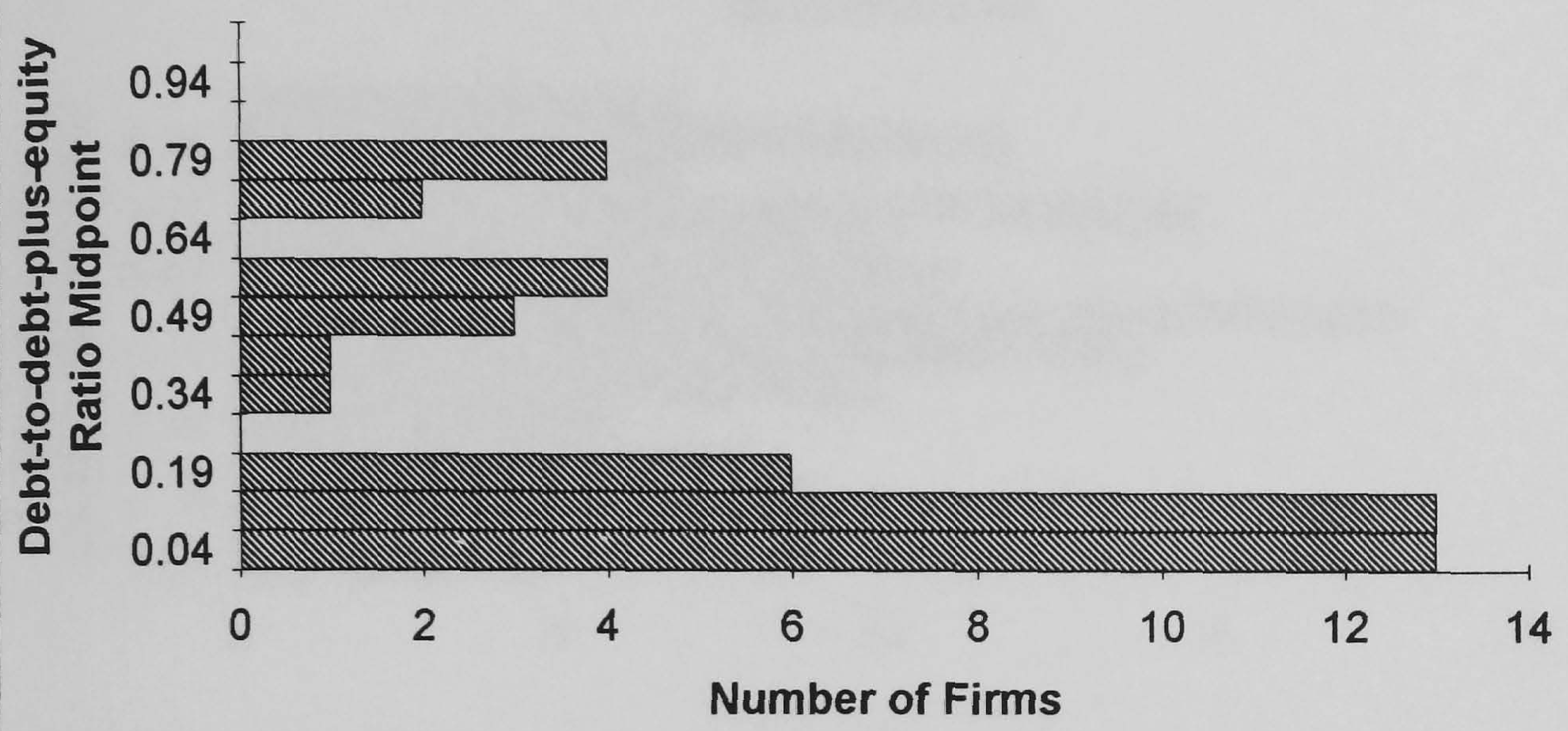


Figure 4.9 Sweden: The Distribution of Corporate Capital Structures

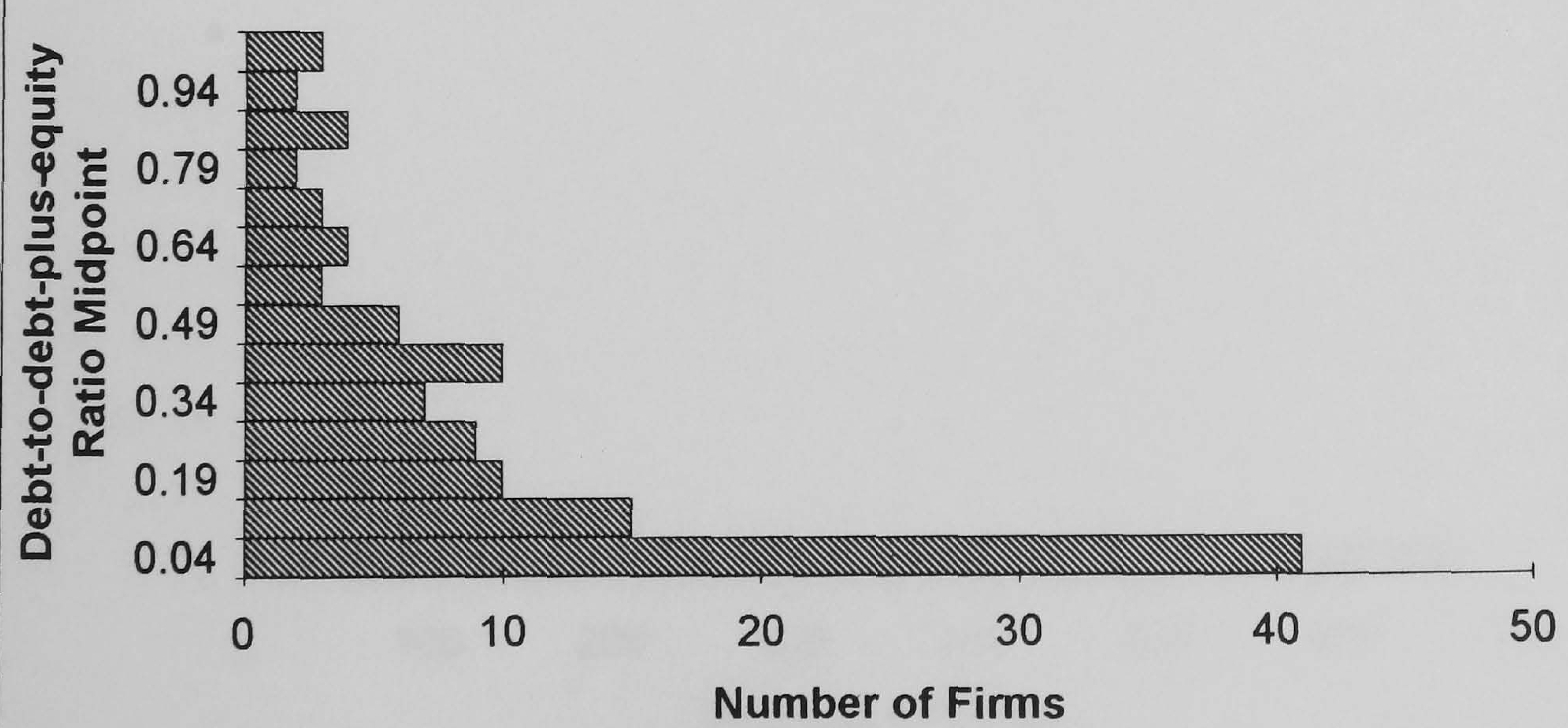


Figure 4.10 Switzerland: The Distribution of Corporate Capital Structures

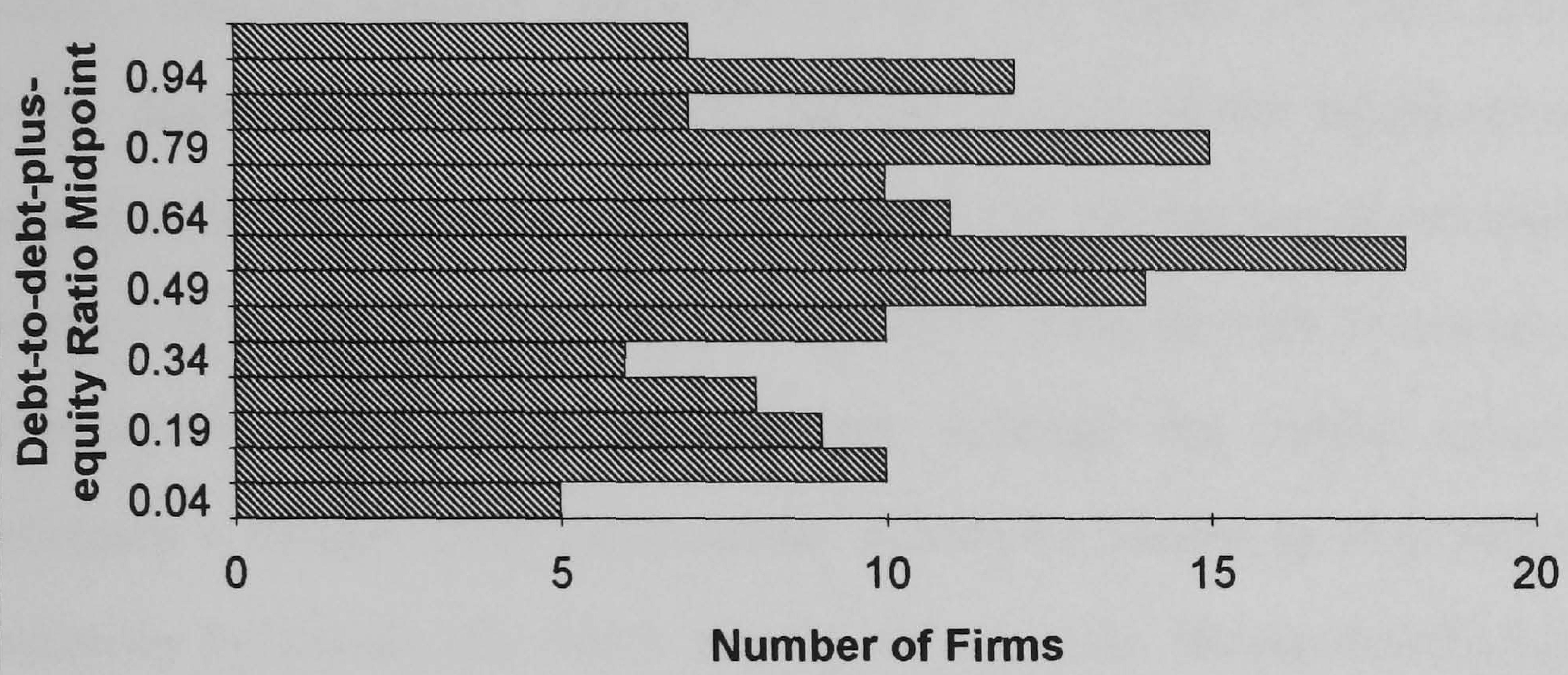
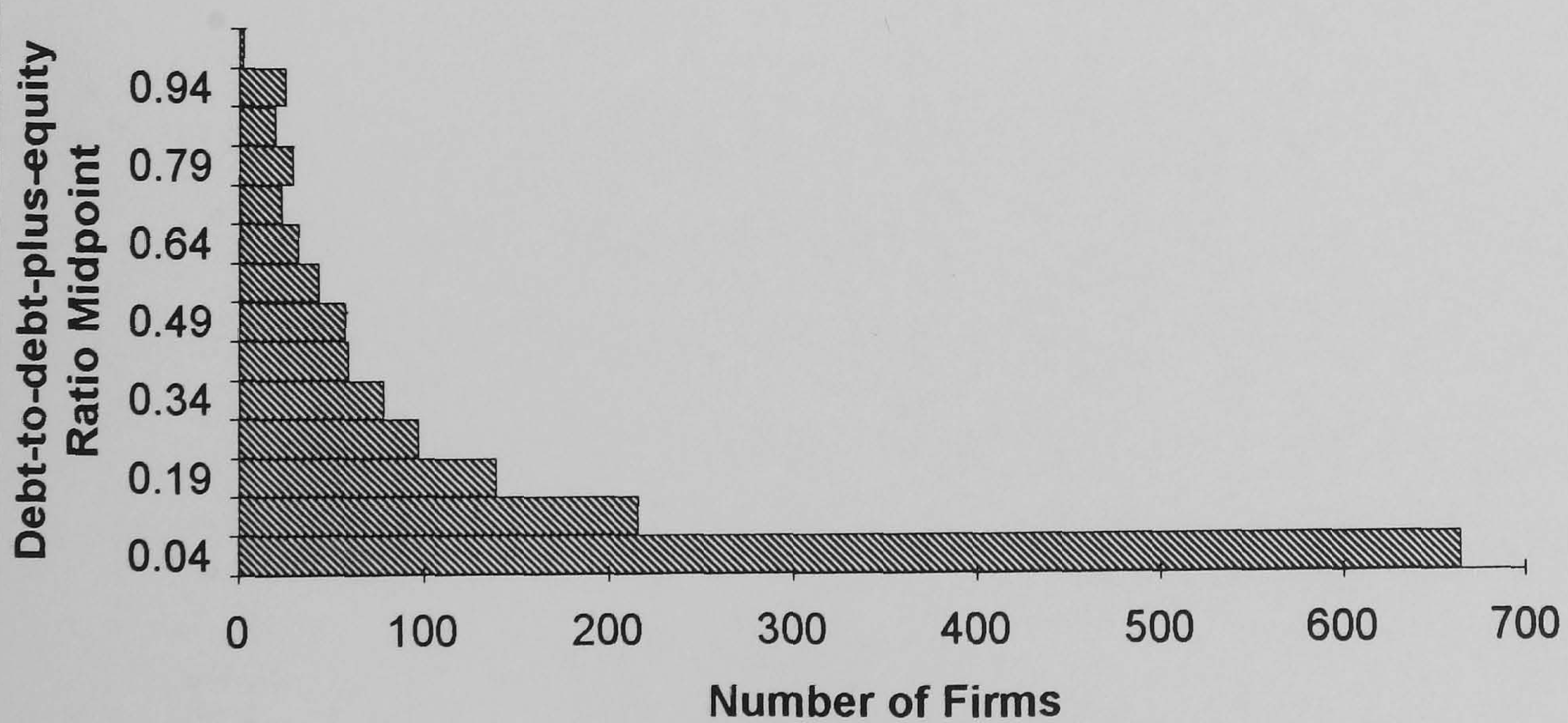


Figure 4.11 U.K.: The Distribution of Corporate Capital Structures



4.6.5 Summary

There are very wide differentials in DDE ratios across Europe, supporting hypothesis H11, which may be explained, at least in part, by institutional factors. The range of DDE ratios therefore justifies further examination of European corporate capital structures and the factors which influence them, as the wide differentials must arise from macro economic (including institutional), taxation or corporate differences between countries. Cultural realms do not bear any impact on DDE ratios across Europe, questioning hypothesis H14, perhaps because of the significant corporate diversity within realms. Indeed, it may merely be that the concept of cultural realms is too vague to be of any use in this context. DDE ratios do vary across tax systems, supporting hypothesis H9 to some extent, although the precise nature of any relationship is unclear. DDE ratios appear to bear no relation to corporate tax rates, questioning hypothesis H8, which may be due to other factors dominating any tax advantage to debt effect arising from variations in the corporate tax rate. Financial leverage clienteles did not generally exist within separate country financial markets, which questions Miller's (1977) capital structure irrelevance model. Thus, the naive analyses of this section suggest that further examination is warranted by the degree of capital structure differentials observed, and that the tax system may cause part of this differential.

4.7 An analysis of the corporate environment and country, tax system and issue decision variations across Europe

4.7.1 Introduction

Section 4.6 demonstrated that significant differentials in corporate capital structures exist across Europe. This section seeks to give perspective to the corporate environment within which the capital structure choice is made, by means of descriptive statistics concerning the more important accounting ratios of European firms. As the evidence here is again observational, it provides merely preliminary testing of hypotheses concerning the importance of retentions (H16), and the relationship between the DDE ratio and firm size (H18). In addition, a multivariate analysis of variance is computed to determine statistically the significance of the country and tax system to which a firm belongs as a determinant of firm accounting ratios, as well as determining the significance of differences between debt and equity issuing firms at the margin, across Europe, and within tax system types and separate countries. This necessitates the statement of new hypotheses which do not derive directly from the literature, but are of importance towards a greater understanding of capital structure determination and ultimately the testing of the central hypothesis. This technique also enables more formal testing of the hypotheses that corporate DDE ratios vary significantly across Europe (H9) and vary significantly across countries (H11). The results are then summarised and discussed.

4.7.2 A descriptive study of the European corporate environment

This section describes the mean accounting ratios of European firms (excluding Sweden for data availability reasons) for the year ending March 1990, computed from data set 2. The ratios should provide a perspective on the European corporate environment and should enable the testing of a number of hypotheses, though only to the limited extent that casual empiricism permits.

The results of computing the mean accounting ratios are given in table 4.7. As data set 2 consists of much larger firms than data set 1, on average, higher DDE ratios are expected in table 4.7 than those of table 4.3 if hypothesis H18 holds. However, the range of DDE ratios in the former is 0.14-0.43 and in the latter is 0.20-0.55, which questions hypothesis H18 as larger firms appear to employ less rather than more long-term debt in their capital structures than smaller firms.

Table 4.7
Means of European accounting ratios

	BD	BG	DK	ES	FR	IR	IT	NL	SW	UK	EUR
DDERATIO	0.24	0.33	0.25	0.22	0.29	0.29	0.27	0.24	0.43	0.14	0.32
DEPRATIO	0.22	0.2	0.14	0.12	0.22	0.1	0.15	0.16	0.14	0.1	0.17
DIVCOVER	2.45	3.53	4.95	2.73	3.51	4.06	2.94	2.68	4.18	2.83	3.4
DTAXRAT		0.02	-0.02	0.17	0.19	0.06	0.08	0.29	0.03	0.16	0.16
FARATIO	0.45	0.45	0.4	0.53	0.46	0.4	0.43	0.54	0.51	0.67	0.43
INTCOVER	10.86	13.22	3.22	3.26	4.96	2.52	4.17	8.32	4.6	16.56	5.14
LARATIO	0.52	0.54	0.78	0.26	0.65	0.53	0.68	0.34	0.64	0.53	0.47
NPMARGIN	3.35	11.27	4.79	9.04	6.22	3.36	4.33	5.15	4.39	8.3	5.67
PAYRATIO	0.47	0.52	0.17	0.43	0.43	0.32	0.21	0.38	0.19	0.41	0.38
QARATIO	1.09	1	1.48	0.77	1.04	1.17	1.09	0.97	1.3	1.01	1.07
RETRATIO	0.38	0.52	0.76	0.42	0.77	1.24	0.43	0.64	0.56	0.52	0.46
ROCE	14.39	12.9	10.57	13.57	15.24	14.32	11.77	21.56	10.15	23.11	14.36
SRLRDEBT	1.65	0.59	1.36	0.83	1.21	0.64	1.67	2.07	0.62	2.45	2.02
STKRATIO	60.63	43.82	52.65	48.33	63.52	48.27	63.7	46.04	68.96	53.28	54.18
TAXONPTP	0.43	-0.26	0.01	0.27	0.26	-0.06	0.37	0.27	0.07	0.36	0.32
TAXRATIO	43.93	18.33	15.09	25.27	17.13	-20.91	38.7	26	32.4	34.47	41.95
WCRATIO	1.71	1.35	1.9	1.08	1.44	1.6	1.39	1.47	1.93	1.47	1.43
WORKCAP	0.41	0.06	0.24	0.1	0.25	0.12	0.22	0.24	0.34	0.21	0.18

Where: DDERATIO = debt-to-debt-plus-equity ratio; DEPRATIO = depreciation ratio; DIVCOVER = dividend cover; DTAXRAT = depreciation-adjusted tax ratio; FARATIO = fixed assets ratio; INTCOVER = interest cover; LARATIO = liquid assets ratio; NPMARGIN = net profit margin; PAYRATIO = payout ratio; QARATIO = quick assets ratio; RETRATIO = retentions ratio; ROCE = return on capital employed; SRLRDEBT = short-run-to-long-run-debt ratio; STKRATIO = stock ratio; TAXONPTP = tax-to-pre-tax-profit ratio; TAXRATIO = tax ratio; WCRATIO = working capital ratio; WORKCAP = net current assets ratio.

A general result arising from this table is that the majority of ratios are of the same order of magnitude, which shows that although significant variation occurs across Europe, this variation still occurs within certain boundaries.

Hypothesis H16 states that retentions are the main source of investment finance. Although this is not tested directly here, it appears that European firms retain approximately half of their profits to fund growth internally (RETRATIO), and thus it is likely that retentions constitute an extremely important form of finance, producing weak evidence in support of H16. Short-term debt is on average twice the value of the long-term debt (SRLRDEBT) employed by the firm across Europe, and thus overdrafts and short-term bank loans are of far greater importance to firms as a form of finance than long-term debt. This may imply that the funding requirements of European firms are erratic or that they require significant funds to finance working capital. However, ratios for Belgium, Spain, Eire and Switzerland are less than unity, indicating a preference for short-term over long-term debt funds in these countries.

Dividend cover (DIVCOVER) and interest cover (INTCOVER) are examined to gauge the ability, on average, of European firms to cover their finance commitments. Such firms are able to cover dividend payments between 3 and 4 times over on average and thus are generally quite prudent with respect to their dividend policies. Firms are able to cover interest payments, on average, in excess of 5 times over, and could therefore greatly extend long-term borrowing if they so desired. Substantial spare debt capacity suggests that, although firms are capable of significantly extending their gearing, they choose not to, possibly because any tax advantage to debt is significantly reduced or even eliminated by factors such as tax exhaustion, bankruptcy and agency costs, and so on. European firms are therefore very prudent in the extent to which they are able to cover fixed and quasi-fixed financing commitments.

Four liquidity ratios were examined. Liquid assets ratios (LARATIO's) reveal that, on average, 50 per cent of short-term liabilities are covered by very liquid funds. Quick assets ratios (QARATIO's) generally appear to be around unity, the ideal ratio prescribed in finance texts, and thus immediate liabilities can easily be covered by fairly liquid assets. Similarly, working capital ratios (WCRATIO's), which include stocks, average out at approximately 1.5 and net current asset ratios exhibit a mean of 0.2. Therefore, European firms are generally very liquid and find it easy to cover short-term liabilities either to banks or trade-creditors as they fall due.

The relative measure of profitability before taxation, the return on capital employed (ROCE), is approximately 15 per cent on average across Europe, but after taxes (NPMARGIN) is reduced to about 6 per cent. Thus taxes significantly impact upon corporate profits. Of the profits earned, European firms pay out approximately 40 per cent to investors as dividends, and thus, capital gains must also be a significant element of equity returns.

Taxation represents a significant cost to European firms, representing a mean of 32 per cent of profits including associates (TAXRATIO) and 42 per cent of profits excluding associates (TAXONPTP). When depreciation is added back to pre-tax profits, the relative tax ratio (DTAXRAT) is reduced to 16 per cent of such profits. It may also be noted that the extent of taxation varies significantly across countries, which may provide indirect evidence in support of hypothesis H9. If the relative tax bill varies across countries then this is likely to cause variations in DDE ratios.

Two ratios which show remarkable consistency across Europe are the stock ratio (STKRATIO) and the fixed asset ratio (FARATIO). The stock ratio shows that most European firms maintain about two months of stock at any time, and the average fixed asset ratio of approximately 43 per cent reveals that the asset structure of most European firms consists of fixed and current assets in roughly similar proportions.

In summary, retentions are indeed an extremely important form of finance, producing weak evidence in support of hypothesis H16, and larger firms appear on average to employ less long-term debt, questioning hypothesis H18. Some weak evidence is found to support hypothesis H9, as the relative tax bill varies significantly across Europe, which is likely to impact, in turn, upon corporate DDE ratios. Short-term debt is twice as important as long-term debt to the average European firm, though it must be remembered that this study is concerned with the <u>long-term</u> external funding decision of the firm and not the short-term financing. Firms appear prudent with respect to their liquidity and coverage ratios, and it is possible that such risk aversion may imply that the costs of financial distress are large. Firm profitability is very similar across Europe, and is significantly reduced by taxation. As firm accounting ratios are observed to vary greatly, and are hypothesized to impact significantly upon DDE ratios, this may constitute preliminary evidence that corporate factors are one of the causes of significant differences in DDE ratios across Europe.

4.7.3 A multivariate analysis of variance of accounting ratio variations within Europe

A multivariate analysis of variance allows the user to determine whether statistically significant differences exist between distinct groups. In such an analysis there are usually two grouping variables and a number of dependents, the latter being termed "dependent" variables as the purpose of the test is to determine whether the value of such variables depends upon the group to which they belong. The analysis is employed within the European corporate capital structure perspective to determine whether significant differences occur in accounting ratios (which describe the accounting structure of the firm) between and within groupings which include the funding issue decision, countries, and tax systems. New hypotheses are developed to structure the analysis, including macro economic, taxation and corporate hypotheses, which are given in table 4.8. The new hypotheses presented here, and subsequent new hypotheses are formulated and tested to produce a wider perspective on the question of capital structure optimality, culminating eventually in a more coherent hierarchy of hypothesis tests than those arising merely from the diverse existing literature studies.

Table 4.8
New (null) hypotheses to support the multivariate analysis of variance tests

Macro economic hypotheses:

H25: There are no differences in accounting ratios between countries.
H26: There are no differences in accounting ratios between debt and equity-issuing firms across Europe.

Table 4.8
New (null) hypotheses to support the multivariate analysis of variance tests (cont.)

Taxation hypotheses: H27: There are no differences in accounting ratios between classical tax system countries and imputation/tax credit tax system countries. H28: There are no differences in accounting ratios between debt and equity-issuing firms in classical tax system countries. H29: There are no differences in accounting ratios between debt and equity-issuing firms in imputation/tax credit tax system countries. Corporate hypotheses: H30: There are no differences in accounting ratios between debt and equity-issuing firms within each separate country.

The analysis of variance test statistic used is Hotelling's T-squared, as it is a multivariate generalisation of the univariate t-value. The hypotheses H25 to H30 are stated in the null hypothesis form that the variances of the two groups are equal. The decision rule states that the null hypothesis is rejected if the significance of F is less than 0.05.

Table 4.9
Multivariate analysis of variance tests on the accounting ratios of European firms

hypothesis	Hotelling's T-squared	Approx/ Exact F	Hypothesis degrees of freedom	Error degrees of freedom	Significance of F	Accept/ Reject
H25	5.1801	17.44687	153	4637	0.000	Reject
H26	0.14417	1.8919	18	237	0.017	Reject
H27	0.16937	3.20868	18	341	0.000	Reject
H28	1.57205	1.47958	17	16	0.219	Accept
H29	0.14390	1.81468	18	227	0.025	Reject
H30: FR	0.39791	0.92845	18	42	0.552	Accept
H30: NL	3.08010	0.90591	17	5	0.605	Accept
H30: UK	0.27838	2.35075	18	152	0.003	Reject

The macro economic hypotheses tested seek to discover whether the accounting ratios of different countries are significantly different (H25), and whether the accounting ratios of debt and equity-issuing European firms are significantly different (H26).

Table 4.9 shows that both of the null hypotheses are rejected. The fact that there are significant differences in corporate accounting structures between countries suggests that a disaggregated approach is warranted. In addition, hypothesis H11 is tested to discover whether there are statistically significant differences in DDE ratios between countries. The result is given is table 4.10.

Thus, the null hypothesis of no differences is rejected, that is, there are statistically significant differences in DDE ratios between countries, supporting hypothesis H11.

Hypothesis H26 is rejected, as there are significant differences between predominantly debt and equity-issuing firms across Europe. This suggests that models of the marginal issue decision of the firm are justified because significant differences exist in accounting ratios between the two groups.

Table 4.10
A Univariate analysis of variance to test the significance of differences in DDE ratios between countries

Hypothesis degrees of freedom =	9
Error degrees of freedom =	533
Hypothesis sum of squares =	1.76687
Error sum of squares =	14.56098
Hypothesis mean squares =	0.19632
Error mean squares =	0.02732
F statistic =	7.18619
Significance of F =	0.000

Tests of the taxation hypotheses seek to discover if significant differences in accounting ratios occur between classical and imputation/tax credit tax systems (H27), and whether significant differences occur between debt and equity-issuing firms within each separate tax system (H28, H29). Significant differences do occur between the different tax systems, and thus the tax system significantly affects the accounting structures of European firms. Hypothesis H9 may also be tested here by employing a univariate analysis of variance test in order to determine whether corporate DDE ratios vary significantly across tax systems, the results of which are given in table 4.11. There is strong evidence, therefore, that DDE ratios do indeed vary significantly between tax system types across Europe.

Table 4.11
A Univariate analysis of variance to test the significance of differences in DDE ratios between tax systems

Hypothesis degrees of freedom =	1
Error degrees of freedom =	358
Hypothesis sum of squares =	0.44377
Error sum of squares =	9.89628
Hypothesis mean squares =	0.44377
Error mean squares =	0.02764
F statistic =	16.05338
Significance of F =	0.000

Hypotheses H28 and H29 seek to determine whether there are significant differences in accounting ratios within each of the two tax system types. The results, shown in table 4.9, reveal that debt and equity-issuing firms are not significantly different within classical tax system countries, but are significantly different within imputation/tax credit system countries, as hypothesis H28 is accepted and H29 is rejected. Therefore, multivariate models of the marginal corporate capital structure choice may prove weaker for classical than imputation/tax credit systems, as debt and equity-issuing firms are not clearly distinguishable by their accounting ratios in the former system. The result implies, interestingly, that the classical tax system exhibits greater neutrality with respect to the marginal issue decision of the firm than the imputation/tax credit system. This is clearly counter intuitive as it is the imputation/ tax credit tax system which should exhibit greater neutrality, as it does not tax equity returns twice and thus should reduce the relative tax advantage to debt over equity.

The "corporate" null hypothesis, H30, states that there are no differences in accounting ratios between debt and equity-issuing firms within each country. This hypothesis is not tested for the majority of countries, owing to the problem of data availability, missing observations and multicollinearity. However, the hypothesis is tested for France, the Netherlands and the UK. Of these countries, only in the UK do significant differences occur between debt and equity-issuing firms, as the hypotheses for France and the Netherlands are rejected. Thus, the issuing decisions of UK firms may be clearly distinguished on the basis of the complete set of accounting ratios. Although most of the other countries are not tested, and hypotheses for France and the Netherlands may not be rejected, it must be noted that the multivariate analysis of variance tests were computed on the basis of the entire set of accounting ratios. It is possible, indeed probable, that non-UK countries' corporate issue decisions may be clearly differentiated on the basis of a subset of the accounting ratios, a proposition which is tested in the multivariate logistic regression models of chapter 5.

In summary, multivariate analysis of variance tests using Hotelling's T-squared statistic were computed to test new hypotheses, H25-H30, concerning variations in accounting ratios between and within a number of important groupings across European firms. There are significant variations in accounting structures between firms in different European countries. Hypothesis H11 is supported as the DDE ratios of different countries are significantly different. Debt and equity issuing firms may also be significantly distinguished across Europe. Thus, macro economic factors significantly influence both accounting structures and DDE ratios across Europe. Different tax systems produce different accounting structures within Europe, though the accounting structures of debt and equity-issuing firms are only clearly differentiated within imputation/tax credit systems. Hypothesis H9 is supported by the evidence as there are significant differences in DDE ratios between tax system types. Therefore, the tax system type impacts significantly on the firm's marginal capital structure decision as well as its stock of funds. However, firms issuing different instruments within classical tax systems are not differentiated by their accounting structures. Furthermore, within each separate country, debt and equity-issuing firms are not generally distinguished by their accounting structures, but may be if a subset of the accounting ratios is modelled in later multivariate marginal finance decision models. Overall, the tests described in this section provide justification for separate country corporate capital structure models, and it is clear that the tax system type impacts significantly upon the capital structure.

4.7.4 Summary

Section 4.7 represents the transition from casual empiricism towards more analytical testing methods, enabling the testing of some fundamental hypotheses, which include both the initial hypotheses stated at the outset as well as new hypotheses. Corporate accounting ratios were computed as a measure of the firm's accounting structure, and it was observed that such structures varied significantly across Europe. Thus, this degree of variation should enable valid models of the corporate capital structure to be estimated using such accounting measures, and, indeed, it may be that the degree of variation itself is a cause of the wide variation in DDE ratios across Europe. Observation of the computed ratios provides weak evidence in support of hypotheses that retentions are the main source of investment finance (H16) and corporate DDE ratios vary significantly across tax systems (H9), though questions hypothesis H18, as there is some evidence of a negative relationship between firm size and the DDE ratio. Firm profitability appears to be significantly reduced by taxation, firms employ twice as much short-term debt as long-term debt, on average, and are very prudent with respect to liquidity and the coverage of finance commitments. Thus, the observational analysis suggests that enough variation should exist, prima facie, to enable the modelling of separate country capital structure models, and that the tax system and extent of taxation may significantly influence funding decisions. However, evidence from casual empiricism is necessarily weak as it requires the support of rigorous statistical testing. The multivariate analysis of variance produces such testing as it gauges the importance of differences between chosen groupings. In particular, hypothesis H9 is tested more formally, as is hypothesis H11, the results of which are that corporate DDE ratios are significantly different between tax systems and countries, respectively. More generally, accounting structures vary significantly across countries and tax systems. The marginal funding choice of the firm is studied, and hypotheses to test the significance of differences between the accounting structures of firms within debt and equity-issuing groups reveal that such groups are quite distinct across Europe as a whole and within imputation/tax credit systems, though are not distinct within classical tax systems and within each separate country. The results justify modelling stock capital structure measures within separate countries, but question the modelling of the marginal funding choice in a country-specific manner, at least using a wide set of independent variables. Firms in countries employing similar tax systems appear to have similar accounting structures and capital structures, a result which highlights the importance of the taxation system (a macro economic characteristic) in setting the parameters of the corporate environment. Thus, the macro economic environment sets the framework within which the taxation and corporate environments impact upon the firm generally, and its capital structure in particular.

4.8 Summary

The purpose of chapter 4 was to formulate the main hypotheses to be empirically tested in this research, to describe the methodology used and the data sets analysed, and to conduct some preliminary analysis and testing upon those data sets. The central hypothesis to be tested, which is consistent with the literature review discussion, is that there exist firm-level optimal capital structures. To allow a comprehensive testing of this hypothesis, three supporting hypotheses are also formulated concerning the importance of macro economic, taxation and corporate factors to the capital structure decision. In turn, these supporting hypotheses may only be addressed by testing a number of subsidiary hypotheses which are divided into macro economic, taxation and corporate factors. Thus, testing the subsidiary hypotheses enables the supporting hypotheses to be addressed, which in turn enable the central hypothesis to be addressed. The methodology described, in addition to addressing the main hypotheses, should also allow consideration of the average, marginal, short-term, and long-term determination of the corporate capital structure, by means of both explicit hypothesis testing procedures and the construction and estimation of empirical models. The data analysed in the empirics was drawn from Datastream and divided into five distinct data sets. The main capital structure measure analysed and modelled, the long-term debt-to-debt-plus-equity, was defined and discussed, as was the marginal issue "debt or equity" dichotomous variable.

Preliminary evidence suggests that the country to which a firm belongs is a significant determinant of its capital structure, and more generally its accounting structure, though there is no evidence of a cultural realm effect. This result appears to warrant the construction and estimation of country-specific capital structure models within Europe, as European-wide models could not take into account the country effect which is associated with significant capital structure variation. There is also evidence of the influence of taxation factors. Although the corporate tax rate is not related to the DDE ratio across Europe on a cross-sectional basis, the influence of the tax system appears to be a significant determinant. Again, the accounting structures of firms also appear to vary significantly between tax systems. Financial leverage clienteles do not generally occur within European financial markets, a result which questions the Miller (1977) capital structure irrelevance model, and thus lends more support to the central hypothesis. Focusing on the marginal funding choice, instead of the stock DDE ratio, reveals that debt-issuing firms and equity-issuing firms exhibit accounting structures which are statistically distinct across Europe, but not within separate countries. The classical tax system appears to exhibit greater neutrality with respect to the marginal issue choice since the two issue groups are not distinct within classical tax system countries, though these groups may be distinguished within imputation/tax credit system countries. The greater apparent neutrality of the classical tax system towards the marginal choice, whereby firms operating within such a system may not be clearly divided into debt and equity-issuing groups, is surprising because it might be expected that this system would be less neutral, due to the double taxation of dividends and consequent higher tax advantage to debt which it brings. Therefore, in summary, the results of this chapter suggest that country-specific models of corporate capital structure (measured in stock form) determination are justified, but that marginal funding choice models may not be valid, unless a greatly reduced set of accounting variables are modelled. It is clear that macro economic and taxation factors impact significantly upon the corporate capital structure, and it is extremely likely that the significant variation in corporate-level factors (accounting ratios) will cause different corporate capital structures across Europe. The preliminary results presented are, therefore, entirely consistent with the firm-level optimal capital structure solution hypothesis, H1.

CHAPTER 5

A STATISTICAL AND ECONOMETRIC MODELLING ANALYSIS OF THE CROSS-SECTIONAL AND MARGINAL DETERMINANTS OF THE CORPORATE CAPITAL STRUCTURE

5.1 Introduction

The objective of chapter 5 is to more formally test and model the relationships between measures of the European corporate capital structure and the factors which influence these measures. Section 5.2 describes an analysis of variance to determine whether the data are consistent with UK firms targeting their capital structures on the norm of the industry to which they belong. Section 5.3 describes a simple descriptive analysis which seeks to determine the extent of tax exhaustion within European firms. Section 5.4 develops the more formal analyses of cross-sectional bivariate corporate capital structure relationships, by means of bivariate regression modelling, to discover whether the determinants arising from the Anglo-American orientated literature are indeed determinants across European firms. Section 5.5 develops corporate capital structure modelling in two respects: by modelling both the marginal issue decision and modelling the multivariate perspective. Section 5.6 summarises the results of the tests and models, to determine the perspective which is provided by the more formal gauging of the cross-sectional and marginal corporate capital structure relationships which are described in the hypotheses deriving from the literature review and those deriving from this research.

5.2 An univariate analysis of variance to determine whether UK firms target their capital structures on the norm of the industry to which they belong

The literature review described empirical evidence which provided very strong support for the hypothesis (H24 in this study) that individual firms target their DDE ratios on the norm (or average) for the industry to which they belong. To be consistent with the literature, a univariate analysis of variance is conducted upon UK corporate data from data set 4. Similar studies for other countries were not possible as the number of quoted companies are generally not large enough to allow sensible division into industry types. DDE ratios are computed for 486 UK firms from 12 industries for the year ending February 1993. The criterion for selection of industries is that only those industries containing greater than 20 firms should be included in the analysis.

For the purposes of the analysis of variance, the industries were coded one to twelve so that they form distinct groups within the test, as shown in table 5.1. The univariate analysis of variance basically compares the variance between the groups (the industries) to the residual variance, that is, the variance within the groups. The method is desirable as it does not require the groups to be of equal size. The null hypothesis is that there are no differences in DDE ratios between UK firms of different industry groups. The results of the analysis of variance test are given in table 5.2.

Dividing the between-groups mean square by the within-groups mean square produces an F-ratio of 14.736 and a probability of 0.000. The null hypothesis is rejected well beyond the 1 per cent level, and thus there is greater variation between groups than within them. Hypothesis H24 is therefore supported by evidence from UK firms as it appears that the DDE ratios of these firms are clustered within a particular industry.

Table 5.1
Industry groupings of UK firms within the analysis of variance

Industry	Code	No. of Firms
Chemicals	1	22
Water	2	31
Breweries	3	33
Conglomerates	4	24
Construction	5	55
Mechanical Engineering	6	69
Food Retailing	7	25
Oil Industry	8	24
Financial Services	9	27
Property Development	10	98
Multiples	11	45
Clothing	12	33
TOTAL		**486**

Table 5.2
A univariate analysis of variance to test the effect of industry classification on corporate capital structures

source of variation	degrees of freedom	sum of squares	mean squares	F-ratio	significance of F
between groups	11	9.302	0.846	14.736	0.000
within groups	455	26.112	0.057		
total	466	35.414	0.076		

This clustering may imply that firms within an industry target their capital structures upon the norm for their industry, possibly reflecting the similar degrees of business risk, tax incentives and other factors experienced by firms within an industry. Alternatively, it may be that the more sophisticated and/or larger firms in an industry, having access to better quality information and analysis techniques, select their optimal capital structures, and the other firms in the industry merely follow their example. Indeed, firms may even be penalised by investors and institutional lenders for deviating too far from industry norms. Therefore, UK firms, and possibly European firms, appear to target their capital structure ratios on the norm for their industry, and in this sense, as discussed in some depth in the literature review, are engaging in optimising behaviour as they are attempting to achieve the capital structure mix considered optimal by firms of similar business risk in their industry.

5.3 An observational analysis of the extent of tax exhaustion across European firms

The literature suggests that the presence of non-debt tax shields may "crowd-out" the tax benefits of corporate debt, reducing the incentive for firms to engage in higher gearing levels. Hypothesis H7 thus states that the corporate DDE ratio is determined by the degree of the firm's tax exhaustion. Whilst this hypothesis is not directly tested, it is argued that if a significant proportion of firms in a particular country are entirely tax exhausted, that is they do not pay any corporation tax, then tax exhaustion may very well be a significant determinant of the corporate capital structure in that country.

Data from data set 5 are examined to test hypothesis H7. The data studied consist of 2,054 firms from 7 European countries for the year ending March 1993. The variable analysed is the corporation tax paid by individual firms (Datastream code 160). Those firms which paid a positive amount of corporation tax in the year studied are coded "0" whereas those firms which paid zero or negative amounts of corporation tax are coded "1". Where data are not available for a particular firm, that firm is eliminated from the analysis. Samples for Eire, Germany, the Netherlands and Sweden are also eliminated from the analysis, as these samples contain less than 20 firms and thus can not be considered representative of the respective financial sectors. The number of firms which are coded "1" is then expressed as a fraction of the total number of firms studied within each country. This represents the percentage of tax exhausted firms in each country. The results are given in table 5.3.

The table shows that corporate tax exhaustion is a significant and widespread phenomenon across Europe, with an average of 29.8 per cent of European firms experiencing complete tax exhaustion in the year of study. The extent of tax exhaustion varies across countries, with only 13.36 per cent of French firms experiencing complete tax exhaustion, but a surprisingly high 72.52 per cent of Swiss firms experiencing complete tax exhaustion. Thus, hypothesis H7 is very strongly supported by evidence from European firms.

Table 5.3
The extent of complete corporate tax exhaustion across Europe

country	number of tax exhausted firms	total number of valid cases	percentage of firms that are tax exhausted
Belgium	15	40	37.50
Denmark	19	38	50.00
France	39	292	13.36
Italy	12	56	21.43
Spain	14	37	37.84
Switzerland	95	131	72.52
UK	419	1460	28.70
total	**613**	**2054**	**29.8 (mean)**

An additional point to note is that the study only identifies those firms which pay no corporation tax at all, and are thus completely tax exhausted. The analysis does not identify those firms which are "partially tax exhausted", that is, those firms which can only partially utilise the tax benefits of debt. Tax exhaustion is thus, if anything, underestimated by this study, as "crowding out" is more widespread than revealed in the analysis.

An interesting result is that Swiss firms appear the most tax exhausted of all European firms studied, whereas they exhibit the highest gearing ratios in Europe. The higher the degree of tax exhaustion, the lower gearing might be expected to be, as tax exhausted firms cannot benefit from the tax incentives to debt. The high gearing levels of Swiss firms are therefore inconsistent with the high degree of tax exhaustion observed. However, it is likely that tax exhaustion may only affect the marginal funding choice and thus may bear little relation to the stock DDE ratio measure. Alternatively, it may be that the tax incentive associated with debt is dominated by other factors such as bankruptcy and agency costs, and this is not an important determinant of the firm's capital structure strategy.

Thus, although hypothesis H7 is tested only indirectly, there is strong evidence to support it, as at least 30 per cent of European firms are severely affected by corporate tax exhaustion. However, highly tax exhausted firms do not necessarily become low-geared firms as tax exhaustion is more likely to influence the marginal issue decision rather than the overall stock of funds.

5.4 A bivariate regression analysis of the corporate capital structure and the factors which influence it

5.4.1 Introduction

Though tests of many of the initial hypotheses have been conducted, in addition to tests of the new hypotheses, none of the methods described have yet modelled the stock DDE ratio measure. The nature of the evidence up to this point has been either casual or has been conducted to determine if there are distinct groupings within the European corporate finance market. Therefore, bivariate least squares regression is utilised to test, statistically, whether a factor supposedly influencing the DDE ratio is linearly associated with the DDE ratio.

5.4.2 The hypotheses to be tested and the bivariate regression modelling method

The bivariate regression method enables a number of hypotheses concerning the corporate capital structure to be tested. The hypotheses to be tested are presented in table 5.4. The majority of the hypotheses derive from the literature, though two new hypotheses, H31 and H32, are also added.

Table 5.4
The hypotheses tested within the bivariate regression analysis

Corporate hypotheses:

H15: The degree of bankruptcy risk increases with the corporate debt-equity ratio.
H17: The corporate debt-equity ratio increases as the payout ratio increases.
H18: The long-term corporate debt-equity ratio increases with firm size.
H21: The corporate debt-equity ratio increases with the degree of liquidity.
H22: The corporate debt-equity ratio increases as firm profitability increases.

New taxation hypothesis:

H31: The corporate debt-equity ratio increases as the relative tax bill increases.

New corporate hypothesis:

H32: The corporate debt-equity ratio increases as dividend yield increases.

The hypotheses are tested using the proxies commonly used in the existing literature, and thus are in some cases tested using a number of measures in turn. A number of proxies for bankruptcy risk, which is the subject of hypothesis H15, are tested: interest cover, equity beta, and current dividend cover. Interest cover is defined as adjusted operating profit plus total non-operating income, expressed as a percentage of total charges. The equity beta measure relates the return on a stock to price movements in the stock market as a whole. Current dividend cover expresses the number of times earnings cover the payment of a dividend. As discussed in chapter 4, the bankruptcy risk hypothesis is stated such that it implies that the DDE ratio is more accurately described as a determinant of bankruptcy risk rather than the converse. Whilst this is the opposite direction of causation from that implied by the majority of other hypotheses (excepting the dividend yield hypothesis), it is argued that the bankruptcy risk hypothesis is stated in a manner consistent with the propositions most common to the existing literature. Therefore, the hypothesis seeks to test whether increased debt significantly increases bankruptcy risk. It may be that the coefficient sign of the estimated bivariate models confirms whether the causation implied by the hypothesis is supported.

The liquidity measures used to test hypothesis H21 are the quick assets ratio and the current assets ratio. The quick assets ratio is defined as the ratio of current assets, less total stock and work in progress, to total current liabilities, whereas the current assets ratio is merely the current assets of the firm divided by total current liabilities.

The profitability measures used to test hypothesis H22 include: the return on capital employed, the net profit margin, and two measures which are better regarded as earnings measures: earnings per share and the price/earnings ratio. The return on capital employed measure is defined as the ratio of profit before interest and taxes to capital employed, and the net profit margin is the ratio of net profit before interest and taxes to turnover. Earnings per share is the total earnings in the last 12 months expressed as a percentage of the share price, whereas the price/earnings ratio is the price of a share divided by the earnings per share. Whilst earnings measures may not be regarded as proxies for profitability, firms with high earnings are often highly profitable firms.

Hypothesis H31 states that there is a positive relationship between the DDE ratio and the relative tax bill, because firms which experience a significant increase in their relative tax bill may seek to reduce future tax bills to "acceptable" levels by issuing more debt to utilise the associated tax benefits. The relative tax measures tested are the tax ratio and the depreciation-adjusted tax ratio. The former measure is defined as the corporation tax charged on profit for the current period divided by pre-tax profit, whereas the latter measure is defined as the former measure with depreciation per the profit and loss account added back to the profit measure.

Hypothesis H32 states that there is a positive relationship between the DDE ratio and dividend yield as equity investors may demand relatively higher dividends to compensate them when the DDE ratio is high. Dividend yield is defined here as the dividend per share divided by the share price. It is noted that the causation implied by this hypothesis is the opposite of that implied in the other hypotheses, excepting the bankruptcy risk hypothesis. Within a cross-sectional analysis of this type, causation may not be determined with any degree of certainty, and therefore in this hypothesis, the most intuitive direction of causation is implied by the hypothesis stated.

The bivariate relationships are estimated separately for each country, and then the coefficient estimates are tested using one-tail t-tests at the 5 per cent level. The one-tail test is computed because the sign as well as the significance of the coefficient are to be tested.

5.4.3 The data

The data set upon which the bivariate regression models are estimated is data set 1, which consists of cross-sectional data for 2,626 European firms from 11 countries for the year ending October 1992.

5.4.4 Results of the bivariate regression models

Table 5.5 gives the results of the individual t-tests. Only those relationships which are significant are shown in the table, along with the sign of the independent variable coefficient. The table shows that certain of the bivariate relationships between the DDE ratio and the variables modelled exhibit widespread significance across Europe, whereas other relationships do not. The signs of the coefficients for each separate variable are consistent across countries in every case.

Table 5.5
Summary results of the bivariate regression t-tests

VARIABLE	BG	DK	IR	FR	BD	IT	NL	ES	SD	SW	UK
Interest cover	-	-	-	-	-	-	-	-		-	-
Beta				+			+				+
Current dividend cover	-	-		-	-	-	-		-	-	
Payout ratio							-				
Total assets employed (size)	+				+			+			
Quick assets ratio		-			-	-		-			-
Current assets ratio		-			-	-				-	-
Return on capital employed	-	-		-	-	-	-	-		-	-
Net profit margin		-		-	-	-	-	-			
Earnings per share		-		-	-		-	-	-	-	-
Price/earnings ratio					-		-				
Tax ratio							-				
Tax ratio (depreciation adjusted)						-	-				-
Dividend yield		+		+		+	+				+

KEY:
"+" = significant positive relationship at the 5% level (1 tail)
"-" = significant negative relationship at the 5% level (1 tail)
BG = Belgium; DK = Denmark; IR = Eire; FR = France; BD = Germany; IT = Italy; NL = the Netherlands; ES = Spain; SD = Sweden; SW = Switzerland; UK = the UK.

The bankruptcy risk measure coefficients are consistent with hypothesis H15, that is, that the degree of bankruptcy risk increases as the corporate DDE ratio increases. Both interest cover and dividend cover are measures of "financial safety" or "inverse risk" measures, and thus the widespread negative relationship across Europe supports the hypothesis. European firms which can cover their debt interest and principal commitments and their dividend payment "quasi-commitments" easily, are generally those which employ lower gearing levels. Higher debt not only threatens the ability of the firm to cover the increased debt interest commitments, but also "crowds out" the ability to cover dividend commitments. Firms which reduce or miss dividend payments are likely to be approaching a position of financial distress, and thus both coverage measures are good proxies for bankruptcy risk. The equity beta measure is not a significant factor influencing the DDE ratio, as a significant positive relationship is only found to hold for three of the countries studied. Although the equity beta is not consistently significant as a bankruptcy risk proxy across Europe, results for both interest and dividend cover ratios reveal that European firms with higher gearing ratios find it more difficult to cover their financial commitments, and run a higher risk of bankruptcy as a result, thus supporting hypothesis H15. It is noted that the direction of causation hypothesized and supported by the evidence is such that the DDE ratio is a determinant (independent variable) of this bivariate relationship rather than a dependent variable. Indeed, a positive relationship would be inconsistent with the theory, as an increase in bankruptcy risk should encourage firms to reduce gearing levels, not increase them. Thus, the sign of the coefficient estimate often leads to one possible causation direction being eliminated within a cross-sectional perspective, otherwise the relationship observed is theoretically counter intuitive.

The payout ratio is found to be negatively related to the DDE ratio, but for the Netherlands only. This relationship is therefore not only generally not observed across European firms, but also has a negative rather than the expected positive coefficient sign. It might have been argued that an increase in the payout ratio leads to firms substituting away from the increasingly costly equity towards debt, but the negative relationship found for the Netherlands suggests that when dividends increase in such a manner, firms increase their equity relative to debt finance, possibly because they find the market more receptive to new equity issues after recent dividend increases. Thus, hypothesis H17 is questioned by evidence from European firms.

Firm size is positively related to the DDE ratio in only three of the countries in the study. The sign of the relationship is consistent with the existing literature, which suggests that larger firms exhibit higher gearing and they are less risky, have greater collateral, lower flotation cost, and are more highly diversified than smaller firms. Thus, hypothesis H18 is only weakly supported by evidence from European firms.

The liquidity ratio measures, the quick assets ratio and the current assets ratio, are both negatively related to the DDE ratio in roughly half of the European countries. The theory of the existing literature proposed a positive relationship, as more liquid firms should be able to service higher debt commitments, and thus should have greater debt capacity and ultimately higher gearing. The evidence from the existing literature was mixed with respect to the nature of the relationship between liquidity and the DDE ratio. The negative relationship found in the European bivariate regression analysis not only questions the theoretical relationship, but also questions the mixed evidence because the relationship is found to be consistently negative in those European countries where the relationship is significant. The result may simply be a result of causation uncertainty, as it is theoretically unclear whether high liquidity firms tend to exhibit higher gearing or whether high gearing firms experience reduced liquidity as a result of the high gearing. The positive relationship of hypothesis H21 implicitly assumes liquidity to be the determinant of the DDE ratio, whereas the actual direction of causation may be the converse. Therefore, the negative relationship found questions the hypothesis as the causation appears to be the converse for European firms, that is, high corporate gearing results in reduced liquidity.

The profitability measures generally exhibit a negative relationship with the DDE ratio across the majority of European countries. Thus, more profitable firms may find it easier to issue equity due to the higher earnings of their equity holders or may fund predominantly internally, as such internal funds will be large for profitable firms. Thus, the relationship may merely reflect the relative abundance of internal funds of more profitable firms, or firms may actually find it easier to issue equity when they are perceived to be successful by potential investors. The earnings per share measure, and to a lesser extent the price/earnings ratio, reinforce this last argument. However, whether due to a preference for internal funds or an increase in potential investor interest in the firm's equity, it is clear that hypothesis H22 is supported, as more profitable firms exhibit lower gearing levels than less profitable firms.

The bivariate regression relationship between European corporate DDE ratios and relative tax bill measures is generally very weak, though of a negative coefficient sign. Thus, cross-sectional evidence from European firms strongly questions hypothesis H31, as firms do not react to relatively higher tax bills by increasing their gearing levels. The reason for this may be causation which could theoretically be in either direction. Indeed, the negative relationship found might suggest that increases in gearing reduce the relative tax bill of the firm.

Finally, a significant positive relationship exists between the corporate DDE ratio and dividend yield in half of the European countries. This may be because equity investors demand higher dividends to compensate them for the increased risk associated with higher gearing levels. Thus, hypothesis H32 is supported by evidence from European firms.

5.4.5 Summary

Bivariate regression models have enabled a more formal testing of hypotheses arising from the existing literature as well as new hypotheses. As the models are disaggregated to the level of each separate country, and are constructed using cross-sectional data, only taxation and corporate hypotheses are tested.

One problem that arises is that a cross-sectional bivariate analysis cannot statistically determine the direction of causation between the two variables modelled. However, it is often the case that only one direction of causation is theoretically consistent, and this direction is supported by the sign of the regression coefficient estimate. The Granger causality analysis of chapter 6 should resolve some of the interpretation problems associated with causation here. Another problem is that of variable coefficient bias owing to omitted variables, although this problem is inherent to all bivariate analyses unless one variable truly accounts for all of the variation in the other variable modelled.

The hypotheses supported by the empirical evidence are H15, H22 and H23. It appears, then, that increases in corporate gearing increase the risk of financial distress (hypothesis H15), a relationship which is an example of corporate gearing determining other corporate factors, rather than the converse, more commonly proposed relationship. More profitable firms either find it easier to issue equity rather than debt funds, or prefer to finance internally before resorting to external finance, and thus appear to employ lower gearing levels than less profitable firms (hypothesis H22). The positive relationship between dividend yield and the corporate DDE ratio of hypothesis H32 is another example where the latter is the determinant. Higher gearing levels require higher dividend payments to compensate equity holders for this increased bankruptcy risk. From these findings, it is possible that increased dividend payments may be associated with either increased profitability and a reduction in gearing <u>or</u> may be associated with demands from equity holders for increased returns to compensate them for an increase in bankruptcy risk resulting from an increase in gearing. This result leads to the proposition that equity investors should not monitor dividend returns in isolation when purchasing new equity, but must also consider the capital structure stocks and flows underpinning them.

There is no evidence to support hypothesis H17 (proposing a positive relationship between the DDE ratio and the payout ratio), H21, and H31, as the first of these hypotheses finds little support across Europe, and the other hypotheses propose coefficient signs which are opposite to those estimated in the models. Thus, contradicting hypotheses H21 and H31 respectively, the higher corporate gearing is, the less liquidity the firm has at its disposal, and, higher gearing levels reduce the relative tax bill of the firm. The liquidity relationship is fairly widespread across Europe, whereas the taxation relationship is not. Thus, the direction of causation appears, yet again, to flow from the corporate DDE ratio to the other factor in the bivariate relationship, that is, changes in the level of gearing cause changes in taxation or corporate factors. Finally, a positive relationship exists between corporate gearing and firm size in only a few European countries.

Changes in corporate gearing, then, appear to determine changes in bankruptcy risk, dividend yield, liquidity, but corporate gearing is determined by changes in firm profitability. Even at this early stage of the research, it appears that many authors have overlooked the issue of causation uncertainty, or have misinterpreted their results. However, it is impossible to infer causality with any degree of certainty from a cross-sectional analysis, and thus studies which involve time-lags, such as marginal or time-series analyses, may help resolve this problem. Furthermore, chapter 6 attempts to determine the possible directions of causation within some of the more important bivariate corporate capital structure relationships of this research.

5.5 Multivariate logistic regression modelling of the marginal corporate capital structure decision

5.5.1 Introduction

The empirical tests conducted so far have concentrated on bivariate relationships between the corporate capital structure and the factors believed to influence it. However, a multivariate modelling approach is required to establish the groups of variables which the firm considers before making a capital structure decision, as well as to establish the interactions between these variables. Another benefit of multivariate analysis as opposed to bivariate analysis is that the bias in parameter estimates arising from omitted variables should be reduced. Additionally, hypothesis tests and models up to this point have generally concentrated upon relationships concerning the stock capital structure measure, the DDE ratio. It may, however, be that the European firm only reacts to changes in important determinants as such changes occur, that is, at the margin. Thus, a detailed analysis of the marginal funding decision of the European firm appears to be warranted, and such an analysis may be conducted by constructing and estimating multivariate logistic regression models for each European country.

The method allows many of the taxation and corporate hypotheses to be tested, though in a somewhat indirect manner. Most of the initial hypotheses are concerned with the factors influencing the stock corporate capital structure measure, the DDE ratio. With regard to the stock measure, changes in determinants may produce changes in the DDE ratio. However, changes in determinants may produce a different influence on the marginal issue decision of the firm. Nevertheless, if the change in a determinant causes the DDE ratio to increase, for example, it is likely that the change will also cause the firm to issue predominantly debt at the margin. After all, it is through these occasional discrete, lumpy issues of securities that firms make alterations to their stock measure capital structures.

5.5.2 The hypotheses to be tested and the multivariate logistic regression modelling method

The hypotheses to be tested in this analysis are listed in table 5.6. The hypotheses consist of the initial hypotheses deriving from the literature, hypotheses deriving from previous analyses, and new hypotheses deriving from consideration of the marginal corporate capital structure environment.

Table 5.6
The hypotheses to be tested within the multivariate logistic regression analysis

Taxation hypothesis:	
H31:	The corporate debt-equity ratio increases as the relative tax bill increases.
Corporate hypotheses:	
H17:	The corporate debt-equity ratio increases as the payout ratio increases.
H19:	The short-term debt-equity ratio increases as the firm size increases.
H21:	The corporate debt-equity ratio increases with the degree of liquidity.
H22:	The corporate debt-equity ratio increases as firm profitability increases.
H23:	The corporate debt-equity ratio increases as the tangibility of the firm's assets increases.
New hypotheses:	
H33:	The firm is more likely to issue debt at the margin, the lower is the corporate debt-equity ratio.
H34:	The firm is more likely to issue debt at the margin, the higher are coverage ratios.

The taxation variables to be modelled are the depreciation-adjusted tax ratio (labelled DTAXRAT), the tax-to-pre-tax-profit ratio (labelled TAXONPTP), and the tax-to-pre-tax-profit (including associates) ratio (labelled TAXRATIO). The tax charge component of the first of these ratios is the corporation tax charge, whereas the tax charge of the other two ratios is the total tax charge. Hypothesis H31 may imply that as the relative tax bill increases, the firm is more likely to issue debt than equity, implying a positive variable coefficient in the marginal models.

Hypothesis H33 implies that the higher the DDE ratio already is, the more likely the firm would be to issue equity rather than debt, to avoid increasing the risk of financial distress. Such a relationship is consistent with a positive variable coefficient. If there is a positive coefficient it may be that firms are increasing debt towards some optimum capital structure which they have not yet achieved, possibly based upon the target capital structure of the industry to which they belong. Such a result would provide support for the central hypothesis, H1, which states that there exist firm-level optimal capital structures. Thus, the nature of the relationship between the stock and the flow capital structure measures across Europe enables two hypotheses to be tested.

Increases in the payout ratio (labelled PAYRATIO) should increase the likelihood of the firm issuing debt, if evidence from the European marginal models is to be consistent with evidence from Marsh (1982). The payout ratio is defined as dividends per share divided by adjusted net earnings per share. Thus the payout ratio variable is generally expected to have a positive coefficient across models.

The short-term to long-term debt ratio (labelled SRLRDEBT) is a measure of debt structure, and is defined as borrowings repayable within one year divided by total loan capital. It might be hypothesized that firms with relatively high ratios are smaller firms which rely to a greater extent on short-term debt, particularly bank debt, in keeping with hypothesis H19. Therefore, the higher this debt structure ratio is, the less likely the firm is to issue long-term external debt at the margin, which suggests a negative variable coefficient due to corporate capital structure scale factors.

The liquidity variables modelled are the liquid assets ratio (LARATIO), the quick assets ratio (QARATIO), the working capital ratio (WCRATIO), and the net current assets ratio (WORKCAP). These are standard textbook liquidity ratios and are defined in appendix A. If hypothesis H21 holds then this implies that an increase in liquidity should also lead the firm to issue debt rather than equity at the margin, thus producing a positive variable coefficient.

The profitability variables modelled are the net profit margin (labelled NPMARGIN) and the return on capital employed (labelled ROCE). The net profit margin is defined as after-tax profit divided by total sales, and the return on capital employed is profit before interest and taxation as a proportion of capital employed. Hypothesis H22 proposes a negative relationship between profitability and the DDE ratio; at the margin, if an increase in profitability causes firms to issue equity rather than debt, producing a negative coefficient sign, then this result would provide indirect support for the hypothesis.

The fixed assets ratio (labelled FARATIO) is a measure of the tangibility of the firm's asset structure, and is merely the proportion of total assets represented by total net fixed assets. Hypothesis H23 may be indirectly supported if the coefficient of the fixed assets ratio is found to be positive, as firms with highly tangible assets can provide greater security to debt investors, thus increasing their debt capacity and encouraging them to issue relatively more debt at the margin.

The financial risk variables modelled are the dividend cover ratio (labelled DIVCOVER) and the interest cover ratio (labelled INTCOVER). Dividend cover is defined as adjusted net earnings per share divided by dividends per share and interest cover is defined as operating and non-operating profit divided by total interest charges. Thus the former measures the ability of the firm to cover its quasi-commitments to equity holders and the latter measures the ability of the firm to cover its commitments to debt holders and thus both are measures of financial safety. Hypothesis H34 states that "safer" firms with relatively high coverage ratios may be more likely to issue debt than equity at the margin and thus coefficients are expected to be positive.

The retentions ratio (labelled RETRATIO) is a measure of the proportion of after-tax profits retained by the firm. A hypothesis relating to this measure is not explicitly stated above because the theoretical underpinning of such a hypothesis is unclear. However, it might be hypothesized that firms which retain more are those firms which have not yet exhausted their borrowing capacity and thus do not yet have to resort to external equity finance, an argument deriving from pecking order hypotheses. This hypothesis would, then, suggest a positive coefficient.

The depreciation ratio (labelled DEPRATIO) is defined as depreciation divided by total net fixed assets. It might be hypothesized that firms with a higher depreciation ratio, that is, firms which depreciate their fixed assets more rapidly, may issue debt rather than equity to fund new investment, in keeping with the pecking order theory of finance. Such a hypothesis implies a positive coefficient in the logistic regression models.

The stock ratio (labelled STKRATIO) is a measure of the amount of stock the firm has at a point in time in terms of days of sales. It might be hypothesized that firms with higher stock ratios will experience reduced liquidity (as measured by the quick assets ratio which adjusts for stock) and thus have a lower debt capacity. Alternatively, the fact that a large proportion of funds are caught up in the stock of a firm with a high stock ratio may mean that it is more inclined to seek external funding, which could come from either debt or equity investors. Thus, the variable coefficient is expected to be either negative or otherwise mixed across models. However, as stocks have a short duration, they may be funded by short-term debt, due to the maturity structure of assets and funding, and thus the stock ratio may show a far clearer relationship with short-term rather than long-term debt, a relationship which is not modelled here.

The above hypotheses are therefore tested by means of the construction and estimation of multivariate logistic regression models. However, before the testing process and results may be discussed, the logistic regression method must be examined.

Logistic regression analysis is a method which estimates the probability that an event will occur for a dichotomous dependent variable. Multivariate logistic regression models consist of a dichotomous dependent variable and a number of independent variables (known as predictor variables). The objective of the method is not only to predict whether an event will occur or not, given a particular data set, but also to identify those variables which are most significant to the determination of a "correct" prediction.

Logistic regression is used in preference to normal multivariate regression analysis and discriminant analysis for a number of statistical reasons. Firstly, the dependent variable under consideration is dichotomous, the distribution of errors is unlikely to be normal, and predicted values may not be interpreted as probabilities, as they are not bounded by 0 and 1. Thus, normal multivariate regression is inappropriate for modelling a dichotomous capital structure variable, even though it is capable of adequately modelling the stock capital structure measure. Secondly, multiple discriminant analysis requires that independent variables are multivariately normally distributed and that the variance-covariance matrices for the two groups to be studied are equal, if the prediction function is to be optimal. Thus, multiple discriminant analysis also appears to be inappropriate. Hosmer and Lemeshow (1989) show that logistic regression model requires far fewer assumptions than multiple discriminant analysis and multivariate regression analysis, whilst generally producing models which exhibit similar predictive powers, and therefore it is the method chosen to model the marginal capital structure decision of the European firm.

The multivariate logistic regression model is such that the probability of an event occurring, in this case the probability of an individual firm issuing predominantly debt rather than equity, equals:

$$\text{Probability (event)} = \frac{1}{1+e^{-Z}} \qquad \text{Equation 5.1}$$

Where Z is a linear function of the independent variables such that:

$$Z = B_0 + B_1X_1 + B_2X_2 + \cdots + B_PX_P \qquad \text{Equation 5.2}$$

The probability is not linearly related to the independent variables, and due to the logistic transformation the probability estimates will always be between 0 and 1, whatever the value of Z.

The coefficients of the independents are computed using a maximum-likelihood technique, such that the coefficients which make the observed results most likely are selected. Coefficients are estimated using an iterative computation procedure, or algorithm, as the model is non-linear and thus does not lend itself to direct estimation methods.

If the estimated probability of the event under consideration is less than 0.5, then it is inferred that the event will not occur. Conversely, if the probability of the event is greater than 0.5, it is inferred that the event will occur. If, however, the estimated probability exactly equals 0.5 then no inference concerning the occurrence of the event may be made.

Modelling the marginal capital structure decision of the firm is not commonly undertaken in the existing literature. However Martin and Scott (1974) and Mackie-

Mason (1990) are probably among the most renowned proponents of such an analysis. Martin and Scott (1974) hypothesized that:

> "Companies choosing to issue debt instead of common equity (or vice-versa) possess distinctive financial characteristics." (Martin and Scott (1974), p.72)

They modelled the marginal capital structure of the firm using multiple discriminant analysis, both to investigate the variables important to the firm when making its marginal decision, and to develop the model as a decision-making tool to be used by firms.

Mackie-Mason (1990) conducted a marginal analysis to model the debt/equity choice of the firm because:

> "Focusing on actual decisions, made at the margin, is likely to provide more powerful tests than the studies of debt/asset ratios because the ratios cumulate numerous decisions made over many years, taken under varying circumstances." (Mackie-Mason (1990), p.1489)

Therefore, they argued that it is better to model the marginal capital structure decision of the firm because the stock capital structure measure is merely a cumulative result of many separate funding decisions, and that debt-issuing firms should possess characteristics which are distinct from equity-issuing firms. Modelling the marginal capital structure decision is thus a fundamental process to undertake within any analysis of the European corporate capital structure environment, and the method chosen to conduct such an analysis is multivariate logistic regression.

Although the statistical basis of logistic regression has already been explained, it is necessary to explain the application of the method to the marginal corporate capital structure decision. In the marginal capital structure choice model, "0" represents predominantly equity-issuing firms and "1" represents predominantly debt-issuing firms. A firm is said to be a predominant equity issuer if equity issued represents at least 75 per cent of the total long-term funds it issues during 1991. A similar definition applies to predominant debt-issuing firms. The independent variables are the accounting ratios (accounting structure measures) from the marginal capital structure data set, data set 2. A twelve month lag is introduced between the accounting ratios and the issue choice variable. The reason for this is that it is hypothesized that the European firm makes its marginal capital structure choice based on recent historical accounting information. As the choice to raise new external long-term finance is a strategic decision of the firm, it is likely that the accounting structure of the firm for the recent past will be considered when making that decision, rather than the current accounting ratios. In addition, if the study period were the same for both the marginal issue decision variable and the accounting ratios, a situation could arise whereby an issue decision made in April 1990 might be modelled upon accounting ratios as at February 1991, which, although both are data from the same accounting year, is entirely counter intuitive. Furthermore, the year lag also helps to resolve any causation uncertainty, as a capital structure decision made in 1991 cannot be a determinant of 1990 accounting ratios, as the 'future cannot cause the past.' Thus, the one year lagged marginal capital structure model addresses the strategic nature of the issue decision, avoids potential timing difficulties, and resolves, at least in part, the problem of causation uncertainty.

Before explaining the model construction and estimation process, the statistical measures of significance used in this process, as well as those used to gauge the validity of the final models, must be discussed.

The Wald statistic is used to test the hypothesis that a particular independent variable coefficient is zero, and the critical value with which to compare the statistic is from a Chi-square distribution (Norusis, 1992). The ratio is merely the variable coefficient divided by the respective standard error, all squared:

$$\text{Wald statistic} = \left(\frac{B}{se}\right)^2 \qquad \text{Equation 5.3}$$

Where:
B = the logistic regression variable coefficient
se = the standard error of the coefficient

The significance level used in the statistic tests is the five per cent level. The Wald statistic, then, enables each individual independent variable (in this case, an accounting ratio) to be tested for significance, thus creating a criterion by which variables may be eliminated from models on a stepwise basis during the model construction process.

The rate of correct classification enables the logistic regression model predictions to be compared with observed outcomes. The percentage of predominant debt and equity issuers correctly classified is calculated. The classification procedure allocates cases (firms) to a particular outcome based on whether the estimated probability is greater or less than 0.5. If the estimated probability is greater than 0.5 then the model predicts that the firm will issue predominantly debt, whereas if the estimated probability is less than 0.5 the model predicts that the firm will issue predominantly equity at the margin. The rate of correct classification, then, is one of the means by which the "success" of the model may be gauged, that is, its ability to correctly predict the issue decision of the firm at the margin.

The model Chi-square tests the null hypothesis that all of the model coefficients, except the constant, are zero, and in this respect is similar to the F-test in normal multivariate regression models. It is equal to the difference between minus two multiplied by the log likelihood for a model with only a constant and minus two multiplied by the log likelihood for the model being tested. The number of degrees of freedom is the difference between the number of parameters in the two models. The likelihood is merely the probability of the observed results, given the estimated coefficients. The likelihood is logged and multiplied by minus two because it is small and less than 1, thus producing the expression -2LL. Therefore, the model Chi-square is compared to a Chi-square distribution to gauge how well the model fits the data.

Thus, the Wald statistic enables the significance of individual independent variables (accounting ratios) to be gauged and the more important variables, in terms of discriminating power, to be identified, whereas the rate of correct classification and model Chi-square both measure the power of the multivariate models.

To demonstrate the great variety of possible model development processes from which the utilised process was drawn, models may be developed by: adding new variables in a stepwise manner (forward development) or removing variables from a model containing all of the possible variables in a stepwise manner (backward development), in addition to employing any of the following statistics as a criterion for variable inclusion or exclusion: the Wald statistic, the model Chi-square, the rate of correct classification, or other statistics. Various combinations of forward and backward development processes on the basis of one or more of these statistics may be imagined. Any of these model development processes may achieve a satisfactory model, although processes which represent 'general-to-specific' (or backward development) approaches are preferable, as they produce models which suffer less from omitted variable bias in the estimators. Additionally, the backward development process enables variables to be removed on the basis of their individual significance relative to the other variables whereas the forward development process does not facilitate such comparison. Finally, the Wald statistic is employed as the criterion for individual variable inclusion or elimination, as it enables individual variables to be measured for significance, rather than each variable's contribution to the overall power of the model.

The process chosen starts with a full, non-restricted model, and variables are generally eliminated on the basis of the Wald statistic, both because the resulting models appear to exhibit higher classification power and because misspecification is reduced as a result. Misspecification is generally a problem in econometric modelling when not all of the variables in a model are known, or can be modelled, but the inclusion of irrelevant variables is better than the exclusion of variables. This is because, although the presence of irrelevant variables may cause a loss of efficiency, it does not cause a loss of consistency, and perhaps, more importantly, it does not cause coefficient estimates to become biased, whereas wrongly excluded variables will yield biased, as well as inconsistent, parameter estimates. Thus, the stepwise elimination of variables from a non-restricted model should in theory produce a more statistically robust model.

The model development process is a three stage procedure, conducted with the objective of producing a high power predictive model, as well as to identify the individual variables which most significantly influence the marginal capital structure choice of the European firm. Thus, separate models are constructed, estimated and developed for firms in each European country (except Sweden owing to data availability problems) which make issues of debt and/or equity during the study period. Firstly, then, the number of missing observations is determined by means of a frequency calculation. This calculation is important because variables with many missing observations may be eliminated at this early stage if no Wald statistic may be computed to measure their univariate significance. Although this may appear to be a somewhat crude elimination process: it is only practised in those weaker estimated models which are estimated on very few firms; there is no strictly optimal procedure for variable elimination anyway; and such variables are later tested more formally using the Wald statistic when the model is in its restricted (reduced) form. Secondly, where Wald statistics may be computed, variables are eliminated in a stepwise manner, with the least significant on the basis of this statistic being eliminated first, and progressing until the rate of correct classification is optimised, that is, until the resulting model attains the highest classification rate possible, given the data set. Thirdly, variables eliminated in the first stage, merely on the basis of large numbers of missing values, are reintroduced, and are either added or eliminated again from the model, so that they may be tested formally by means of the univariate Wald statistic.

Once final models have been developed, the rate of correct classification and Chi-square statistics are computed, and each model is interpreted in detail, examining the model as a whole as well as the separate independent variables which comprise the model.

5.5.3 The data

The data for the multivariate logistic regression models is taken from data set 2, which contains capital structure and accounting information on 395 firms from 10 European countries. As discussed earlier, the marginal issue variables are those applicable to the year ending March 1991, whereas the accounting ratio variables are those applicable to the year ending March 1990. Detailed definitions of the variables are given in appendix A. The data set is obviously much smaller than data set 1, used for the bivariate regression models, because it examines only those firms which made predominantly debt or equity long-term external capital structure changes during the year ending March 1991. The estimated model results to be given greatest importance are those for the UK, Germany and France, as data sets for these countries contain somewhat more firms than the data sets of other countries.

5.5.4 Results of the multivariate logistic regression models

It is necessary to examine how the marginal European corporate capital structure models may be used to predict the outcome of a decision to raise new external finance, before the full set of European models are examined. Therefore, the UK logistic regression marginal corporate capital structure model is used to demonstrate how such a model works. Accounting ratio data from predominant debt and predominant equity issuing firms are substituted into the model as an example of model predictions which are consistent with observed marginal corporate capital structure behaviour, as demonstrated in table 5.7. The model consists of a set of variable coefficients and a constant. The model coefficients are multiplied by the respective observed accounting ratio data for a particular firm, and the constant is added to the sum of these calculations to produce a linear function sum. The linear function sum is then transformed using equation 5.1, where the linear function is Z in the equation, to produce a probability of the outcome occurring, that is, the issue of predominantly debt by the firm.

Table 5.7
Table showing the computation of a predicted outcome of either predominant debt or equity issue from the UK marginal corporate capital structure model

Coefficient name	Coefficient value	Observations for case 4 Albert Fisher	Linear Function	Observations for case 1 AAH Holdings	Linear Function
DDERATIO	-3.3989	0.13	-0.441857	0.02	-0.067978
DEPRATIO	-6.3344	0.08	-0.506752	0.16	-1.013504
DIVCOVER	-0.3115	2.92	-0.90958	2.46	-0.76629
DTAXRAT	-4.2166	0.16	-0.674656	0.23	-0.969818
FARATIO	1.9885	0.33	0.656205	0.49	0.974365
INTCOVER	-0.0146	6.3531	-0.0927553	5.8235	-0.0850231
LARATIO	0.7449	1.67	1.243983	0.33	0.245817
PAYRATIO	-1.7817	0.34	-0.605778	0.41	-0.730497
QARATIO	-2.0027	2.21	-4.425967	0.91	-1.822457
ROCE	-0.0125	20.86	-0.26075	18.50	-0.23125
SRLRDEBT	-0.0028	0.09	-0.000252	14.12	-0.039536
STKRATIO	-0.0223	30.51	-0.680373	32.58	-0.726534
WCRATIO	2.4235	2.79	6.761565	1.28	3.10208
Constant	1.9810		1.9810		1.9810
Observed outcome		**1**		**0**	
Predicted linear function sum			**2.04403274**		**-0.1496251**

The model correctly predicts that the firm Albert Fisher, case number 4 of data set 2, will issue predominantly debt, because the probability of the outcome, which in the marginal capital structure models is an issue of predominantly debt, is 0.88534, which is merely the predicted linear function sum transformed in equation 5.1. It is noted that a value of unity would represent a certain probability of a predominant debt issue at the margin. The model also correctly predicts that the firm AAH Holdings, case number 1 of data set 2, will issue predominantly equity, because the probability of the outcome is only 0.46266, which again is the predicted linear function sum transformed in equation 4.1. A value of zero would represent a certain probability of a predominant equity issue at the margin.

Table 5.8 shows the optimal marginal capital structure decision models for firms in each of the separate European countries studied. The variable coefficients are not so easily interpreted as the coefficients of linear regression models such as those discussed in section 5.4. A positive coefficient multiplied by its respective (non-negative) observation will increase the probability of the event occurring, in this case the firm issuing predominantly debt. A negative coefficient multiplied by its respective (non-negative) observation will reduce the probability of the firm issuing predominantly debt. Thus, the higher the profitability ratio, ROCE, for example, the greater the probability of a firm issuing predominantly equity, as the variable has a negative sign in the models in which it is employed.

Table 5.8
The individual European logistic regression marginal funding models

	BD	BG	DK	ES	FR	IR	IT	NL	SW	UK
DDERATIO	2.2673	47.3864	46.171				3.1951		-15.199	-3.3989
DEPRATIO	5.1406	128.079				-73.463				-6.3344
DIVCOVER					-0.0326				1.3503	-0.3115
DTAXRAT					1.086					-4.2166
FARATIO	7.9344	-53.126					3.8637		6.4877	1.9885
INTCOVER	0.1166				-0.0855		-0.183		-0.3998	-0.0146
LARATIO	-1.601						-6.6559	-5.6261		0.7449
NPMARGIN									-0.6846	
PAYRATIO	5.9406			9.041				-14.352		-1.7817
QARATIO								2.3006		-2.0027
RETRATIO	2.2368		-1.5504				5.424	6.5788		
ROCE	-0.0724				-0.394		-0.7218			-0.0125
SRLRDEBT	0.6912				0.5843			-0.1957		-0.0028
STKRATIO										-0.0223
TAXONPTP			8.5713		8.2934					
TAXRATIO	-0.0643				-0.1808			7.3378		
WCRATIO					3.4593					2.4235
WORKCAP	6.124				-0.0599	14.433	30.443	-4.4116		
Constant	-6.5088	4.512	-9.2518	-6.0846	-2.5635	3.1805	7.1441	0.2677	4.8346	1.981

Before the results of the models are interpreted, it is necessary to examine the power of the models by computing the rate of correct classification and the Chi-square statistic for each of the European models estimated. Table 5.9 details the rate of correct classification statistics for each of the separate country marginal corporate capital structure choice models.

The table reveals that the models are generally very effective at predicting the outcome of the marginal issue decision of the European firm. However, the models appear more able to correctly identify issues of debt than issues of equity. This may be due to the fact that the data set contained more marginal issues of debt than equity, thus to some extent weighting the coefficients towards correction prediction of debt issue outcomes. All of the models have predictive powers such that they correctly predict the outcome of a marginal funding decision correctly in at least two out of three issues, with most models attaining predictive powers in the range 80 to 100 per cent. Therefore, the models appear to be able to successfully predict the outcome of the marginal corporate capital structure decision of the European firm.

Table 5.9
Table showing the percentage of correct predictions made by the European marginal corporate capital structure models
(the number of firms is shown in parentheses)

Country	Equity issuers classified correctly	Equity issuers classified incorrectly	Debt issuers classified correctly	Debt issuers classified incorrectly	Percentage classified correctly overall
Germany	58.82 (10)	41.18 (7)	100.00 (49)	0.00 (0)	89.39
Belgium	100.00 (3)	0.00 (0)	80.00 (4)	20.00 (1)	87.50
Denmark	75.00 (3)	25.00 (1)	100.00 (8)	0.00 (0)	91.67
Spain	0.00 (0)	100.00 (0)	100.00 (2)	0.00 (0)	66.67
France	60.00 (15)	40.00 (10)	81.58 (31)	18.42 (7)	73.02
Eire	50.00 (1)	50.00 (1)	100.00 (4)	0.00 (0)	83.33
Italy	80.00 (4)	20.00 (1)	100.00 (14)	0.00 (0)	94.74
Netherlands	90.91 (10)	9.09 (1)	92.31 (12)	7.69 (1)	91.67
Switzerland	75.00 (3)	25.00 (1)	100.00 (19)	0.00 (0)	95.65
UK	68.29 (56)	31.71 (26)	81.11 (73)	18.89 (17)	75.00

The Chi-square statistics for the models are given in table 5.10. The table shows that most of the models are very significant, with models for Germany, Denmark, France and the UK exhibiting significance at the 5 per cent level, and models for Italy, the Netherlands, and Switzerland becoming significant at the 10 per cent level. The estimated models for Belgium, Spain and Eire are not significant, even at the 10 per cent level, probably because they are estimated upon very small data sets, and they consist of only a few variables.

The models estimated for the UK, France and Germany are the most robust on the basis of two criteria. Firstly, they are highly significant, producing Chi-square statistics which are significant at the 5 per cent level and classification powers in excess of 73 per cent. Secondly, they are estimated upon samples of greater than 60 issues (UK= 172 observations, France = 63 observations, Germany = 66 observations). It is reasonable to regard the results from these models, then, with the greatest weighting in this marginal corporate capital structure analysis. However, the results of the other models are also examined for the sake of completeness.

Table 5.10
Chi-square tests of significance for the European marginal corporate capital structure models

Country	Model Chi-square	Degrees of freedom	Significance	Significant at 5% level?
Germany	20.082	11	0.0442	YES
Belgium	6.093	3	0.1072	NO
Denmark	9.293	3	0.0256	YES
Spain	0.276	1	0.5993	NO
France	17.869	9	0.0367	YES
Eire	2.873	2	0.2377	NO
Italy	12.750	7	0.0784	NO
Netherlands	12.961	7	0.0731	NO
Switzerland	9.838	5	0.0799	NO
UK	39.990	13	0.0001	YES

A more graphic means of examining model power is provided by presenting histograms of observed issue groups and predicted probabilities, as shown in figures 5.1 to 5.11, found at the end of this section. The predicted probabilities are the estimated probabilities of firms being predominant debt issuers. In a good model, debt-issuing firms should appear to the right of 0.5 (those firms represented by the number 1 in the histogram) and equity-issuing firms should appear to the left of 0.5 (those firms represented by the number 0). In very powerful models, firms will cluster at the respective ends of each group. The histograms not only confirm the results of the Chi-square significance test results of table 5.10, but also reveal the extent to which firms cluster on either side of the 0.5 probability mark. It is apparent that debt issuing firms are generally far more clustered than equity-issuing firms, and that many debt-issuing firms are clustered along, or near to, the 1.0 probability mark, whereas the probabilities of equity-issuing firms appear to be more dispersed, though with many of the predicted probabilities positioned around the 0.5 mark. Again, it is observed that the models are generally far better at predicting the correct marginal capital structure choice for debt-issuing firms than equity-issuing firms.

Examination of the coefficients allows the hypotheses deriving from the literature to be tested, albeit in a somewhat indirect manner. As already discussed, most authors in the area of corporate capital structure concentrate on the stock measure of the capital structure, the debt-to-debt-plus-equity ratio (the DDE ratio) or variants of this measure, probably more for reasons of data availability than being guided by the underlying theory. Thus most of the hypotheses relate to the stock capital structure measure and it is not necessarily the case that they hold at the margin. This is because marginal capital structure adjustments are likely to be more erratic and "lumpy", different processes are at work at the margin, and firms may be pursuing a target capital structure and a target accounting structure. Therefore, the relationship between the accounting ratio and the marginal issue decision of the firm may appear to be inconsistent with the theory, particularly if firms are pursuing targets.

Wald statistics are computed for the individual accounting ratios which make up the models, and these are presented in appendix B. To summarise the results of such univariate tests of significance, it is found that in none of the models are any of the variables significant at the 5 per cent level, with only a few variables becoming significant at the 10 per cent level. However, many of the variables are significant at the 20 per cent level and almost all variables are significant at the 40 per cent level. This general lack of significance of the individual accounting ratios which make up the models is both disappointing and surprising. It is disappointing in the sense that if some of the variables were individually significant then their relative importance to the marginal funding decision might be gauged. The lack of significance is also surprising as the overall models are generally significant and exhibit high predictive powers. Therefore, it must be the multivariate relationship between the marginal issue variable and the accounting ratios, and/or the interaction between the accounting ratios themselves, which produces such high powered models, in a manner analogous to multicollinearity.

The magnitudes of the variable coefficients require a somewhat complex interpretation, and thus it is the sign of the coefficient which shall be considered in this analysis. Table 5.11 summarises the signs of the coefficients for ease of exposition, whereas the actual coefficient values are given earlier in table 5.8.

It is useful to examine which variables are most commonly used in the marginal models. The variables most commonly employed in the models are, then, the DDE ratio, the fixed assets ratio, interest cover, and the net current assets ratio, as these ratios are used in at least half of the marginal capital structure models. Thus, before even examining the coefficients of the variables, it is possible to observe the most important factors considered by European finance managers before making a decision to raise either debt or equity at the margin. It is not surprising that the manager first of all considers the stock of finance claims already owed before making a flow decision which will alter that stock. Only a foolish manager of a firm with a very high gearing level, for example, would not carefully consider and reconsider a decision to issue yet more debt.

Table 5.11
The sign of model coefficients and their frequency of employment in the marginal corporate capital structure models (P=positive; N=negative)

	BD	BG	DK	ES	FR	IR	IT	NL	SW	UK	SIGN	TOTAL
DDERATIO	P	P	P				P		N	N	P	6
DEPRATIO	P	P				N				N	P/N	4
DIVCOVER					N				P	N	N	3
DTAXRAT					P					N	P/N	2
FARATIO	P	N					P		P	P	P	5
INTCOVER	P				N		N		N	N	N	5
LARATIO	N						N	N		P	N	4
NPMARGIN									N		N	1
PAYRATIO	P			P				N		N	P/N	4
QARATIO								P		N	P/N	2
RETRATIO	P		N				P	P			P	4
ROCE	N				N		N			N	N	4
SRLRDEBT	P				P			N		N	P/N	4
STKRATIO										N	N	1
TAXONPTP			P		P						P	2
TAXRATIO	N				N			P			N	3
WCRATIO					P					P	P	2
WORKCAP	P				N	P	P	N			P	5
Constant	N	P	N	N	N	P	P	P	P	P	P	10

The other most important variables all describe the firm's ability to support new debt, in addition to old debt. Thus, the manager examines the firm's fixed assets ratio to gauge the firm's collateral for new borrowing. He or she considers the firm's interest cover to determine whether or not a new tranche of debt is likely to materially alter the firm's probability of financial distress. Finally, by considering the net current assets ratio, the manager examines the ability of the firm to meet current liability commitments as well as the net current assets margin as a proportion of total assets. Therefore, the finance manager of the European firm, when considering the form of a new tranche of financial securities, appears primarily preoccupied by the existing stock of capital structure claims and possibly the strategic reasoning behind the mix of such funds, as well as the firm's ability to support new external funds.

It is clear that the finance manager examines the most important and intuitive determinants of the firm's capital structure as a priority before examining less important influences on the marginal funding choice. However, the above priority order of considerations does not enable examination of the nature of such influences. To facilitate such an analysis, variables are divided into the following groupings to aid interpretation and hypothesis testing: capital structure variables, financial risk variables, taxation variables, profitability variables, liquidity variables, and miscellaneous variables. Quick perusal of table 5.11 shows that the variable coefficient signs are fairly erratic and are not consistent across country models.

The capital structure variables utilised are the DDE ratio, the retentions ratio, and the ratio of short-term to long-term debt. The DDE ratio is seen to have a positive coefficient in the majority of the models where it is present, and thus the more debt a firm already employs in its capital structure, the more likely it is to issue more debt again. This supports hypothesis H1 and questions hypothesis H33, and thus firms appear to be acting in an almost counter intuitive manner by making marginal capital structure choices which exacerbate the risk of financial distress, though this may be rationalised by targeting behaviour.

The estimated coefficient of the retentions ratio is generally positive in the models in which the variable is employed, supporting the hypothesis stated earlier. Thus, firms which have not exhausted their external borrowing capacity and are generally the more buoyant firms which make relatively large retentions, are more likely to issue debt than equity at the margin.

Hypothesis H19 states that the short-term debt-equity ratio increases as the firm size increases. Firms with relatively high short-term-to-long-term debt-equity ratios are likely to be smaller firms and thus the higher this ratio is, the less likely the firm is to issue long-term debt at the margin, a relationship which proposes a negative coefficient. However, the signs of the coefficients in the models in which the variable appears are mixed, and thus the hypothesis is neither supported nor questioned by the models.

Hypothesis H34 proposes that safer firms with higher interest and dividend cover ratios are more likely to issue debt than equity at the margin, as their risk of financial distress is lower and debt capacities are higher than riskier firms with lower coverage ratios. However, the coefficients of both of the variables are generally negative, suggesting that safer firms are more likely to issue equity rather than debt at the margin. This may merely be a result of causation, as safer firms are by definition those which employ relatively less debt and probably issue more equity at the margin. However, owing to the twelve month lag, the causation should flow from the coverage ratio rather than the converse. It is thus possible that even a twelve month lag is not sufficient to resolve the problem of causality. It appears also that interest cover is more widely employed in models than dividend cover, which is intuitive as it suggests that firms give more consideration to fixed commitments than quasi-fixed commitments. Therefore, the financial risk variables reveal that safer firms appear to issue equity at the margin, and that the problem of causation uncertainty may not be entirely resolved by introducing a short lag in the marginal corporate capital structure models.

The coefficients of the taxation variables are not consistently positive, except for the tax-to-pre-tax-profits ratio, and thus hypothesis H31 is neither supported nor questioned by the coefficients of the marginal corporate capital structure models. Therefore, firms do not consistently react to relatively high tax bills by issuing more debt in an attempt to drive down future tax bills by utilising the tax benefits of debt.

Although the profitability ratios are not employed widely in the marginal corporate capital structure models, particularly the net profit margin, it is observed that in all models which do contain a profitability measure the sign of the coefficient is negative. Thus, indirect support is provided for hypothesis H22, as more profitable firms prefer to issue equity rather than debt at the margin.

The coefficients for the liquid assets ratio are generally negative, although this ratio is complicated by the inclusion of stock in the numerator, whereas the coefficients for the quick assets ratio are mixed. However, the coefficients of the other liquidity ratios are generally positive. On balance, then, positive coefficients were observed for the liquidity ratios, thus providing some support for hypothesis H21. More highly liquid firms appear to prefer to issue debt rather than equity at the margin, as their debt capacity increases with the degree of liquidity.

Finally, the remaining "miscellaneous" variables are the payout ratio, the depreciation ratio, the fixed assets ratio, and the stock ratio. Hypothesis H17 proposes a positive relationship between the stock DDE ratio and the payout ratio, and implies a positive coefficient for the logistic regression coefficient for the payout ratio. However, it can be seen that there is a mix of coefficient signs across the models which employ this variable, and thus the hypothesis may neither be questioned nor supported. It may be that firms do not consider the cost of dividend payments to be a direct cost of equity finance, as they are only quasi-commitments, that is, they may be passed up if the firm so wishes. Indeed, this appears consistent with the observation that more models contain the interest cover variable than the dividend cover variable, as European firms are generally more concerned with interest commitments than the payment of dividends, and this indifference may produce the mix of coefficient signs observed.

The coefficients of the depreciation ratio are mixed. Thus, it may be that European firms which operate rapid depreciation policies, such as high technology firms, do not prefer debt to equity finance at the margin, questioning a pecking order preference for debt over equity at the margin.

The coefficients of the fixed assets ratio measures are predominantly positive, supporting hypothesis H23. Thus, firms with highly tangible assets appear to prefer to issue debt rather than equity at the margin, as they can offer lenders a high degree of collateral with which to support such borrowing.

The stock ratio is seen to exhibit a negative coefficient, but the variable is only employed in a single European model, and thus little inference may be drawn from this result.

In summary, evidence which is generally of an indirect nature supports hypotheses H1, H21, H23, and H22. Therefore, issues of debt at the margin (and higher DDE ratios) are generally associated with higher DDE ratios, higher liquidity, higher asset tangibility, and lower profitability, and such relationships are consistent with the existing literature. Hypotheses H33 and H34 are questioned by the signs of the model coefficients. Thus, highly geared firms are more likely to issue debt than equity at the margin and "safer" firms are more likely to be those risk averse firms which issue equity at the margin. However, the model results neither support nor question hypotheses H17, H19, and H31, as issues of debt at the margin (and higher DDE ratios) are not associated with higher payout ratios, a lower proportion of short-term debt, or higher relative tax bills.

Less profitable firms may find it easier to issue debt rather than equity at the margin because their equity holders will not be very receptive to new equity issues owing to lower equity earnings. More tangible and liquid firms are able to provide greater collateral against which to borrow and are more able to service the principal and interest commitments of debt, and are therefore more likely to issue debt than equity at the margin. The curious result that firms which are already relatively highly geared appear more likely to issue debt at the margin may be explained by capital structure targeting, that is, firms may be increasing their gearing even though it is already high, to reach the target capital structure which is based upon the norm of the industry to which they belong. This supports hypothesis H1, as an optimising behaviour is apparent at the level of the firm, as well as hypothesis H24 to some extent, as such behaviour must be explained in terms of industry targeting.

Taxation, in the form of the relative tax bill, appeared to have an unclear effect on the marginal capital structure choice of the firm. Hypothesis H31 states that there should be a positive relationship between the DDE ratio and the relative tax bill, implying a possible positive coefficient of the relative tax bill variables in the models. The fact that the coefficients exhibited a mixture of signs may indicate that firms in some countries are proactive, whereas firms other in countries are reactive, to changes in the extent of their tax burden. If firms were proactive, they would increase debt to drive down their relative tax bills, producing a negative tax variable coefficient. Conversely, if firms were reactive, they would observe an increase in their relative tax bills and then would issue relatively more debt than equity at the margin to drive the tax bill down, producing a positive tax variable coefficient. The reactive relationship is that hypothesized in H31, and that tested here, because of the twelve month lag which is incorporated to address the problem of causation uncertainty. The fact that a number of negative tax variable coefficients are observed implies that the causation uncertainty problem is not solved in these models. Thus, capital structure changes may cause changes in the relative tax bill or vice versa.

Other results deriving from the marginal capital structure models are that debt issues are more likely the higher is the relative level of retentions, and the lower is financial risk and the stock ratio, although the results for the depreciation ratio are mixed. Therefore, more buoyant firms, which still have considerable debt capacity and make relatively large retentions, are more likely to issue debt than equity. Somewhat surprisingly, "safer" firms, that is, firms with lower financial risk, are more likely to issue equity than debt at the margin. This is possibly because, by definition, "safer" firms are those risk averse firms which generally do not engage in heavy gearing and thus issue predominantly equity at the margin. The remaining results add little to the marginal corporate capital decision perspective.

FIGURE 5.1
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE GERMAN MODEL

```
           16 +                                                            +
              |                                                            |
              |                                                            |
    F         |                                                            |
    R      12 +                                                            +
    E         |                                                            |
    Q         |                                                            |
    U         |                                                           1|
    E       8 +                                                           1+
    N         |                                                           1|
    C         |                                                           1|
    Y         |                                                           1|
            4 +                                                 1         1+
              |                                       11     1   11 1 11  11|
              |                           0   11      01 1   1   11 1111 111|
              |0           0 00    0  00 00  10 1 1 101 11 11  110110111001|
 Predicted     ---------------+----------------+---------------+-------------
   Prob:       0             .25               .5             .75            1
   Group:      000000000000000000000000000000111111111111111111111111111111

               Predicted Probability is of Membership for 1

 KEY:          Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
                        1 = PREDOMINANT DEBT ISSUING FIRM

               Each Symbol Represents 1 Case.
```

FIGURE 5.2
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE BELGIAN MODEL

```
            4 +                                                            +
              |                                                            |
F             |                                                            |
R           3 +                                                            +
E             |                                                            |
Q             |                                                            |
U             |                                                            |
E           2 +                                                           1+
N             |                                                           1|
C             |                                                           1|
Y             |                                                           1|
            1 +0                 1   00                                 111+
              |0                 1   00                                 111|
              |0                 1   00                                 111|
              |0                 1   00                                 111|
Predicted      ---------------+--------------+--------------+--------------
  Prob:        0             .25             .5            .75            1
  Group:       000000000000000000000000000000111111111111111111111111111111

               Predicted Probability is of Membership for 1

KEY:           Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
                        1 = PREDOMINANT DEBT ISSUING FIRM

               Each Symbol Represents .25 Cases.
```

FIGURE 5.3
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE DANISH MODEL

```
                 Observed Groups and Predicted Probabilities

         8 +                                                            +
           |                                                            |
F          |                                                            |
R        6 +                                                            +
E          |                                                           1|
Q          |                                                           1|
U          |                                                           1|
E        4 +                                                           1+
N          |                                                           1|
C          |                                                           1|
Y          |                                                           1|
         2 +                                                           1+
           |                                                           1|
           |0  0    0                       1   1       0    1        1|
           |0  0    0                       1   1       0    1        1|
Predicted  ---------+--------------+--------------+---------------------
  Prob:     0      .25            .5             .75                   1
  Group:    000000000000000000000000000000111111111111111111111111111111

          Predicted Probability is of Membership for 1

KEY:      Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
                   1 = PREDOMINANT DEBT ISSUING FIRM

          Each Symbol Represents .5 Cases.
```

FIGURE 5.4
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE SPANISH MODEL

```
          4 +                                                            +
            |                                                            |
F           |                                                            |
R         3 +                                                            +
E           |                                                            |
Q           |                                                            |
U           |                                                            |
E         2 +                                                            +
N           |                                                            |
C           |                                                            |
Y           |                                                            |
          1 +                              1     0             1         +
            |                              1     0             1         |
            |                              1     0             1         |
            |                              1     0             1         |
Predicted    ---------------+--------------+--------------+---------------
  Prob:      0             .25             .5            .75             1
  Group:     000000000000000000000000000000111111111111111111111111111111

             Predicted Probability is of Membership for 1

KEY:         Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
                      1 = PREDOMINANT DEBT ISSUING FIRM

             Each Symbol Represents .25 Cases.
```

FIGURE 5.5
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE FRENCH MODEL

```
           4 +                             1                                +
             |                             1                                |
             |                             1                                |
  F          |                             1                                |
  R        3 +                             0                    1     11    +
  E          |                             0                    1     11    |
  Q          |                             0                    1     11    |
  U          |                             0                    1     11    |
  E        2 +  0         1        1 11  0 01  1 1  111 1 1     1  11 11    +
  N          |  0         1        1 11  0 01  1 1  111 1 1     1  11 11    |
  C          |  0         1        1 11  0 01  1 1  111 1 1     1  11 11    |
  Y          |  0         1        1 11  0 01  1 1  111 1 1     1  11 11    |
           1 +  0  0  10  0       01000 00 00000 01 00110111101111101 11    +
             |  0  0  10  0       01000 00 00000 01 00110111101111101 11    |
             |  0  0  10  0       01000 00 00000 01 00110111101111101 11    |
             |  0  0  10  0       01000 00 00000 01 00110111101111101 11    |
Predicted  ---------------+--------------+--------------+---------------
  Prob:    0             .25             .5             .75             1
  Group:   000000000000000000000000000000111111111111111111111111111111
```

Predicted Probability is of Membership for 1

KEY: Symbols: 0 = PREDOMINANT EQUITY ISSUER
1 = PREDOMINANT DEBT ISSUER

Each Symbol Represents .25 Cases.

FIGURE 5.6
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE EIRE MODEL

```
        4 +                                                             +
          |                                                             |
F         |                                                             |
R       3 +                                                             +
E         |                                                             |
Q         |                                                             |
U         |                                                             |
E       2 +                                                             +
N         |                                                             |
C         |                                                             |
Y         |                                                             |
        1 +0                                         1  101          1  +
          |0                                         1  101          1  |
          |0                                         1  101          1  |
          |0                                         1  101          1  |
Predicted ---------+---------------+---------------+---------------
  Prob:   0       .25             .5              .75             1
  Group:  000000000000000000000000000000111111111111111111111111111111
```

Predicted Probability is of Membership for 1

KEY: Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
1 = PREDOMINANT DEBT ISSUING FIRM

Each Symbol Represents .25 Cases.

FIGURE 5.7
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE ITALIAN MODEL

```
            8 +                                                            +
              |                                                           1|
  F           |                                                           1|
  R         6 +                                                           1+
  E           |                                                           1|
  Q           |                                                           1|
  U           |                                                           1|
  E         4 +                                                           1+
  N           |                                                           1|
  C           |                                                           1|
  Y           |                                                           1|
            2 +                                                       1   1+
              |                                                       1   1|
              | 00   0      0                     1     1    1 1     10 1 1|
              | 00   0      0                     1     1    1 1     10 1 1|
Predicted  ---------------+--------------+--------------+---------------
  Prob:    0             .25             .5            .75             1
  Group:   000000000000000000000000000000111111111111111111111111111111

           Predicted Probability is of Membership for 1

KEY:       Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
                    1 = PREDOMINANT DEBT ISSUING FIRM

           Each Symbol Represents .5 Cases.
```

FIGURE 5.8
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE DUTCH MODEL

```
      4 +                                                            +
        |                                                            |
        |                                                            |
F       |                                                            |
R     3 +                                                         1  +
E       |                                                         1  |
Q       |                                                         1  |
U       |                                                         1  |
E     2 +0                                      1               1 1  +
N       |0                                      1               1 1  |
C       |0                                      1               1 1  |
Y       |0                                      1               1 1  |
      1 +00   0    0     0  10 0 0  0  1 1      1  1       1 1  1 0 1+
        |00   0    0     0  10 0 0  0  1 1      1  1       1 1  1 0 1|
        |00   0    0     0  10 0 0  0  1 1      1  1       1 1  1 0 1|
        |00   0    0     0  10 0 0  0  1 1      1  1       1 1  1 0 1|
Predicted --------------+--------------+--------------+---------------
  Prob:   0            .25            .5             .75             1
  Group:  000000000000000000000000000000111111111111111111111111111111
```

Predicted Probability is of Membership for 1

KEY: Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
1 = PREDOMINANT DEBT ISSUING FIRM

Each Symbol Represents .25 Cases.

FIGURE 5.9
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE SWISS MODEL

```
          8 +                                                            +
            |                                                            |
            |                                                           1|
F           |                                                           1|
R         6 +                                                           1+
E           |                                                           1|
Q           |                                                           1|
U           |                                                           1|
E         4 +                                                          11+
N           |                                                          11|
C           |                                                          11|
Y           |                                                          11|
          2 +                                                        1 11+
            |                                                        1 11|
            |0               0        0       1        1   1 11   1   0111|
            |0               0        0       1        1   1 11   1   0111|
Predicted    --------------+--------------+--------------+---------------
  Prob:      0            .25            .5             .75             1
  Group:     000000000000000000000000000000111111111111111111111111111111
```

Predicted Probability is of Membership for 1

KEY: Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
1 = PREDOMINANT DEBT ISSUING FIRM

Each Symbol Represents .5 Cases.

FIGURE 5.10
HISTOGRAM OF OBSERVED GROUPS AND PREDICTED PROBABILITIES FOR THE UK MODEL

```
          16 +                                                            +
             |                                                            |
 F           |                                                            |
 R        12 +                                                            +
 E           |                                                            |
 Q           |                                                            |
 U           |                             1                              |
 E         8 +                 0           1                              +
 N           |                 0           1    11    1                   |
 C           |                 0           11 1 11    1111    1           |
 Y           |                 0          1101 1111   1111    1           |
           4 +            1    0     1    01011111111 1101    11          +
             |            0   10   0 101  00011111111 1101 1  11          |
             |0 010  010  00  000001 00010001111000110000 01 10      1   11|
             |0 0001 000 000  000000 000000000010001000000001010 1 11111111|
Predicted  ---------------+---------------+---------------+---------------
  Prob:      0           .25             .5              .75              1
  Group:     000000000000000000000000000000111111111111111111111111111111
```

Predicted Probability is of Membership for 1

KEY: Symbols: 0 = PREDOMINANT EQUITY ISSUING FIRM
1 = PREDOMINANT DEBT ISSUING FIRM

Each Symbol Represents 1 Case.

5.5.5 Summary

Section 5.5 set out to extend the analysis of the European corporate capital structure in two important respects: to introduce a multivariate perspective and to model the marginal issue decision. Marginal models are vital to a greater understanding of corporate capital structure determination, as it is at the margin that the finance manager looks at the firm's stock DDE ratio and stock accounting ratios before making a decision to raise new external funds. The multivariate logistic regression method allows the dichotomous, "debt or equity" choice to be modelled upon accounting ratio measures from the year prior to the issue year, for various theoretical reasons, and in an attempt to resolve the causation uncertainty which was seen to greatly affect the cross-sectional bivariate regression models. A complex iterative model development process is described to enable the modelling of small data sets within a "general to specific" framework.

Models are seen to perform effectively, correctly predicting an outcome in at least two thirds of issues, though individual variables are generally insignificant at conventional levels of significance. Contemporary holdout samples on which to test the models are not used in the analysis, owing to the fact that the data sets are small and thus do not enable division. Holdout samples for preceding or subsequent years are also not used as the factors influencing the marginal capital structure decision are likely to evolve from year to year.

The frequency of employment across the European models, as well as the sign of the logistic coefficients, is used to gauge those determinants important to the marginal funding decision of the firm.

Finance managers appear to examine two key factors when considering raising new external finance: their current capital structure policy and their ability to adjust that policy. Thus, the finance manager considers the current capital structure policy of the firm first, that is, he or she considers the cumulative effect of past marginal funding decisions - the DDE ratio. However, somewhat curiously at first glance, the manager appears to be more likely to issue debt the higher the gearing the firm already has. . Such behaviour may only be rationalised by an optimisation strategy, as the firm may be in a continual state of partial adjustment towards some perceived optimum, possibly targeting the norm of the industry to which the firm belongs.

The ability to adjust the capital structure policy is bounded by three key variables: the fixed assets ratio, interest cover, and liquidity. The finance manager recognises that the more tangible the assets of the firm are, that is, the higher the fixed assets ratio, the higher is the collateral that may be utilised to support borrowing. Thus, the tangibility of the firm's assets, and possibly its future investment projects, affects its ability to engage in higher gearing. "Safer" firms appear to be those with a low gearing policy, and thus the finance managers of such firms with a low risk of financial distress will generally issue equity rather than debt at the margin, to maintain their risk aversion stance. In addition, interest cover appears more consistently important as a marginal issue determinant than dividend cover, probably because the debt interest is regarded by the finance manager as a finance commitment whereas dividends are only a quasi-commitment. This result is reinforced by the apparent indifference of managers to the size of the payout ratio. Thus, the degree of risk aversion and the contractual nature of new claims will influence the finance manager's decision. The manager looks at the wider liquidity of the firm after considering its ability to cover commitments, recognising that the liquidity of the firm determines its debt capacity. Whether considering an issue of debt or negotiation with a bank or other lender over the terms of new long-term borrowing, the finance manager will examine the two key factors described, either using them to decide on potential investor returns or to negotiate a reasonably favourable deal with bankers or lenders.

More generally, the finance managers of healthy firms may decide to issue either debt or equity, depending on the extent of their requirements for external finance. Those firms making relatively large retentions will be able to fund largely internally, but if they decide to supplement this funding externally, they are more likely to issue debt than equity because they have not yet exhausted their debt capacity. Highly profitable firms which require large tranches of external funds may prefer to issue equity rather than debt, as it is likely that such heavy users of external funds may have exhausted their debt capacity and must therefore resort to equity finance. Such results are consistent with the pecking order hypothesis of the existing literature.

With regard to taxation, firms in some European countries appear proactive with respect to their tax-reduction strategies, increasing gearing, at least in part, to drive down their tax bills, whereas firms in other countries are reactive, substantially increasing gearing only in response to relatively high tax bills.

It is possible that the variables which exhibit mixed coefficient signs across models are those which the firm targets individually with regard to industry norms. This certainly might explain the mixed results for variables such as the depreciation ratio and payout ratio.

In summary, then, the finance manager of the European firm examines two key factors before making a marginal finance decision: the current capital structure of the firm and its ability to adjust that capital structure. There is some evidence of finance managers targeting their capital structures of their firms, to some extent, on the norm for the industry to which such firms belong. Regardless of the presence of any industry targeting behaviour, the fact that managers consider such a range of complex factors before making a marginal issue decision implies that managers are choosing optimal capital structures which are specifically optimal to their firms alone. Thus support is provided for the central hypothesis, H1.

5.6 Summary

Chapter 5 represents the transition from naive, indirect testing of corporate capital structure patterns, to a more direct testing of hypothesized relationships by means of econometric models.

The chapter begins by examining the influence of two factors which the existing literature suggests are key determinants of the corporate capital structure. Firstly, evidence from UK firms strongly supports the fact that the finance managers appear to target the capital structures of their firms upon the norm for the industry to which the firm belongs, a result which the existing literature suggests would hold for a wider range of countries, although data limitations restricted a more comprehensive study for European firms. It is argued that such industry targeting represents a bounded optimisation policy by the firm, whereby finance managers match their DDE ratios to the norm for their industry, believing this to be the optimal capital structure for their particular degree of business risk or believing that they are gaining from the more sophisticated information gathering efforts of other firms in their industry. Secondly, at least 30 per cent of European firms, on average, are completely tax exhausted and many other firms are likely to be partially tax exhausted. As the degree of tax exhaustion results directly from the level of non-debt tax shields such as investment allowances that the firm attempts to utilise, and because the value of such allowances varies with the investment strategy of each firm, for example, the effective tax advantage to debt for each individual firm is different and therefore so is the optimal capital structure mix for each firm. Therefore, industry norm targeting and the effect of tax exhaustion may bring about optimal firm-specific capital structure solutions as the former causes firms to engage in bounded optimisation and the latter causes firms to arrive at unique capital structure solutions.

Bivariate regression analysis is employed to specifically test many of the hypotheses arising from the existing literature. Although many of the hypotheses have been tested

Table 12
Cointegration tests for the French weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
LNPLUSEQlag0	2.20/1.80	0.824	1.320	1,9	A	-4.78	-3.5690	R
LNPLUSEQlag1	2.20/1.80	0.559	1.777	2,8	A	-2.822	-3.6443	A

Table 13
Cointegration tests for the French non-weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
HMVEQUITYlag0	1.75	0.824	1.320	1,9	A	-1.479	-3.5690	A
HMVEQUITYlag1	1.99	0.559	1.777	2,8	A	-1.432	-3.6443	A
LNPLUSEQlag0	1.90	0.824	1.320	1,9	A	-1.991	-3.5690	A
LNPLUSEQlag1	2.07/1.93	0.559	1.777	2,8	A	-1.955	-3.6443	A

in the preceding chapter by means of observational analyses of apparent relationships and analyses of variance of corporate finance patterns, bivariate regression analysis enables the tentative results of such initial analyses to be formalised. The most important result arising from the bivariate models is that the stock corporate capital structure measure, the DDE ratio, is often better considered as a determinant itself of other corporate environment factors. The importance of this result derives from the fact that most of the existing literature implicitly assumes the corporate capital structure ratio to be the dependent variable in any bivariate relationship, whereas the new research suggests that it often acts as an independent variable, determining other variables in the analysis. The evidence suggests that changes in the DDE ratio cause changes in bankruptcy risk, dividend yield and liquidity, although corporate gearing is determined by changes in firm profitability. Increases in gearing, then, increase the risk of financial distress, increase the returns required by equity holders to compensate them for the higher gearing, and decrease the liquidity of the firm, whereas increases in profitability appear to reduce gearing. This suggests that the DDE ratio measure is exogenous with respect to many corporate ratios, thus resulting in causal inequality between the variables. This may be because the DDE ratio is a long-run measure which is the result of the cumulative funding adjustments of numerous years and contains components which are adjusted to accommodate long-term funding requirements. It is interesting to note that taxation variables do not prove to be significant in the bivariate modelling exercise, and that the only influences which are consistently significant across European firms are those which suggest a detrimental influence of debt. The main tangible benefit of debt is the tax deductibility of corporate interest payments, whereas the tangible costs of debt finance are numerous. Therefore, either the modelling of taxation is naive in the bivariate regression models or debt is characterised by most European finance managers by the costs rather than the benefits which it imposes.

Multivariate logistic regression modelling introduced two new dimensions to the corporate capital structure modelling of this research. Firstly, a marginal or flow perspective on the capital structure choice of the firm is vital as it is at the margin that the finance manager examines the stock DDE ratio and stock accounting ratios of the firm before making a decision to raise new external funds. Secondly, a multivariate perspective allows consideration not only of the interaction between the capital structure issue decision and each separate influence on that decision, but also enables consideration of the manner in which the accounting variables interact to multivariately determine the type of issue as well as some measure of the more and less important variables to the issue decision. The results of the models suggest that the finance manager appears to examine two fey factors when considering raising new external finance: the current capital structure policy of the firm, as measured by the DDE ratio, and his or her ability to adjust that policy. The stock of finance claims which the firm has is the most important influence upon the marginal decision, although highly geared firms are not necessarily more likely to issue equity rather than debt at the margin. Such a result may arise as firms are continually in a state of partial adjustment towards an industry norm target capital structure, rather than seeking to limit the risk of financial distress by issuing relatively more equity when gearing is high. The finance manager's ability to adjust the firm's capital structure is bounded or limited by three factors: the fixed assets ratio, interest cover, and liquidity. Firms will find that they are more able to expand gearing if the firm's fixed assets ratio and liquidity are relatively high, as the former represents collateral to potential lenders and the latter is a measure of the firm's debt capacity. However, "safer" firms which can easily cover debt servicing commitments somewhat surprisingly do not appear to be those firms which are more willing to increase gearing, but instead appear to be risk averse and wish to maintain low gearing as an implicit part of their financial strategy. Therefore, the finance managers of European firms monitor the two key factors discussed before making a decision to issue new external financial securities, whilst considering the effect of a new issue decision upon the risk aversion stance and targeting policy that the firm maintains.

Measures of the relative extent of taxation liabilities do not appear to influence the firm's marginal capital structure choice to any great extent, and additionally firms in certain countries appear more proactive in their tax reduction strategies than firms in other countries. Again, either taxation is less important as an influence on the corporate capital structure decision of the firm or the taxation measures modelled are too naive to adequately represent the influence of taxation.

The apparent inconsistency of variable coefficients in the logistic regression models across countries may be the result of accounting ratio targeting which occurs in addition to capital structure targeting ratio behaviour, as firms target such ratios upon the norms for the industry to which they belong. Thus, targeting behaviour may be wider than capital structure targeting alone, as firms seek to set their ratios to be consistent with other firms in the industry to which they belong, targeting in an attempt, perhaps, to emulate the behaviour of the larger of more successful firms in the industry.

It is noted that whether the cross-sectional or marginal perspective is modelled, similar influences upon the corporate capital structure of the European firm emerge. Both the stock DDE ratio and the marginal issue decision appear to be significantly related to measures which describe the firm's ability to support debt. The ability to support debt may be measured in terms of the risk of financial distress, liquidity, interest cover, asset tangibility, and so on. However, although such factors are significantly related to the DDE ratio and the marginal issue choice, the causation between the separate measures and the capital structure measures may differ between the cross-sectional and marginal models. In the cross-sectional models, the DDE ratio is a determinant itself of the "ability to support debt" factors, whereas in the marginal models the "ability to support debt" factors actually determine the issue decision. This causation reversal is induced by the twelve month lag introduced to the marginal models to help address the causation problem, as it is based upon the conventional wisdom that "the future cannot cause the past". Therefore, by means of the introduction of a short lag to help resolve causation uncertainty, it is observed that causation may work in either direction and it may be inferred, then, that circular causation exists within the corporate environment. Such an inference is fairly intuitive, as, for example, increases in liquidity increase the ability to support greater debt, and if the firm increases gearing as a result then liquidity is decreased due to the increased principal and interest payments of debt. The former relationship is positive whereas the latter is negative, but both co-exist within the corporate environment, even though at a particular moment in time the firm may only perceive half of the circular flow. For example, at the margin, the finance manager may only perceive the increased liquidity of the firm and decide to issue debt to fund new investment as a result, and if the investment is successful and yields an increased cash flow then the second half of the circular flow does not cause a problem and is therefore not perceived by the manager.

An alternative perspective on causation is that the stock DDE ratio is a determinant of other corporate factors at the cross-section because it is a large stock measure which dwarfs flow measures such as liquidity, whereas, at the margin, measures such as liquidity may be regarded more as stock measures than a pure marginal capital structure flow of debt or equity, and are more likely to be of a similar order of magnitude to such funding flows.

Therefore, causation introduces a new degree of complexity into consideration of the corporate capital structure environment of the European firm, as the corporate capital structure decision is made after consideration of all or part of the circular flow of causation, bearing in mind the magnitudes and stock or flow natures of the variables under consideration. The issue of causation is more formally tested in chapter 6.

Therefore, the European firm appears to make its capital structure choice after consideration of its ability to support new debt and the influence that the new debt will have, in turn, upon other corporate factors. There appears to be a circular flow of corporate factors such that the stock and flow capital structure measures are merely part of the circle and may only be isolated as dependents or independents in certain perspectives. Finance managers may target certain accounting ratios, in addition to the capital structure ratio, upon the norms for the industry to which the firm belongs. Industry capital structure targeting may be considered "bounded" optimisation and the strong influence of corporate tax exhaustion must produce unique capital structure solutions. These phenomena in conjunction with the partial adjustment capital structure behaviour of the firm all point towards unique optimal capital structure solutions at the level of the individual European firm.

CHAPTER 6

AN INTRODUCTION TO THE TIME SERIES ANALYSIS OF THE CORPORATE CAPITAL STRUCTURE

6.1 Introduction

6.1.1 The time series perspective

The analyses so far have identified some of the more important situations where the DDE ratio may be determined by, or itself determines, key corporate and taxation variables. However, in the preceding chapters, hypothesis testing and modelling have been restricted to the cross-sectional and marginal perspectives, from which little may be inferred about the determination (and influence) of the European corporate capital structure through time. Static and marginal analyses enable examination of the capital structure environment at a particular moment in time, but are not able to examine the short-term and long-term processes of capital structure determination which may be more important, particularly with respect to their influence upon the corporate capital structure strategy of the firm. Time series analysis is therefore essential to a greater understanding of the strategic determination of the European corporate capital structure.

At a particular point in time, it may be that only a disequilibrium capital structure relationship may be observed. Whilst analyses of a static nature contribute to a greater understanding of the operational capital structure decisions of the firm, they reveal nothing about the long-run equilibrium relationships between a measure of the capital structure and variables related to it. Thus, up to this point, analyses have not been able to distinguish between a capital structure relationship which is in equilibrium and one which is in disequilibrium. The time series analyses enable long-run equilibrium relationships to be identified and examined, in addition to the extent to which capital structure relationships may be in a state of disequilibrium at a point in time.

The introduction of time series analysis, which comprises a number of modern and fairly complex techniques, allows short-run and long-run time series perspectives to be considered, in addition to the average (cross-sectional) and marginal perspectives already considered. Indeed, within a time series relationship, short-run and long-run processes often co-exist. Separation of the processes would aid a clearer examination of their exact nature. Probably the only method currently available to enable the examination of both processes within a single relationship is known as cointegration analysis. The short-run processes studied may correspond to a state of disequilibrium of the capital structure ratio with respect to the factors which influence it, whereas the long-run processes in a cointegrating relationship correspond to a state of equilibrium of the capital structure ratio with respect to the factors which influence it. In addition to enabling the consideration of the state of equilibrium of the capital structure ratio within a time series relationship, cointegration analysis is extremely important in modern econometric analysis as the statistical properties of regression analyses using non-stationary time series are dubious (Phillips, 1986). The concepts of integration and cointegration are discussed in some detail in the relevant sections of this chapter, and thus, at this stage it is sufficient to argue that time series analyses which are not conducted within a cointegration analysis methodology are highly questionable as many of them ignore the distinction between the equilibrium and disequilibrium states of the variables modelled.

6.1.2 The data

The data set analysed throughout the time series research of chapters 6, 7 and 8 is data set 3, which consists of corporate, taxation, and macro economic annual time series data over the period November 1968 to November 1993. The UK samples consist of up to 314 firms over the period 1968-93, the Dutch samples consist of up to 56 firms over the period 1978-92, the German samples consist of up to 204 firms over the period 1981-92, and the French samples consist of up to 354 firms over the period 1983-92. The data set may be subdivided, then, into eight samples, as there are two samples for each of the four countries studied: one which represents weighted data and the other which represents non-weighted data. The distribution of firm size within the European time series data sets is explored in detail in section 6.1.5.

Each country sample contains corporate, taxation and macro economic variables. Appendix C defines each of the variables. Variable definitions vary across countries although the variables chosen are believed to achieve the greatest consistency possible across countries, given the constraints of data availability. All of the data used are drawn from the Datastream financial database. The following corporate environment variables are defined is chapter 5: the DDE ratio (DDERATIO), dividend cover (DIVCOVER), interest cover (INTCOVER), the return on capital employed (ROCE), the total tax ratio (TAXRATIO), and the working capital ratio (WCRATIO). Total assets (ASSETS) is employed as a proxy for firm size. Therefore, many of the variables found to be important to the models of chapter 5 are also studied in the time series analyses.

A number of new taxation measures are introduced: the corporation tax ratio, the corporate tax rate, the basic rate of income tax, and the tax advantage to debt, although such measures may only be computed for selected countries in the study. The corporation tax ratio (CTAXRATIO) is a measure of the relative corporate tax liability of the firm. The corporate tax rate (CTRATE) and basic rate of income tax (INCTAX) are self explanatory measures, and are macro economic rather than corporate variables. The tax advantage to debt (TAXADV) variable is an estimate of the tax advantage to debt, computed by substituting the above tax rates into naive tax advantage to debt models. Thus, it is anticipated that the tax advantage to debt measure should be a significant determinant of the DDE ratio across European countries as its computation is based upon a theoretical model of the tax incentives to debt in a particular country. The relative tax bill variable, the corporation tax ratio, is included in the analysis as it may be the only taxation variable which non-sophisticated firms perceive and understand, and thus may impact upon the corporate capital structure decision. The tax rates are included as a means of computing the tax advantage to debt and because the corporate tax rate is highly correlated with any tax advantage to debt.

Other macro economic variables include: short-medium, and long-term interest rates, stock market indices, inflation indices, aggregate investment, and aggregate output. The short-term (SRINT), medium-term (MRINT), and long-term (LRINT) interest rates are used to determine if a relationship exists between such rates and the stock capital structure measure, and to determine which of the rates exerts an important impact upon the decision to adjust the relative extent of debt in the firm's capital structure. Stock market indices (SMIND) are examined as they are believed to be related to the firms willingness to issue equity. Inflation indices (INFLATE) are modelled as the literature review demonstrated their potential effect upon the external financial instrument choice. Aggregate investment (INVEST) and output (GDP or GNP) are employed to examine any relationship which exists between the corporate funding mix in a country and the performance of the country's economy.

The Q-ratio (QRATIO) is also introduced as a new corporate environment variable. It is introduced to determine whether firms with higher expected future profitability (as defined by the market value of the firm divided by the replacement costs of its capital stock) choose debt rather than equity to fund their investment projects.

Therefore, although the majority of the corporate environment variables modelled are those already examined in chapter 5, chapters 6, 7 and 8 analyse the time series nature of such variables in addition to modelling new taxation, macroeconomic and corporate variables.

6.1.3 Data set restrictions

Unfortunately, the time series data set is fairly restrictive for a number of reasons. Firstly, reasonable length data time-spans are only available for four of the eleven European countries studied in chapters 4 and 5: the UK, the Netherlands, Germany, and France. Secondly, even then, the data time-spans for Germany and France are very short, and even the data sample for the Netherlands may be questioned with respect to its ability to test theoretical models. However, it is argued that a time series analysis, and a cointegration analysis in particular, of European corporate capital structures is justified by the lack of empirical investigation of cointegrating European corporate capital structure relationships within the existing literature, as well as the argument that the empirical investigator must work with the data available, even if the results of the estimated models must be somewhat qualified. Additionally, even though data time-spans may be short for certain samples, each data point of the time-span is generally made up of very many (up to 354) separate firm observations and thus even short data time-spans still implicitly contain very large amounts of information. Samples are not analysed for the majority of European countries merely because many European countries do not contain large numbers of quoted companies.

Therefore, although data set 3 contains only a very restricted data set, the benefits of time series analysis of such data arguably outweigh their shortcomings. It is, however, noted that the results of the estimated models must be qualified to some extent owing to the paucity of data time-spans.

6.1.4 The macroeconomic perspective

The time series analysis also enables macro economic variables to be incorporated into models of European corporate capital structure determination for the first time in this research. Intuitively, macro economic variables are by definition aggregates and thus could not be included in cross-sectional or marginal analyses as the macro economic variable would be the same for each firm. Therefore, to observe the influence of the macroeconomy on the corporate capital structure of the firm requires aggregation of individual firm data and a record of such observations through time. Hence samples consist of either weighted or simple mean data points for each variable for each year. A time series analysis of the corporate capital structure decision, then, enables the statistical nature of the more important macro economic influences to be gauged.

Time series modelling does not require a wide selection of different country corporate data to be analysed because it is the inter-temporal variation rather than the inter-country variation which is being modelled. Therefore, the inclusion of macro economic variables in time series models requires the analysis of data from less countries than for cross-sectional models.

6.1.5 The distribution of firm size within the European time series data sets

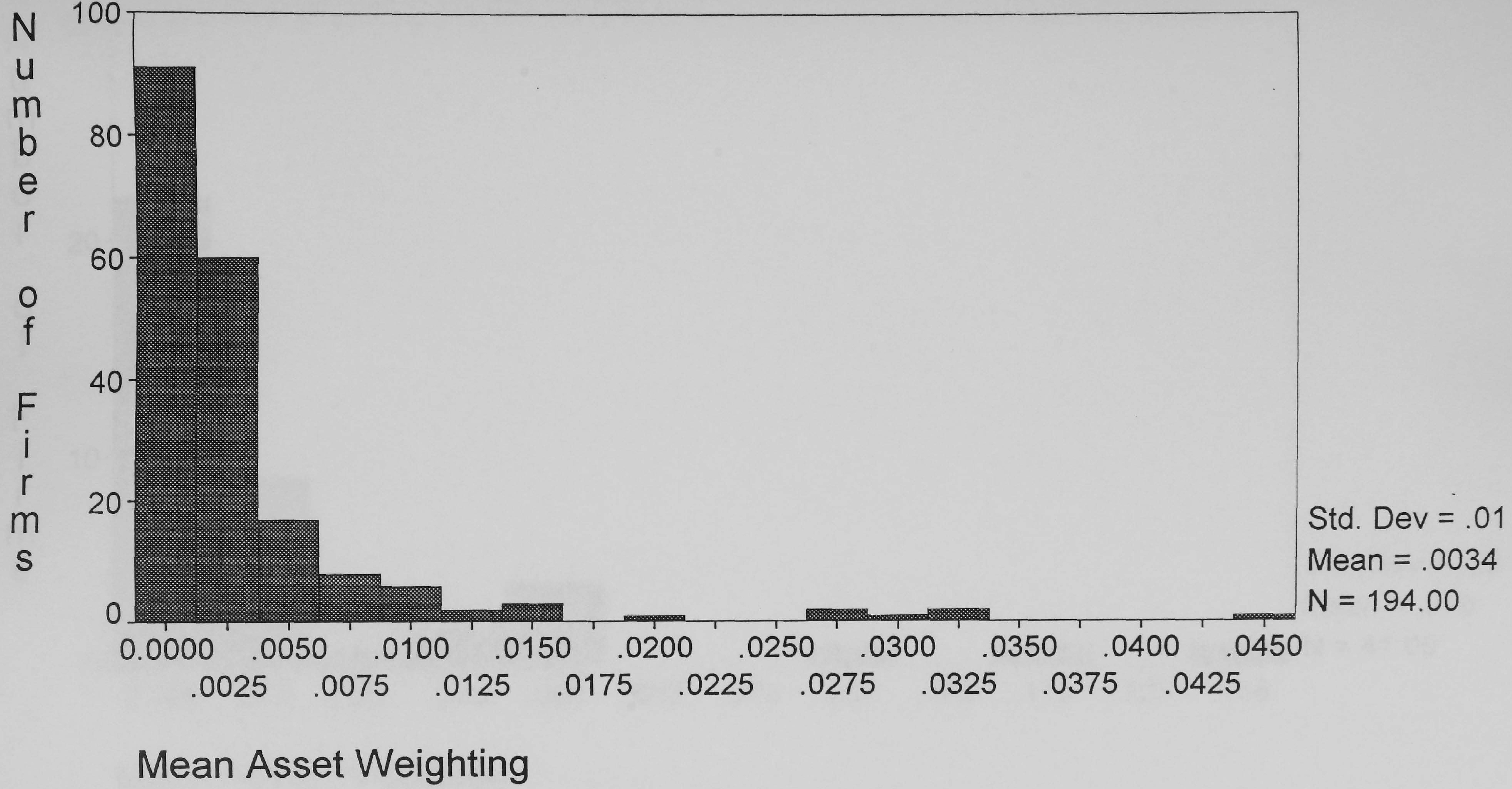
Before conducting any time series analyses, it is necessary to examine the distribution of firm size within each European time series data set. The importance of this exercise stems from the fact that time series analysis necessarily involves the aggregation of firm-specific data before testing and modelling may take place. To examine the distribution of firm size within each European sample, firms are given a weighting to represent the value of the total assets employed by the firm as a proportion of total assets employed in the sample. Thus a weighting of 0.01 would mean that the total assets employed by the firm represent 1/100th of the total assets employed in the sample as a whole. The weighting variables are computed for each firm in each of the four country samples, and then the five year average weighting for the period 1988-92 is computed for each firm. A histogram of these five year average weighting variables is then plotted for each of the four European country samples to show the distribution of firm sizes over the period. The weighting exercise avoids problems related to the measurement of asset values as the weighting variable represents a fraction and thus need not be adjusted for inflation year-on-year. Additionally, firm growth is accounted for as firm size is represented by a proportion of the whole sample total assets employed. The mean asset weighting histograms for the European time series data sets are given in figures 6.1 to 6.4. In the figures, the horizontal axes represent the five year average total assets weighting variable (labelled MEAN5Y) and the vertical axes represent the number of firms.

It is clear that, although the scales on the axes of the figures vary across the samples, the weighting distributions all approximate an exponential decay curve, showing that there are many smaller firms and fewer larger firms within each sample. This is an unsurprising result as it simply reflects the general size distribution of firms in any economy.

As firm size appears to vary significantly across firms within each sample, the sample for each country is expressed in both a weighted and a non-weighted form, whereby in the weighted sample corporate and taxation variables are weighted by the total assets of individual firms, which is a widely used proxy for firm size. The data set thus contains, for each country studied, a weighted sample within which the larger firms are given greater weighting, and a non-weighted sample within which all firms are given the same weighting (and thus the latter sample type gives greater representation to firms which are smaller). It is argued that the weighted samples should represent, to a greater extent, the larger, more sophisticated firms within a country which are likely to be the more established firms with relatively low levels of risk resulting from high reserves and diversification; they should engage in sophisticated capital structure monitoring and adjustment procedures; and they are likely to make more frequent changes to their capital structures due to the economies of issue costs. In some respects the weighted samples represent the "true" average of particular corporate-level aggregated time series variables. Conversely, the non-weighted samples should over-represent smaller, less sophisticated firms which are more risky; may engage in the monitoring only of those variables essential to the operation of the firm; and are less likely to make frequent changes to their capital structures due to the costs of issue. The two sample types within each country, although containing exactly the same firms, enable two distinct types of firm to be distinguished and studied, as it is expected that the two firm types will adjust their capital structures in very different fashions. Indeed, the non-weighted samples highlight the behaviour of smaller firms compared to the weighted samples which are a more accurate representation of the respective economies as a whole.

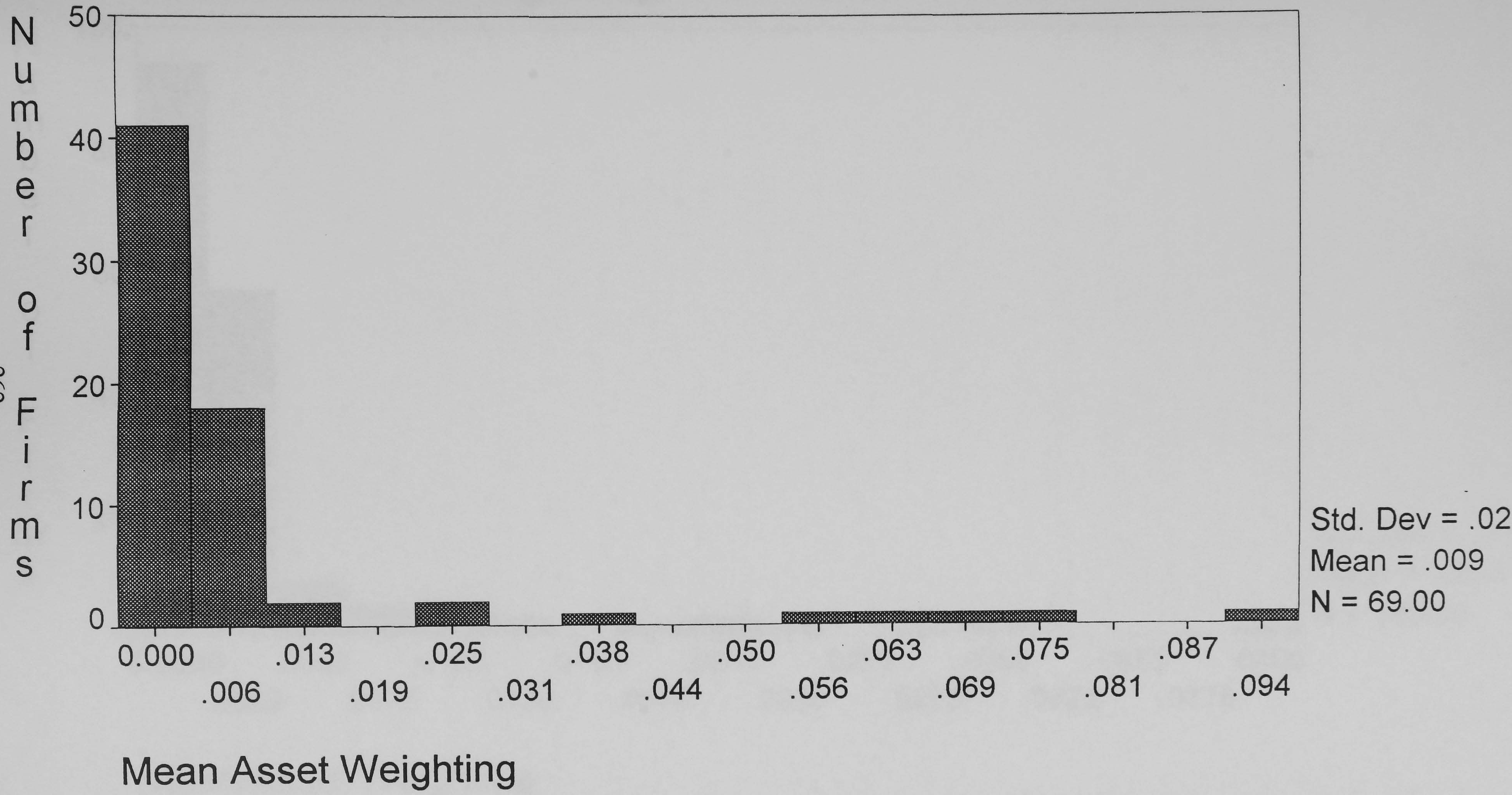
Weighting is used in preference to dividing each sample into smaller and larger firms for a number of reasons, mainly related to the difficulty of the latter compared to the former method. Firstly, it is unclear exactly how to define and distinguish a "larger" from a "smaller" firm, and it is noted that what is defined as a larger firm in one year may become a smaller firm in a later year. The parameters change so radically over time that it is better to compute a relative measure of firm size and to conduct a weighting exercise to represent larger in relation to smaller firms. Secondly, firms within industries, and particularly across industries, grow at different rates so that a firm which is classed as a small firm at the beginning of a sample time series may be classed as a large firm at the end of a sample time series. Dividing the sample into larger and smaller firms would thus be very difficult because of differential growth rates across industries, and firms would have to be divided differently between larger and smaller firm classifications in each year of the sample. Thirdly, the division of firms into larger and smaller classifications would be arbitrary as what is classified as a larger firm in one country sample may be different from what is classified as a larger firm in another country sample. By arbitrarily dividing firms into size groupings, comparability across samples is lost.

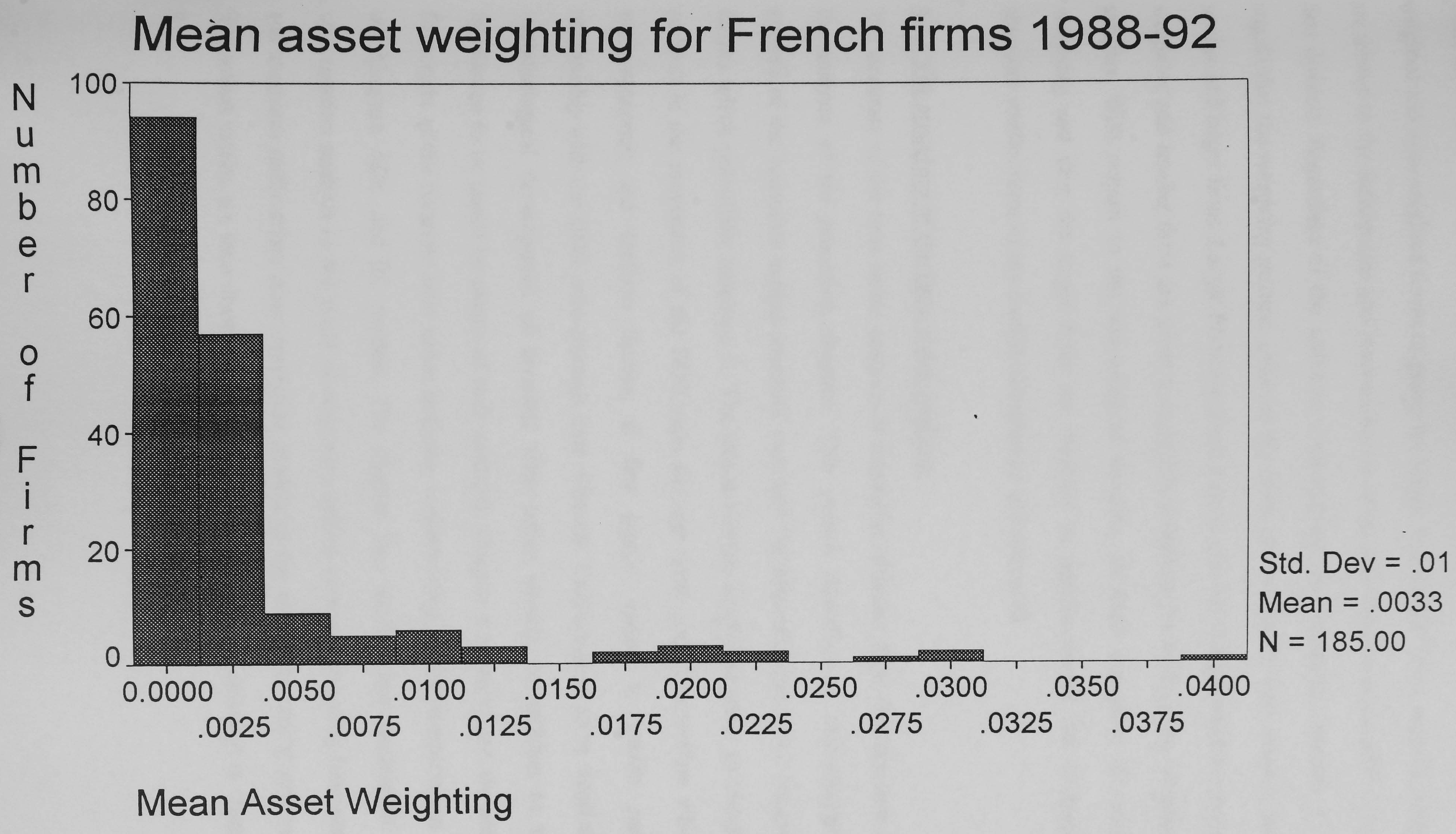
Mean asset weighting for UK firms 1988-92




Mean asset weighting for Dutch firms 1988-92
Number of Firms
30
20
10
0
0.000
.013
.025
.038
.050
.063
.075
.087
.100
.113
.125
.138
Mean Asset Weighting
Std. Dev = .03
Mean = .019
N = 41.00

Mean asset weighting for German firms 1988-92




Mean asset weighting for French firms 1988-92
Number of Firms
100
80
60
40
20
0
0.0000
.0025
.0050
.0075
.0100
.0125
.0150
.0175
.0200
.0225
.0250
.0275
.0300
.0325
.0350
.0375
.0400
Std. Dev = .01
Mean = .0033
N = 185.00
Mean Asset Weighting

Thus, there are a number of reasons why the sample for each country is expressed in weighted and non-weighted forms to proxy for larger and smaller firms, most of which are related to the deficiencies and inconsistencies of the alternative method of firm-by-firm division. Regardless of the rationale underpinning the weighting exercise, it is argued that the weighting method achieves the same end as firm-by-firm division into smaller and larger firms. Larger firms are given a more correct or representative model weighting and smaller firms are given a negligible weighting for each of the weighted samples. With respect to the non-weighted samples, all firms are given the same weighting and thus the larger firms are dwarfed in significance by the relatively abundant smaller firms in any models constructed and estimated.

6.1.6 The structure of the time series analyses

The structure of the time series analyses is somewhat different from the structure of the analyses of the preceding chapters. This chapter describes an inter-temporal analysis of the corporate capital structure ratio and the macroeconomic and taxation factors which potentially influence it. The casual analysis employed seeks to identify patterns in the movement of the DDE ratio through time, and to determine which macroeconomic and taxation factors, at first glance, appear to exhibit some relationship with the DDE ratio through time. Chapter 7 discusses in some detail the methodological development of bivariate time series models, in addition to the hypotheses to be tested by means of such methods. Chapter 8 presents and discusses the results of the bivariate time series analyses, concentrating on the interpretation of the bivariate ADL and EC models. The chapter also extends the application of cointegration analysis to the study of corporate capital structure targeting behaviour, and examines multivariate error correction models of the corporate capital structure. The salient results are then drawn together and discussed in the conclusion in chapter 9.

6.2 An introduction to the inter-temporal analysis of the corporate capital structure ratio

Before conducting econometric time series analyses of the corporate capital structure ratio and its potential determinants, it is useful to plot the time series data to determine patterns in the movement of such data through time. The importance of this casual empiricism lies in the ability to determine: apparent trends in each time series variable, particularly with respect to key macroeconomic and taxation events; similarities and differences in time series between European countries; and apparent relationships between time series within a particular country. As this chapter seeks only to provide an introduction to the wider macroeconomic and taxation environment of the European firm with particular reference to its capital structure decision, the more precise consideration of causal relationships is postponed until later in chapters 7 and 8 when the econometric techniques required to facilitate such consideration are discussed.

There are some important caveats to be made before discussing the various time series data plots: nothing may be inferred about the direction of causation of any relationships which are identified; it is difficult to gauge the extent of deviation of one variable from its apparent relationship with another variable through time; and the plots do not readily enable lag structures to be identified in a relationship between the corporate capital structure ratio and another variable. Such potential shortcomings inherent in a graphical analysis are all addressed in the econometric analyses of chapters 7 and 8.

In section 6.3, the corporate capital structure ratio, the debt-to-debt-plus-equity ratio, is plotted for each of the four European countries studied, and separate plots are produced for the weighted and non-weighted samples. This enables broad trends in the data to be determined and the influence of key macroeconomic and taxation events to be discussed. In section 6.4, the corporate capital structure ratio is plotted in addition to various key macroeconomic time series, again producing separate plots for the weighted and non-weighted samples. The purpose of this is to establish which of the factors may potentially exert some influence on the corporate capital structure ratio through time. In section 6.5, the corporate capital structure ratio is plotted in addition to various taxation factors, again producing plots for the weighted and non-weighted samples, to determine the effect of changes in European fiscal policy. Finally, section 6.6 draws together the results of this casual analysis to provide a general perspective within which the time series econometric analyses to follow may be better interpreted.

6.3 The inter-temporal movement of the European corporate capital structure ratio and key macroeconomic and taxation events which may influence that movement

Figure 6.5 and figure 6.6 give the weighted and non-weighted corporate capital structure ratios for UK, Dutch, German and French firms over the period 1968 to 1993, although only the UK samples span the whole period. There are a number of patterns readily apparent in the data time series.

Firstly, corporate capital structures appear to be converging through time, particularly in the decade approaching 1992. Convergence may be the result of: a gradualist approach to fiscal harmonisation; the greater internationalisation of financial markets which should reduce taxation disparities across European countries; and a general reduction in the reliance on debt finance across Europe in the last decade as a result of reductions in corporate tax rates and therefore the tax advantage to debt.

Secondly, comparing the plots for weighted and non-weighted corporate capital structure ratios, the weighted DDE ratios are generally much higher than the non-weighted DDE ratios. This result appears to lend some support to hypothesis H18, which states that the long-term corporate debt-equity ratio increases with firm size. This is because the weighted DDE ratio sample gives greater weighting to the larger quoted firms in the sample, which have greater access to debt markets than smaller firms due to the fact that they are more diversified, have lower levels of risk and higher reserves, and they benefit more from economies of issue costs. However, other than the differential in the level of debt between larger and smaller firms, the patterns appear at first glance to be very similar for larger and smaller firms within a country.

Thirdly, there are various shocks which appear to influence corporate capital structure across the countries studied. The stock market crash of 1987 affected all of the four markets to some extent, although the German finance market appears to be the least affected. The reaction to the stock market crash is intuitive in that investors apparently withdrew their funds from corporate equity and bought corporate debt instead, causing the DDE ratio to increase sharply after the crash. Thus, the stock market crash caused a reversal of the downward trend in reliance on corporate debt, although there are signs that this may be a mere fluctuation in the longer-term trend, particularly for the UK and Dutch financial markets. The oil crises of 1973-74 and 1978-79 appear to have exerted an important effect on European financial markets, causing firms to rapidly expand debt to fund the supply shock. Such a reaction appears to be only temporary, however, as the proportion of debt to total funds is then reduced in the years following the crises. Re-unification in Germany also appears to have reversed the decline in the use of debt finance, as firms sought new funds for restructuring. The figures show that this effect is most pronounced for the non-weighted sample, which gives greater representation to smaller firms, possibly because such firms have less retentions to draw upon than larger firms. Therefore, financial markets are extremely sensitive to various macroeconomic shocks, and the effects of such shocks may be either temporary or more protracted.

Figure 6.5
European weighted DDE ratios

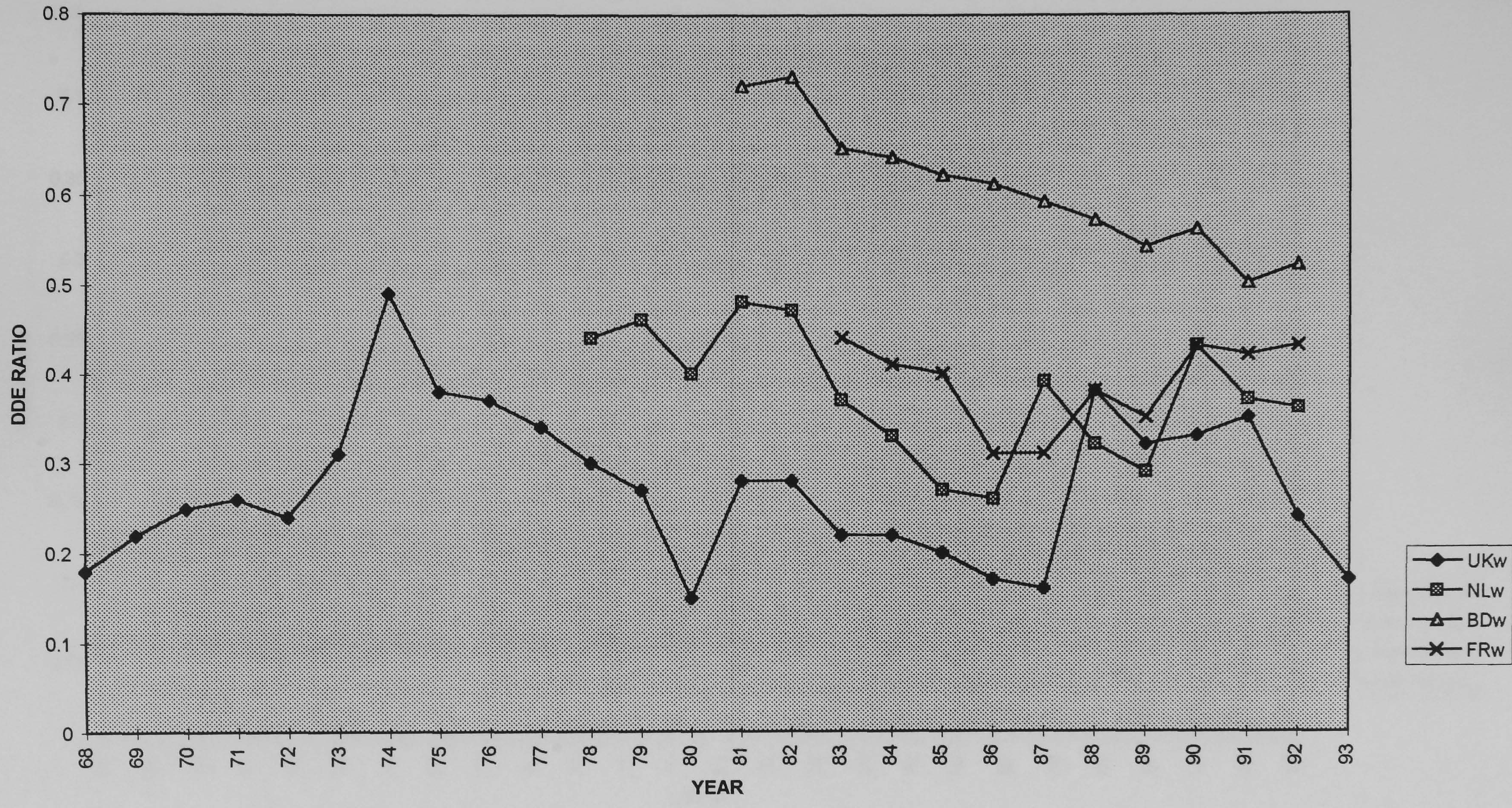
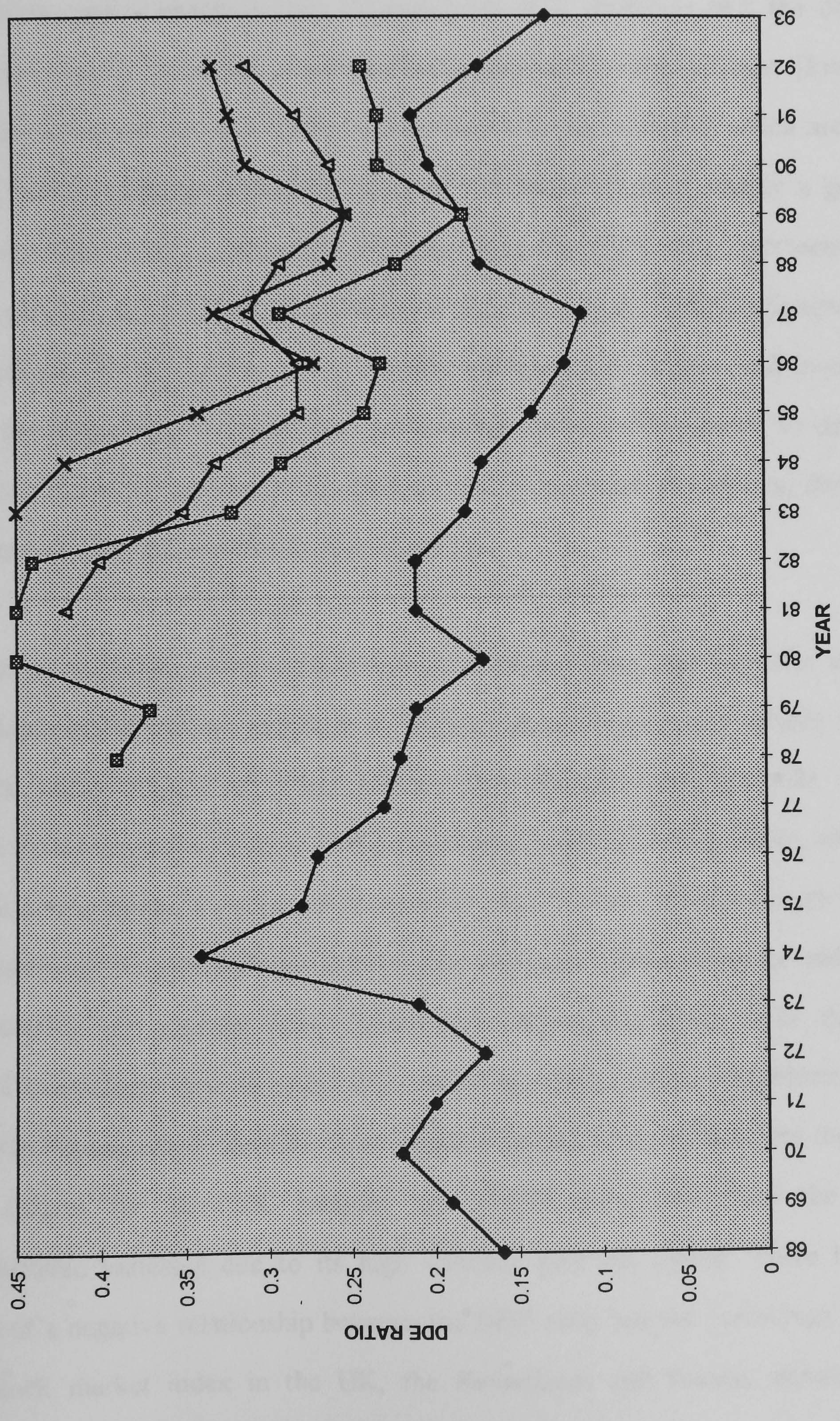


Figure 6.6
European non-weighted DDE ratios



6.4 The inter-temporal movement of the European corporate capital structure ratio and macroeconomic factors which may influence that movement

The literature review of chapter 3 identified a number of important macroeconomic influences upon the corporate capital structure. Before embarking upon complex econometric analyses of the relationship between various macroeconomic variables and the corporate capital structure ratio through time, it is useful to plot the data to provisionally identify where the most significant relationships might occur. However, as the time series are not necessarily transformed into the variables which are later modelled, such a plotting exercise is naive and provides, at best, merely a general perspective within which to frame the later modelling exercises. The macroeconomic variables plotted may be classed as: financial markets factors, inflation factors, and macroeconomic activity factors. Each of these sub-groupings is discussed in turn to describe the relationship deriving from the existing literature hypotheses, to describe the results observed from the figures plotted, and to compare the existing literature hypotheses with the actual prima facie relationships.

The financial markets factors comprise stock market indices and long-run interest rates. Marsh (1982) found evidence to suggest that higher equity prices should encourage equity issues and lower interest rates should encourage debt issues. Evidence from Martin and Scott (1974) supports this result for equity issues, although the result is questioned by evidence from King (1977). Two hypotheses are tested, then, concerning the relationship between the corporate capital structure and stock market indices and interest rates, respectively. Hypothesis H12 states that the corporate debt-equity ratio is negatively related to stock market performance. The relationship between these variables is observed in figures 6.7 to 6.16, where the stock market indices for the UK samples are plotted separately from the other macroeconomic variables due to its high variance over the period. There is clear evidence of a negative relationship between the DDE ratio and the percentage change in the stock market index in the UK, the Netherlands and France, although the relationship is not so clear in the German samples. Therefore, hypothesis H12 is generally supported as firms tend to issue relatively more equity when the stock market is buoyant, thus reducing the DDE ratio and producing a negative relationship. Hypothesis H13 states that the corporate debt-equity ratio increases as debt interest rates decrease. Interestingly, there is some evidence of a positive relationship, thus questioning hypothesis H13. It appears, then, that the DDE ratio of the firm increases as debt interest rates increase. This seems counter intuitive from a supply-side perspective, although intuitive from a demand-side perspective as investors would find debt more attractive when interest rates are higher (particularly when they are set at a higher premium over the underlying rate of inflation). Therefore, overall, financial markets factors appear to be related, at least at first glance, to the DDE ratio through time.

Inflation figures in the existing literature as a key macroeconomic determinant of the corporate capital structure. Authors such as Zwick (1977), Corcoran (1977), Holland and Myers (1977), Rudolph (1978), and Kim and Wu (1988) found evidence of a positive relationship. Most of these authors argued that such a relationship exists because firms perceive borrowing to be more worthwhile at times of higher inflation as they are essentially repaying "cheaper" pounds to investors. However, this argument is questioned if it is assumed that expected inflation is subsumed within the price that investors are willing to pay for corporate bonds. From the perspective of the UK economy, where a large proportion of debt investors are large institutions rather than individuals, it may be argued that such investors are unlikely to be consistently "fooled" by firms in this manner through time, and thus any positive relationship found must be the result of some other unexplained relationship. Hypothesis H10 states that the corporate debt-equity ratio increases with increases in the inflation rate. The price indices in each country are expressed in percentage change terms to enable them to be plotted within the same range as the DDE ratio. There is some evidence of a positive relationship in the UK and Dutch samples, but no relationship is readily observable for the German and French samples. Therefore, there is some weak evidence supporting the hypothesis, weakened perhaps because the relationship may involve lag structures which are difficult to discern from the figures. There may, then, be a weak positive relationship between the DDE ratio and the rate of inflation, but the theoretical underpinning of this relationship is perhaps questionable.

The macroeconomic activity factors examined here comprise gross domestic product (or gross national product for Germany due to data constraints) and gross domestic fixed capital formation. Both measures are transformed into percentage change form to enable them to be plotted on the same scale as the DDE ratio. In the literature reviewed, Rudolph (1978) proposed that as an economy moves from a recession into a recovery period, firms should employ a relatively higher proportion of long-term debt, although he found no evidence to support this proposition. The relative change in the gross domestic product and aggregate investment are good measures of the position of an economy within a particular economic cycle. It may be argued that firms greatly increase their long-term debt financing towards the perceived end of a recession to finance investments to cope with the increased demand associated with eventual recovery. Debt financing may occur at this stage in preference to equity financing as firms may be unwilling to issue equity when equity prices are perceived to be low during a recession. However, it might be argued that all investors have the same information as firms about the nature of recovery and the increased demand which it brings, and therefore debt should not be preferred to equity as the price of both forms of finance should reflect such expectations. The figures suggest that there is generally little observable relationship between the DDE ratio and the percentage change in GDP through time, excepting perhaps the UK weighted sample. However, there is indeed some evidence of the investment variable exhibiting a positive relationship with the DDE ratio, such that an increase in investment precedes an increase in debt by a short lag of one or two years. This may be because firms make a decision to invest their way out of the recession, financing such investment through retentions initially. When retentions become exhausted or greatly depleted, the new investment projects are then financed using corporate debt, in a pecking-order fashion. Therefore, the figures suggest that it is not so much the economic cycle as a whole which determines changes in corporate financing, but the timing of recovery-phase investments which determines such changes.

Overall, financial market factors and the timing of recovery-phase investments appear to be determinants of the corporate capital structure in the four countries studied. The influence of inflation and the economic cycle appear to be weaker. However, this casual/observational approach is somewhat naive as the time series are generally fairly noisy and little account can be made of lag structures and other model components. What may be argued with some degree of certainty is that macroeconomic factors do appear to have some impact upon the corporate capital structure, although the nature of that impact is difficult to gauge without conducting further, more formal empirical analysis.

Figure 6.7
The UK firm weighted DDE ratio and the stock market index

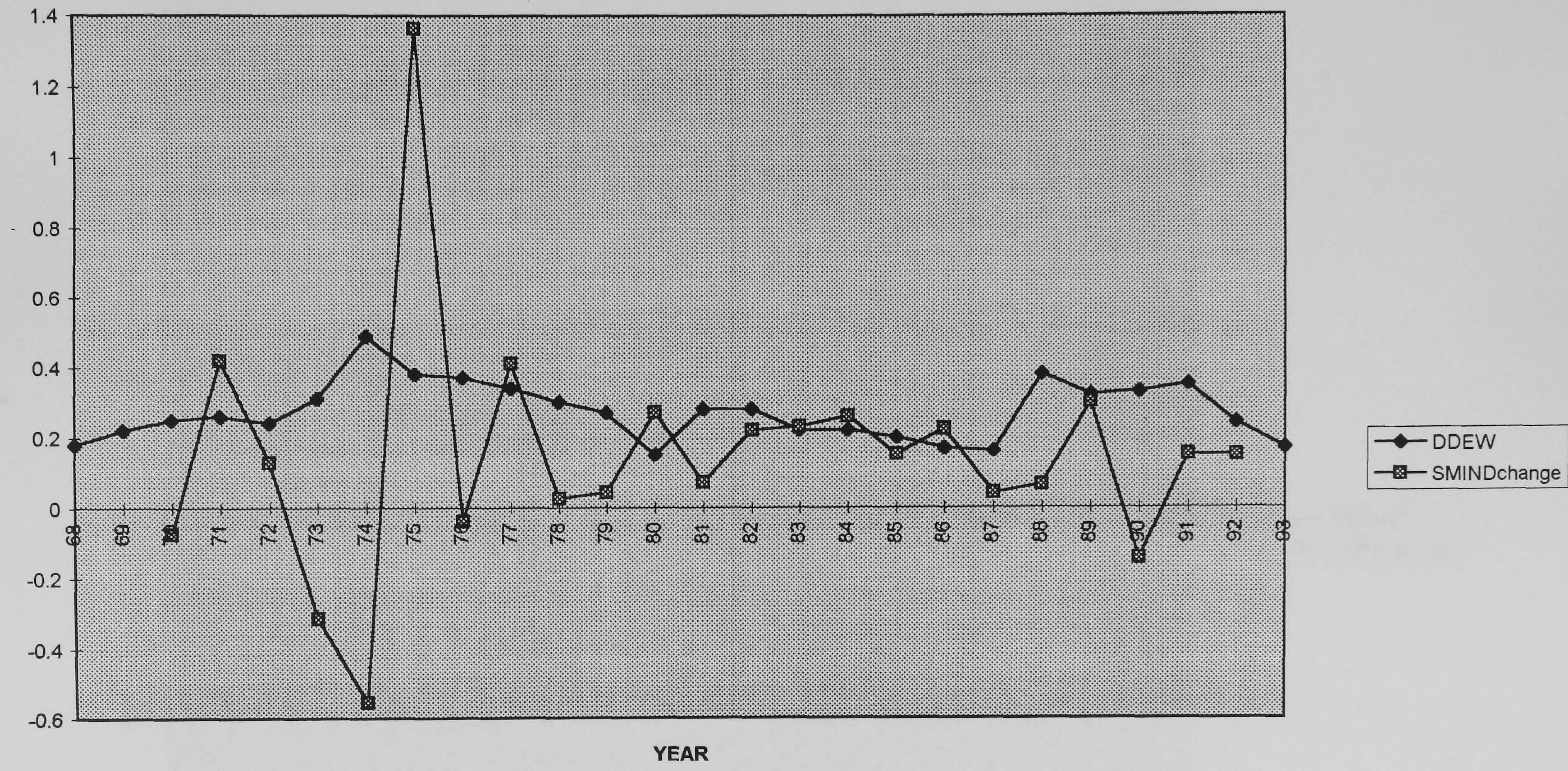


Figure 6.8
The UK firm non-weighted DDE ratio and the stock market index

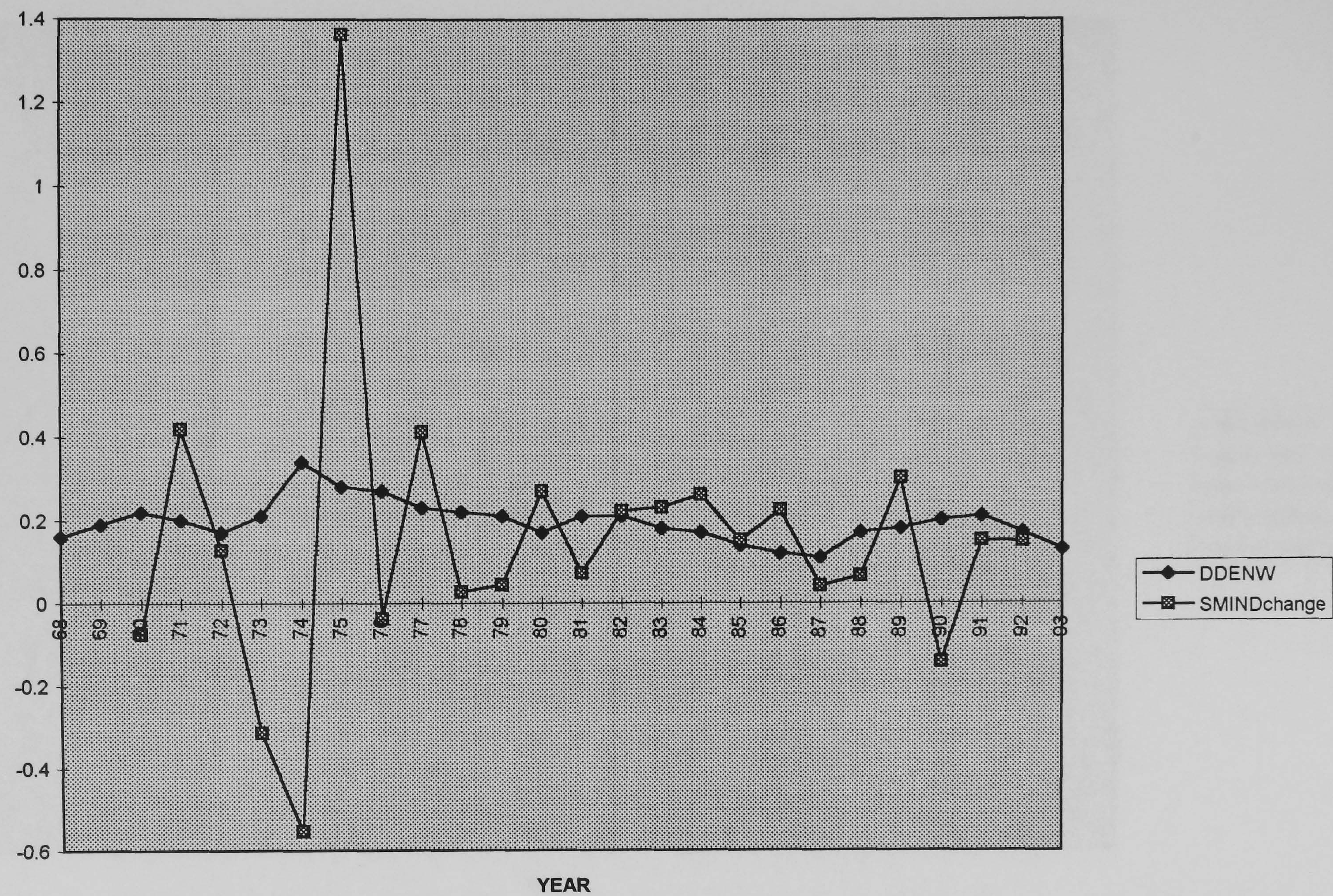


Figure 6.9
The UK firm weighted DDE ratio and macroeconomic factors

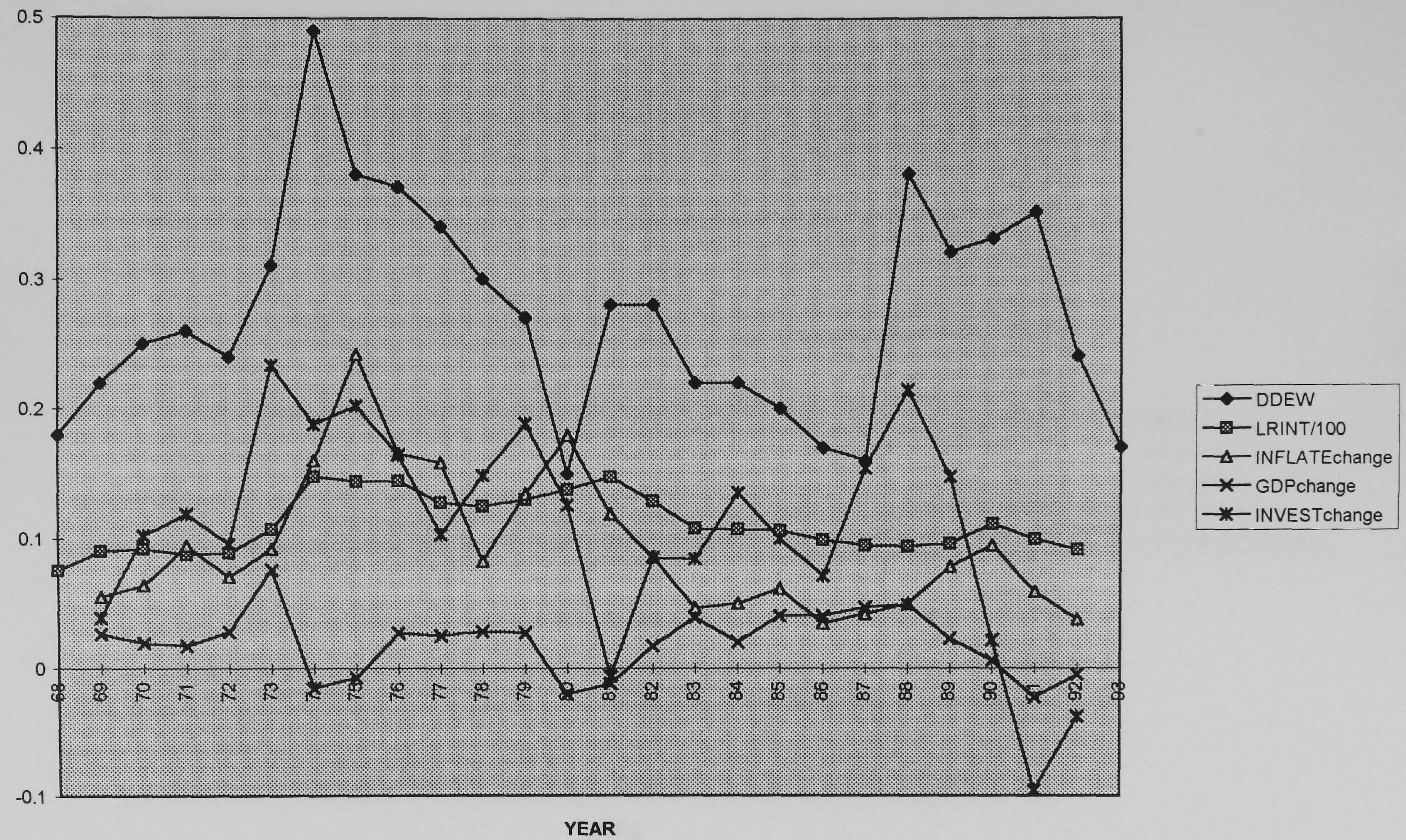


Figure 6.10
The UK firm non-weighted DDE ratio and macroeconomic factors

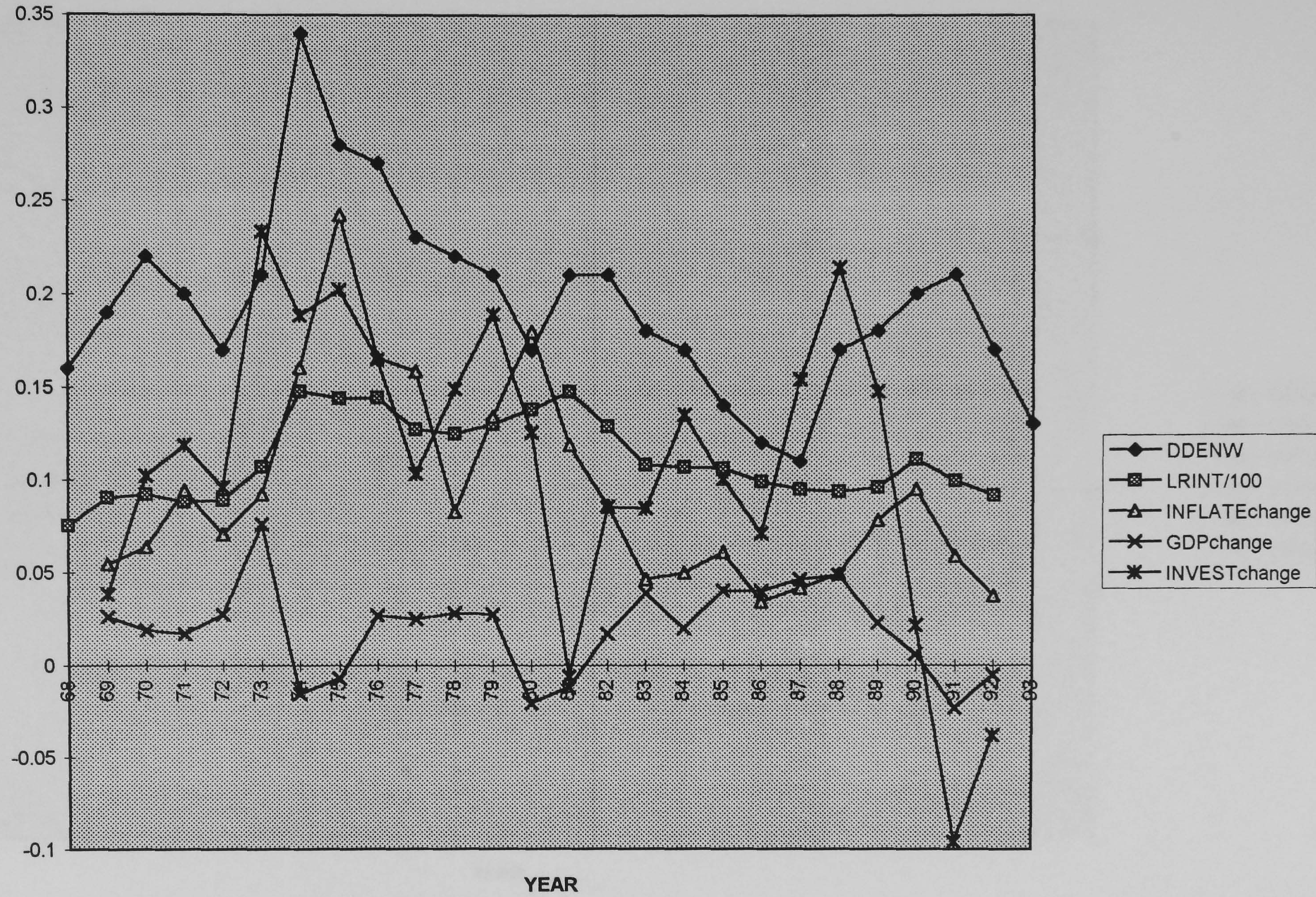


Figure 6.11
The Dutch firm weighted DDE ratio and macroeconomic factors

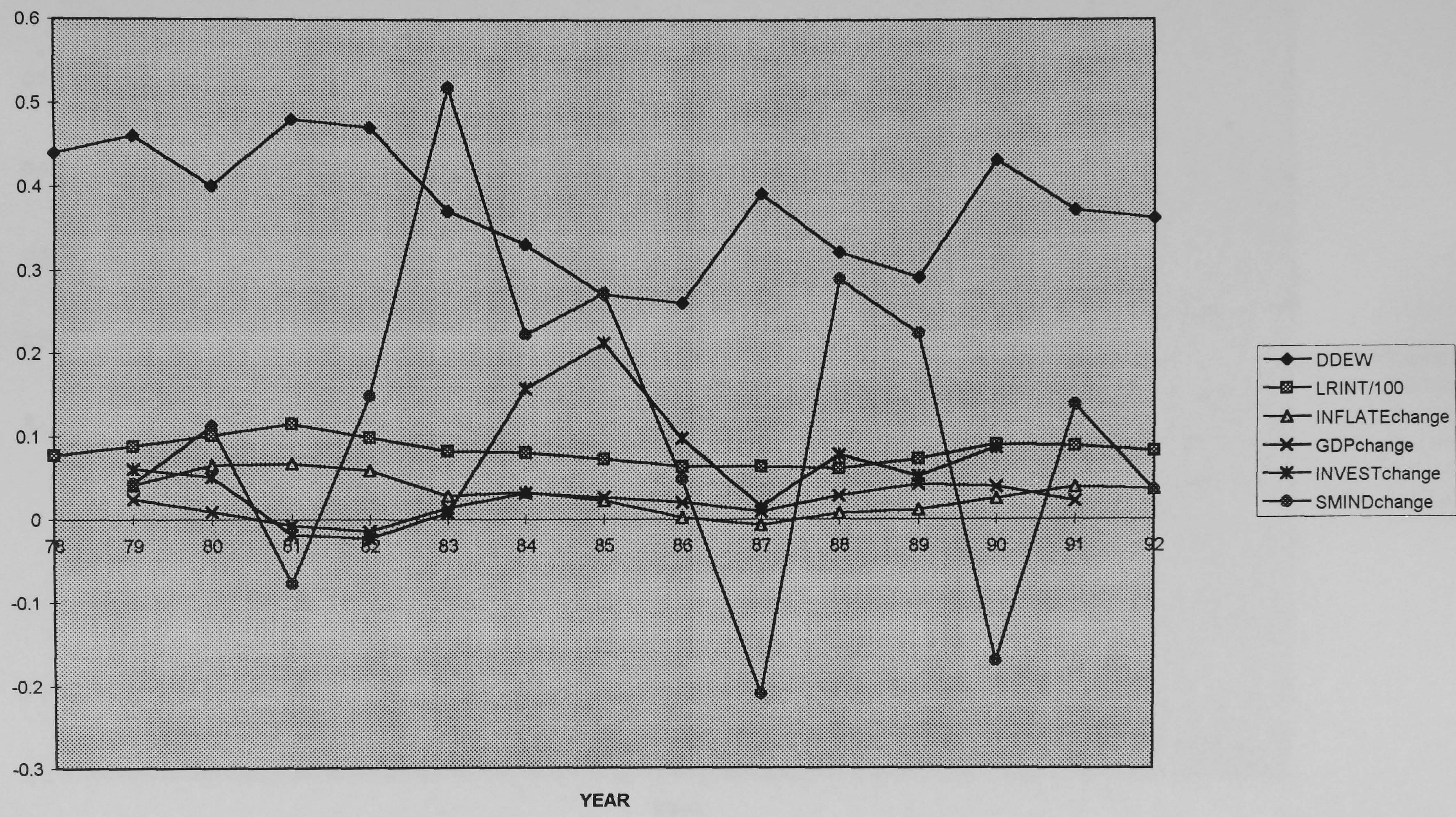


Figure 6.12
The Dutch firm non-weighted DDE ratio and macroeconomic factors

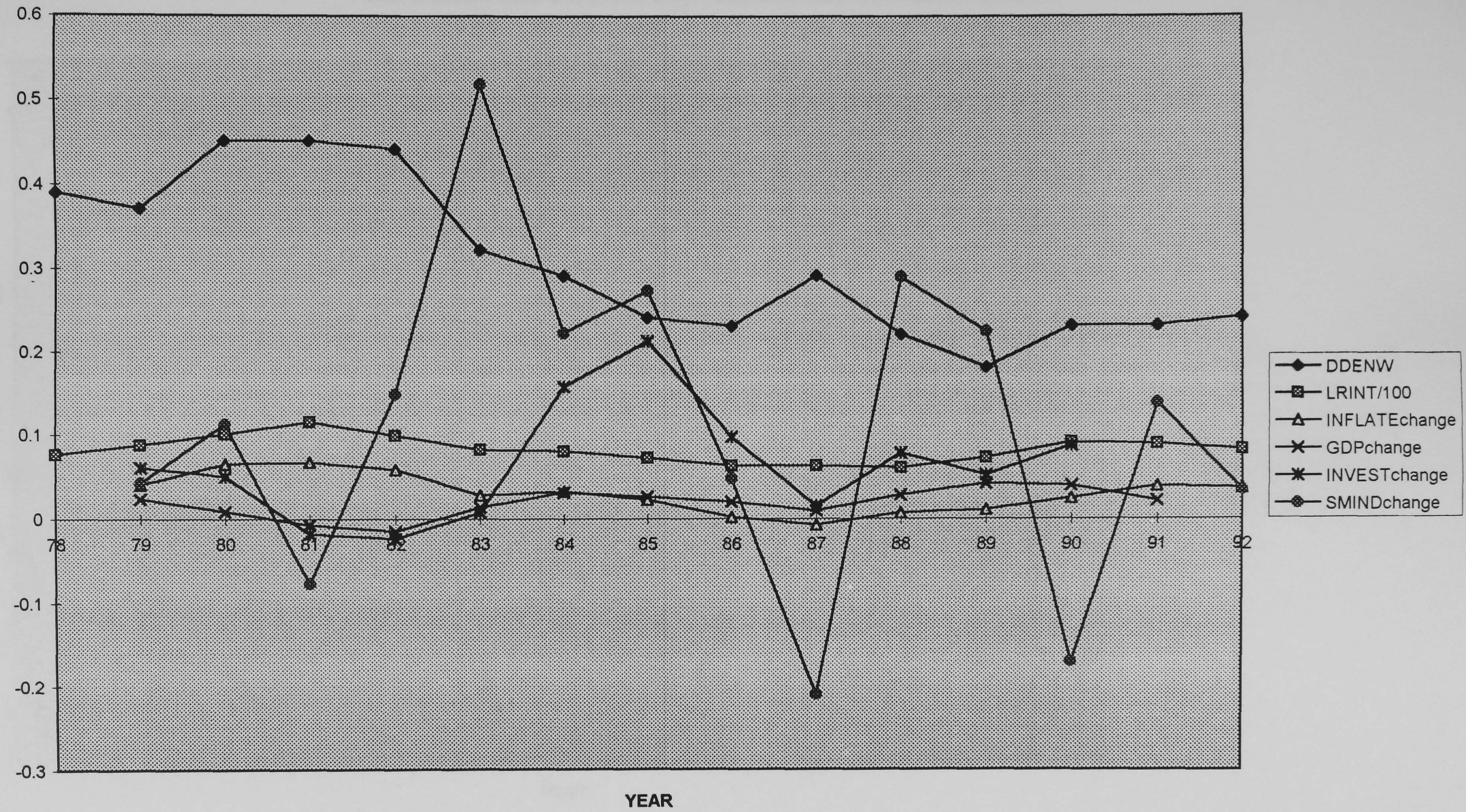


Figure 6.13
The German firm weighted DDE ratio and macroeconomic factors

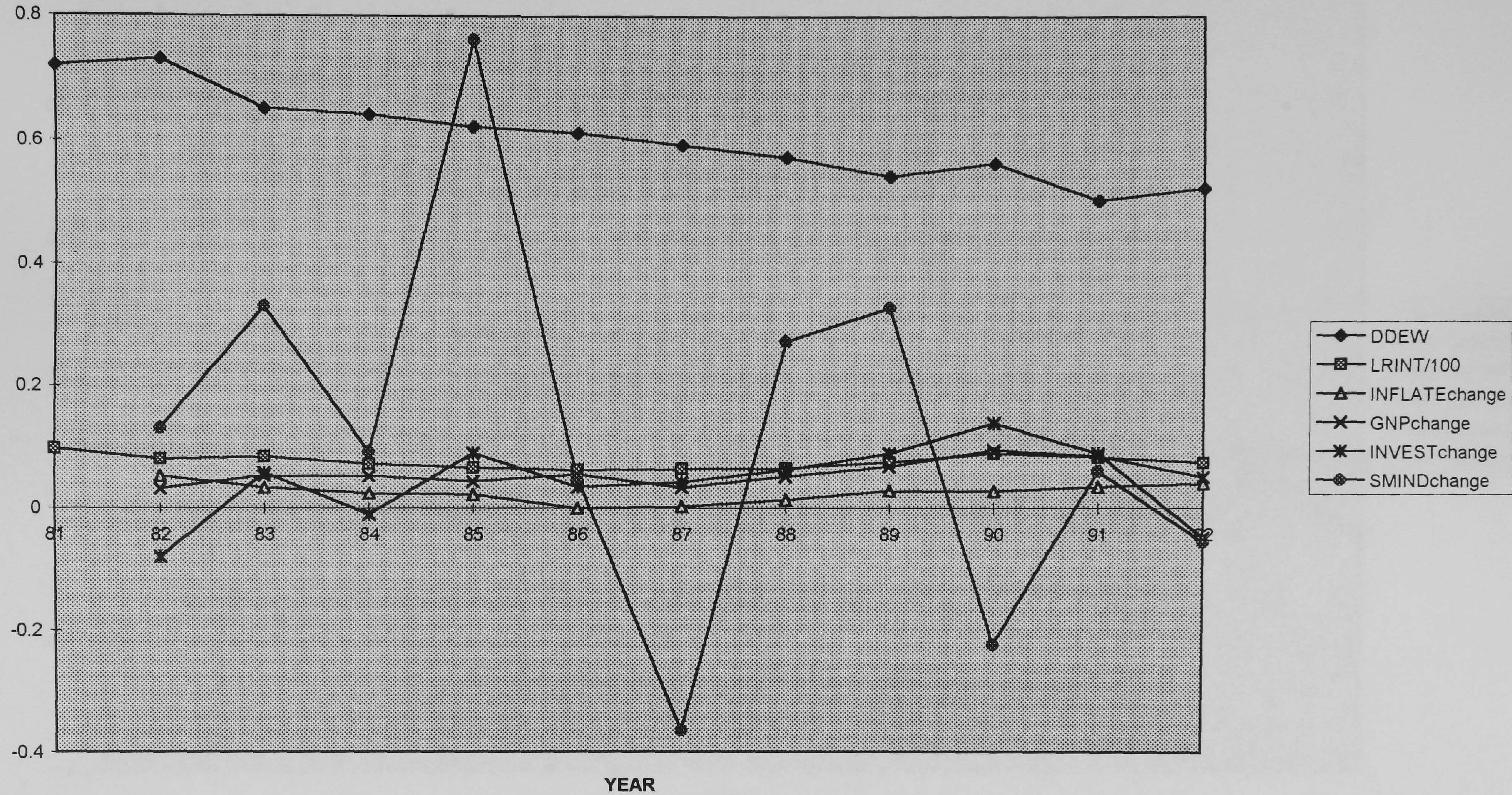


Figure 6.14
The German firm non-weighted DDE ratio and macroeconomic factors

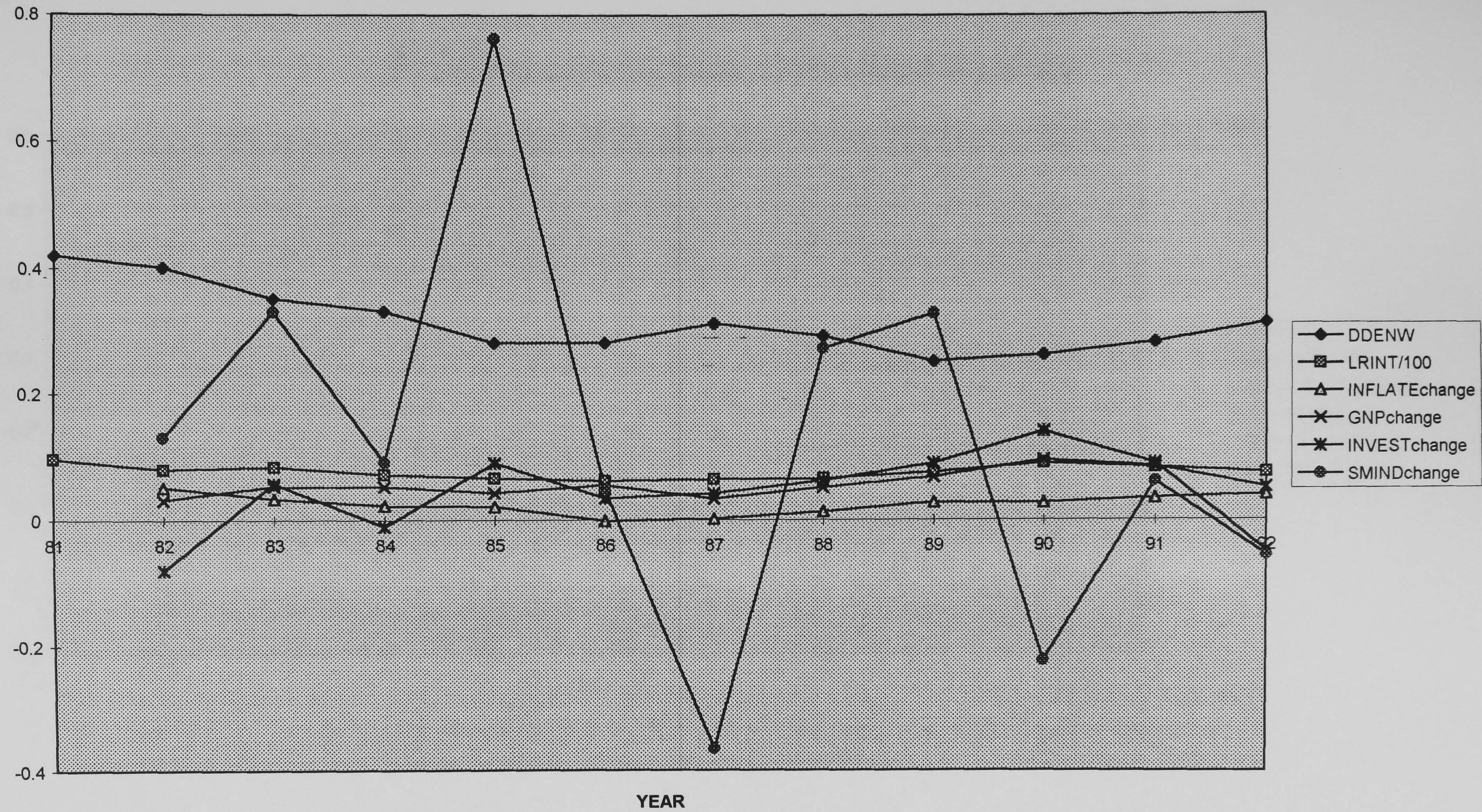


Figure 6.15
The French firm weighted DDE ratio and macroeconomic factors

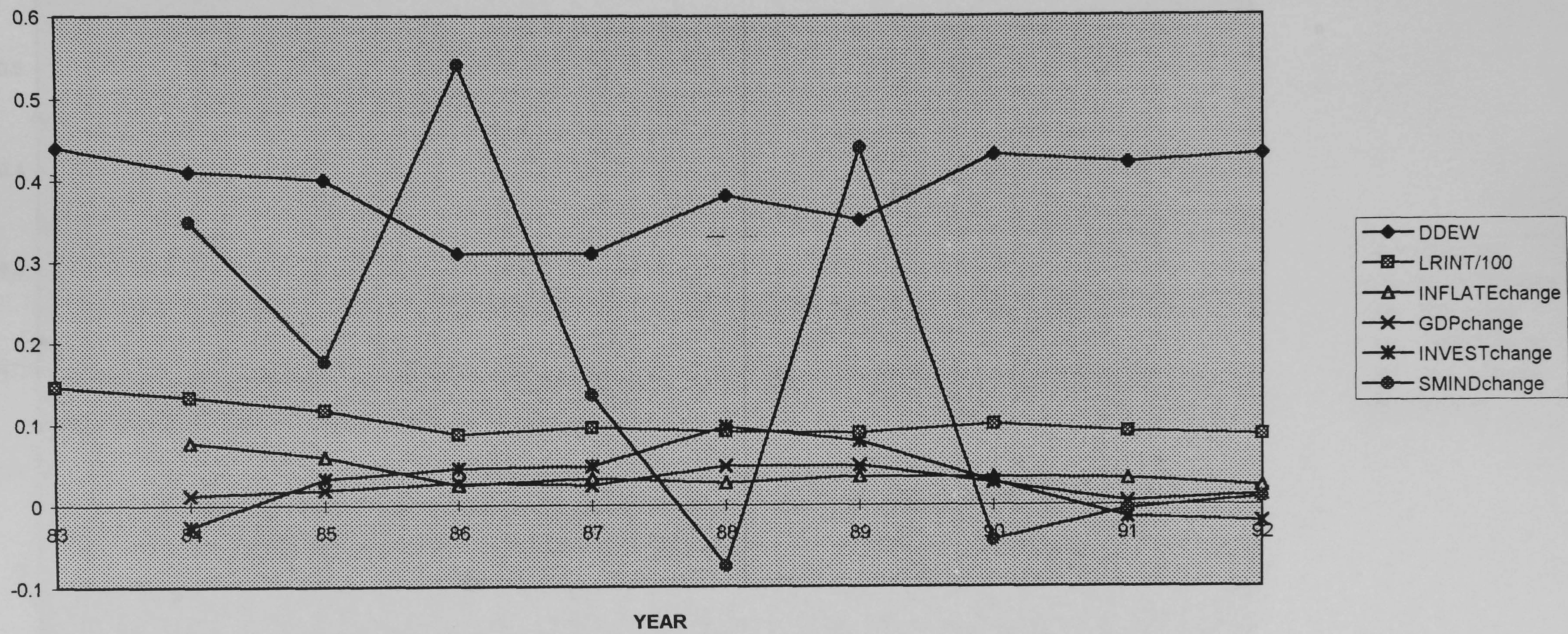
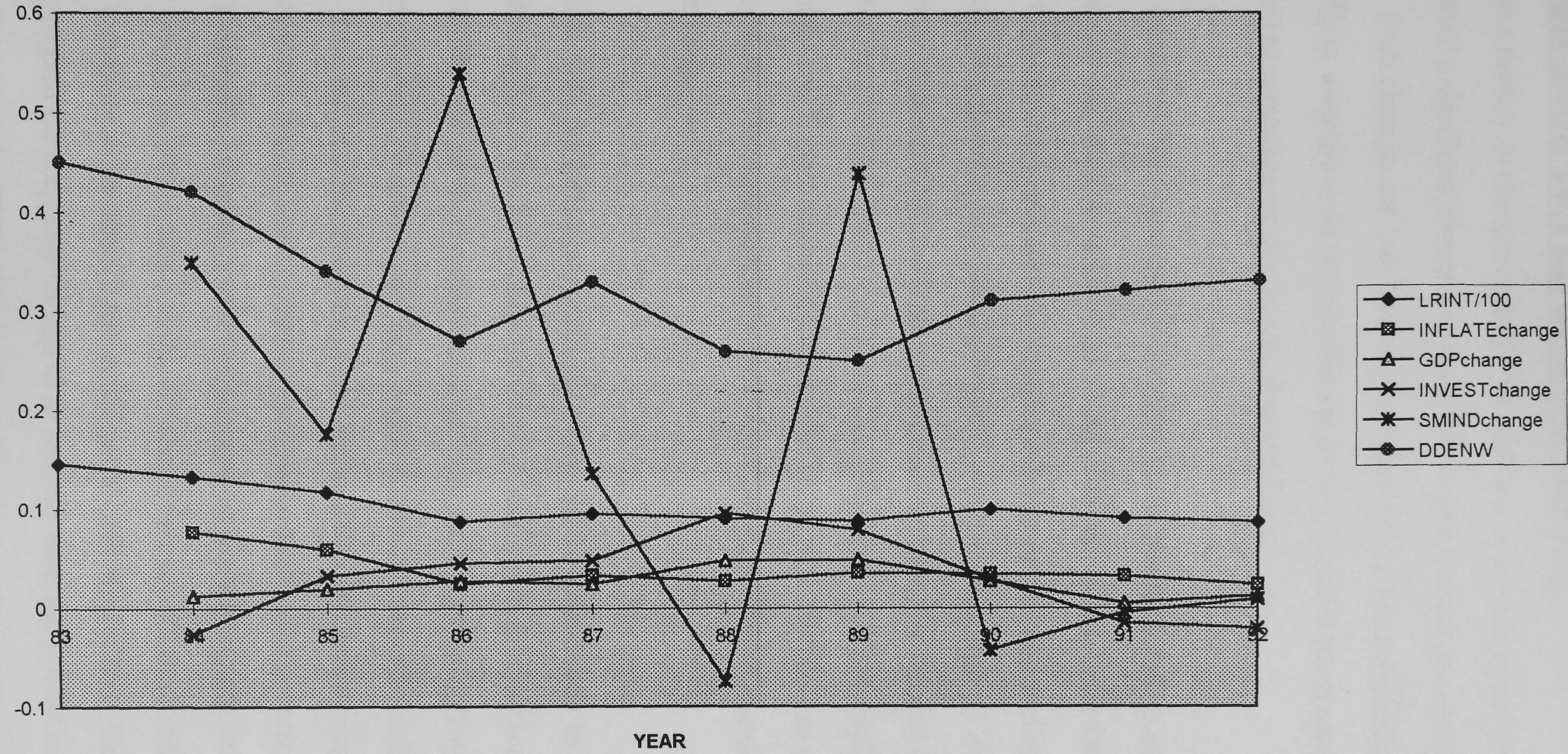


Figure 6.16
The French firm non-weighted DDE ratio and macroeconomic factors



6.5 The inter-temporal movement of the European corporate capital structure ratio and taxation changes which may influence that movement

There have been a number of changes in corporate taxation across European countries which have exerted a significant impact on the corporate capital structure over the last three decades. Such changes are based upon ideological shifts, tax competition and convergence effects, dramatic shifts in corporate tax rates, changes in tax systems, and specific measures to encourage the greater use of equity finance.

Figures 6.17 to 6.22 show the movement of the DDE ratio, the corporate tax rate and the tax advantage to debt in those countries for which such data are available. Data for Germany are not shown as 90 per cent of German firms are not incorporated and are thus not subject to corporate tax, and additionally the tax advantage to debt in Germany is zero through time due to full imputation. The tax advantage to debt is also not presented for the Netherlands, as it is merely the corporate tax rate multiplied by the amount of debt and is thus represented clearly already by the corporate tax rate in figures 6.19 and 6.20. The computation of the tax advantage to debt is discussed in more detail later in chapter 7.

The figures show that corporate tax rates (and thus the tax advantage to debt) generally exhibit an upward trend until the early 1980's, and then exhibit a fairly steady decline thereafter. One of the main explanations for the growth phase of this trend is that public expenditure rose dramatically in response to the oil crises of the 1970's, particularly in response to the significant increases in unemployment during that period. Tax rates had to rise to fund the public expenditure expansion. However, from the early 1980's onwards, economic growth rates began to recover and governments feared that the size of the public sector might be "crowding-out" private investment. Therefore, the reduction in the size of the public sector and the reduced need for higher tax rates enabled the corporate tax rate to be reduced. Running parallel to these developments, there was a general desire across European countries to shift the emphasis from direct towards indirect taxation in the 1980's. Indeed, Briotti (1994) argued that:

> "The fiscal reforms concerning the taxation of corporate income have generally broadened the taxable base thus making it possible to reduce the actual tax rates while maintaining the same tax revenue." (Briotti (1994), p.69)

Thus the broadening of the tax base has facilitated the reduction in European corporate tax rates. As corporate tax rates in the last decade have declined fairly steadily, this impacts upon the value of the tax advantage to debt, which has been radically reduced or even eliminated in countries such as France and the UK in the last few years.

The Ruding Committee Report (1992) argues that the reduction or convergence of corporate tax rates observed across Europe in the 1980's may be the result of tax competition, such that low-tax countries may attract more foreign companies than high-tax countries to limit the erosion of their tax base or even improve it by attracting such foreign direct investment. The consistency of reductions across countries implies that governments are concerned about the detrimental consequences of merely maintaining tax rates and not reducing them, and thus tax competition may indeed be an important factor. The report notes that the standard deviation of tax rates reduced from 7.8 percentage points in 1980 to 6.7 percentage points in 1991, thus providing some evidence of convergence. Therefore, the Europeanisation of finance markets brings with it a steady reduction in the level of the corporate tax rate and thus causes a steady reduction in the tax advantage to debt through time, making equity more attractive.

The Ruding Committee Report shows that corporation tax rates within the Community fell substantially during the 1980's, such that the average tax rate on retained earnings in 1980 was 46 per cent, falling to 40.1 per cent by 1991. This overall trend is observed quite clearly in the figures, where corporate tax rates fell from approximately 50 per cent to 33 per cent over the decade to 1992. As a result, the tax advantage to debt is dramatically reduced or even eliminated, particularly in the UK and France, where the difference between the corporate tax rate and the imputed rate becomes very small or even negative.

Specific tax system changes impact upon the corporate capital structure in addition to changes in the structure of tax rates. Currently, of the four countries studied, the Netherlands operates a classical corporation tax system whereas Germany operates a total imputation system, and France and the UK operate a partial imputation system. The classical tax system essentially taxes dividends twice - at the corporate level and then at the shareholder level, thus discriminating against equity finance in favour of debt. By granting imputation credits, this discrimination is reduced, as seen in the other countries studied. Indeed, in Germany, where there is a full imputation system, the tax advantage to corporate debt with respect to equity is zero. Over the periods studied for each individual country, the only major tax change is that in the UK, whereby the classical tax system was abandoned in favour of an imputation system. The majority of tax system changes occurred in the 1960's and 1970's in other European countries, thus representing periods not covered by the graphs plotted. The switch to the imputation system in the UK should relieve to some extent the double taxation of equity returns, thus reducing the tax advantage to debt. This change is not clearly observable in the figures because it occurred at the same time as the first oil crisis, the rapid growth of public expenditure, and the upward trend in corporate tax rates. Thus, these macroeconomic effects masked the impact of the tax system change. What might have been expected is that firms would employ more equity after the change than before it as equity returns are taxed less. The longer-term trend, however, does support this expected behaviour as DDE ratios have a long-term downward trend due to the increased use of equity finance. Indeed, this downward trend in the DDE ratio is interrupted only in the late 1980's due to the investor response to the 1987 stock market crash, causing a resurgence in the employment of debt finance.

In addition to the general objective across Europe to relieve the double taxation of dividends by switching to imputation tax systems, there have been other specific government actions which have had the effect of explicitly encouraging the use of equity finance. As a matter of ideology, the Conservative government in the UK have sought to promote wider share ownership as a key part of their 1979 election manifesto. They attempted to achieve this by such measures as reducing the stamp duty on transactions and abolishing the income tax surcharge on investment income in 1984 (which corresponds to a sharp decrease in the DDE ratio in figures 6.17 and 6.18) and by promoting the use of personal equity plans to stimulate portfolio investment in 1986. The German tax system now exhibits a more or less zero corporate tax burden on all profit distributions to nationals as a result of full imputation and the lack of capital gains taxes for most private shareholders. However, the main method of encouraging equity finance has been the sharp reduction in the corporate tax rate over the decade to 1992.

The corporate capital structure response to changes in the corporate tax rate and thus the tax advantage to debt is observed in the figures of the samples studied. Hypothesis H8 states that the corporate debt-equity ratio increases with the corporate tax rate. There is some evidence of a positive relationship in the UK and Dutch samples, although the relationship is less clear in the French samples. Thus, there is some evidence to support hypothesis H8. Hypothesis H6 states that the corporate debt-equity ratio increases as the tax advantage to debt increases. Again, there is some evidence of a positive relationship for the UK samples, but the relationship is less clear for the French samples, where the relationship even appears at times to be negative. Thus, only weak support is given to hypothesis H6 on the basis of this casual empiricism. Overall, there is only some fairly weak evidence of a positive relationship between the DDE ratio and the corporate tax rate or the tax advantage to debt, although such a casual analysis does not enable the lag structures which may be important characteristics of bivariate taxation relationships to be adequately accounted for.

In summary, perhaps the most important taxation events in the last few decades have been the switch to imputation systems in the majority of European countries in the 1960's and 1970's and the dramatic reduction in corporate tax rates in the last decade. Such events have been grounded in the desire to reduce the size of the public sector, to achieve convergence (or increase tax competition), to reduce the tax distinction between debt and equity finance, and to promote wider share ownership. Most of these objectives have had the effect of greatly reducing or even eliminating any tax advantage to debt and thus reducing debt finance as a proportion of total corporate finance over the last decade. The only interruption to this longer-term trend was the stock market crash of 1987 which encouraged some resurgence in the popularity of debt finance. Although there is likely to be a positive relationship between the corporate DDE ratio and taxation variables such as the corporate tax rate and the tax advantage to debt, such relationships are not clearly ascertainable from the casual analysis undertaken.

Figure 6.17
The UK firm weighted DDE ratio and taxation factors

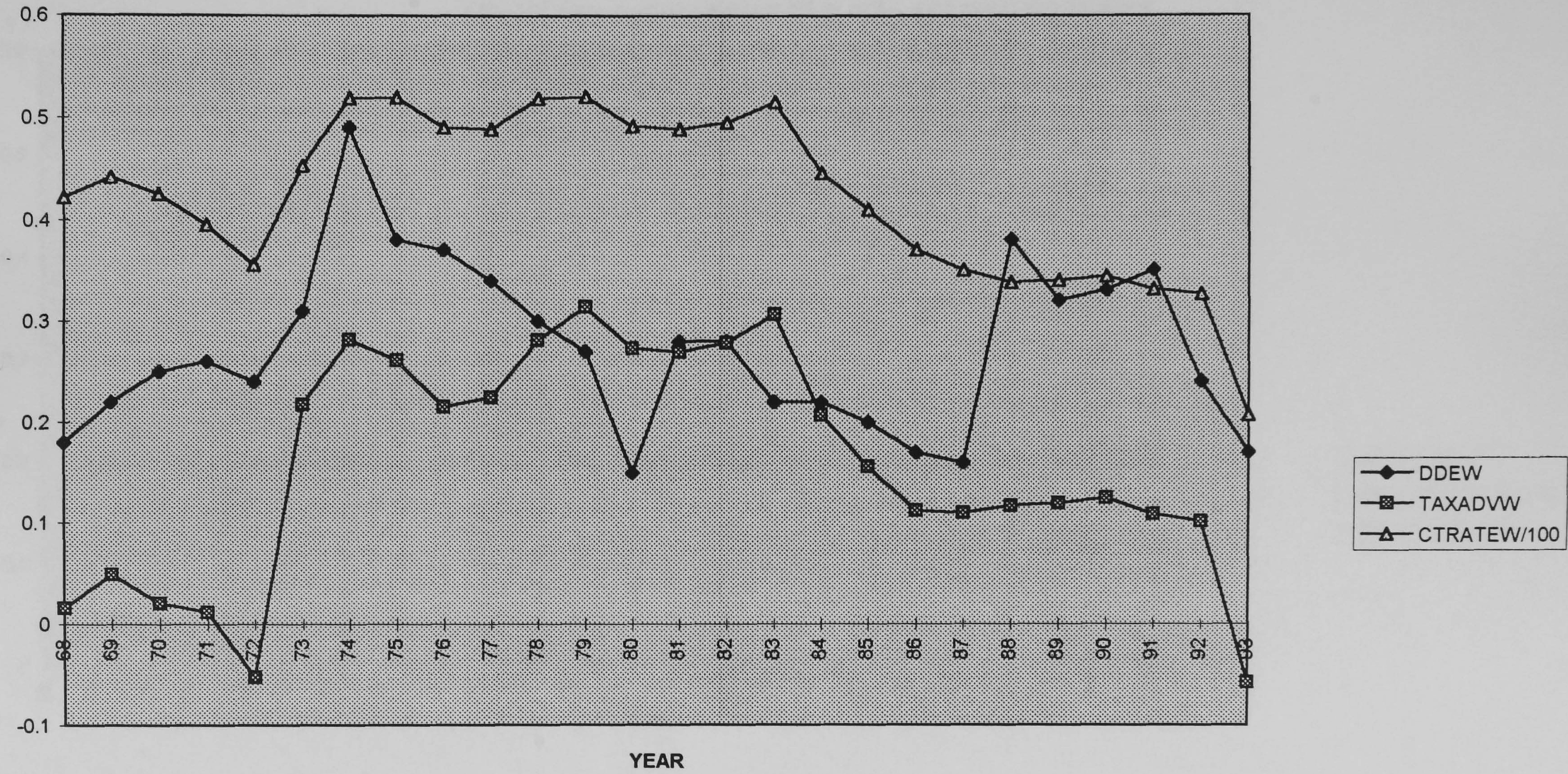


Figure 6.18
The UK firm non-weighted DDE ratio and taxation factors

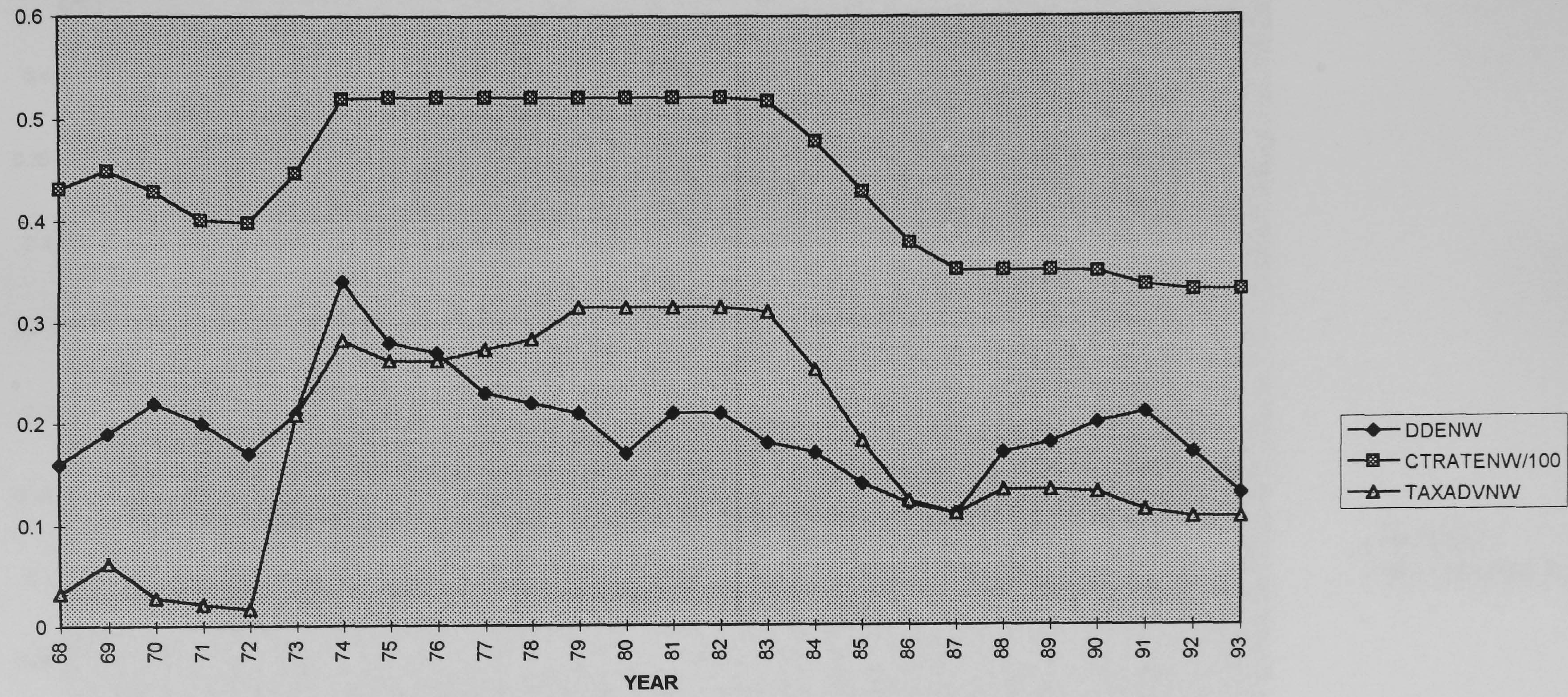


Figure 6.19
The Dutch firm weighted DDE ratio and taxation factors

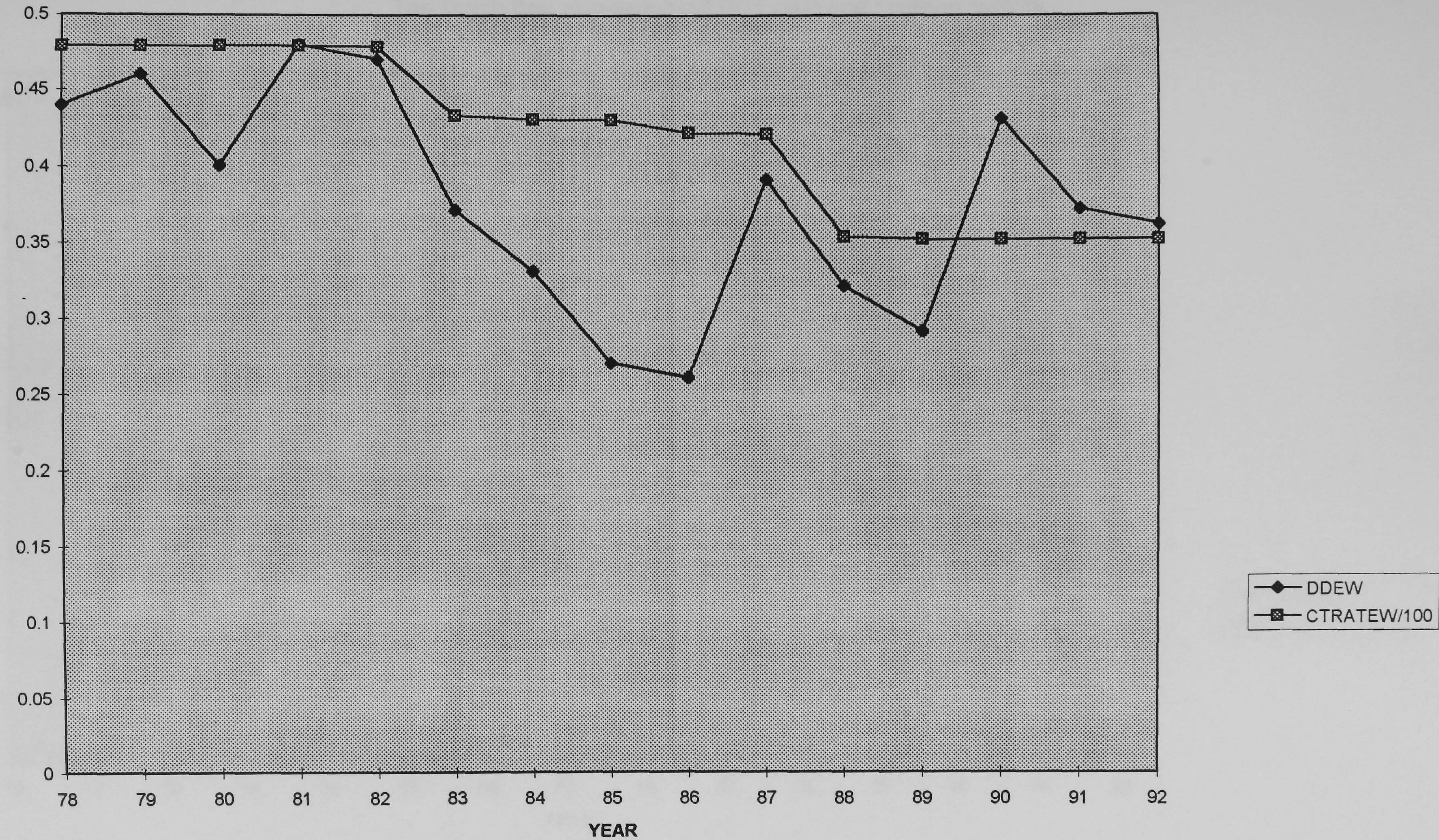


Figure 6.20
The Dutch firm non-weighted DDE ratio and taxation factors

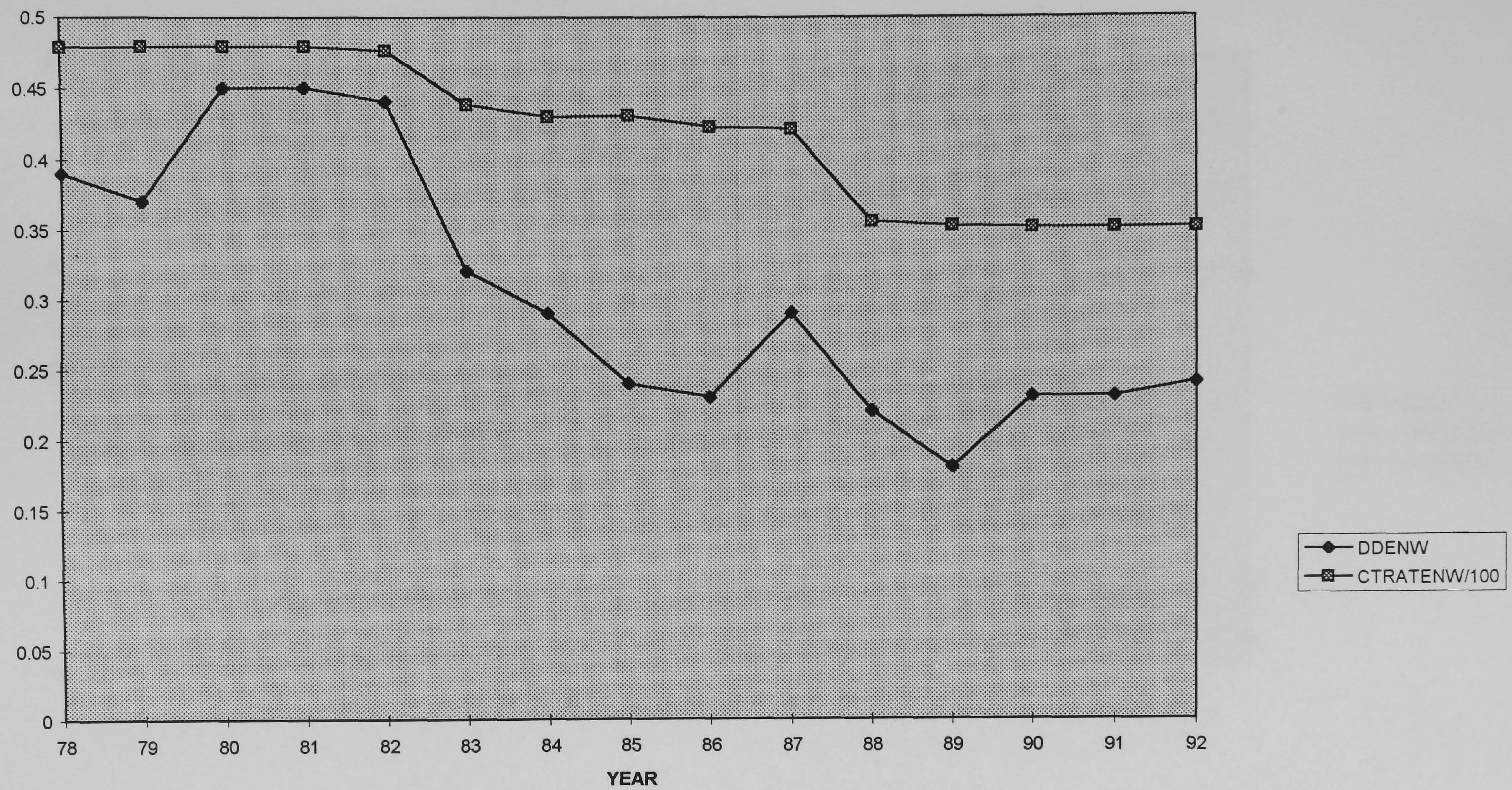


Figure 6.21
The French firm weighted DDE ratio and taxation factors

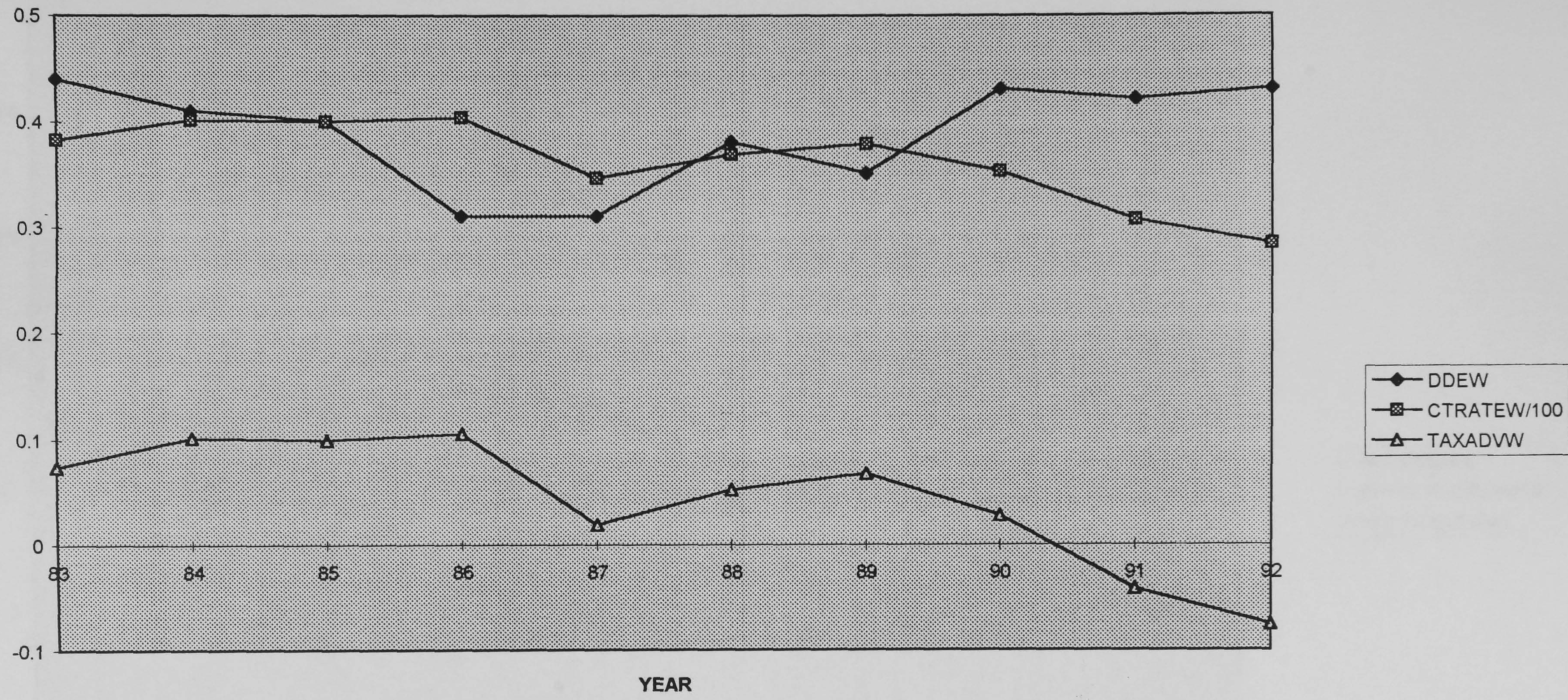
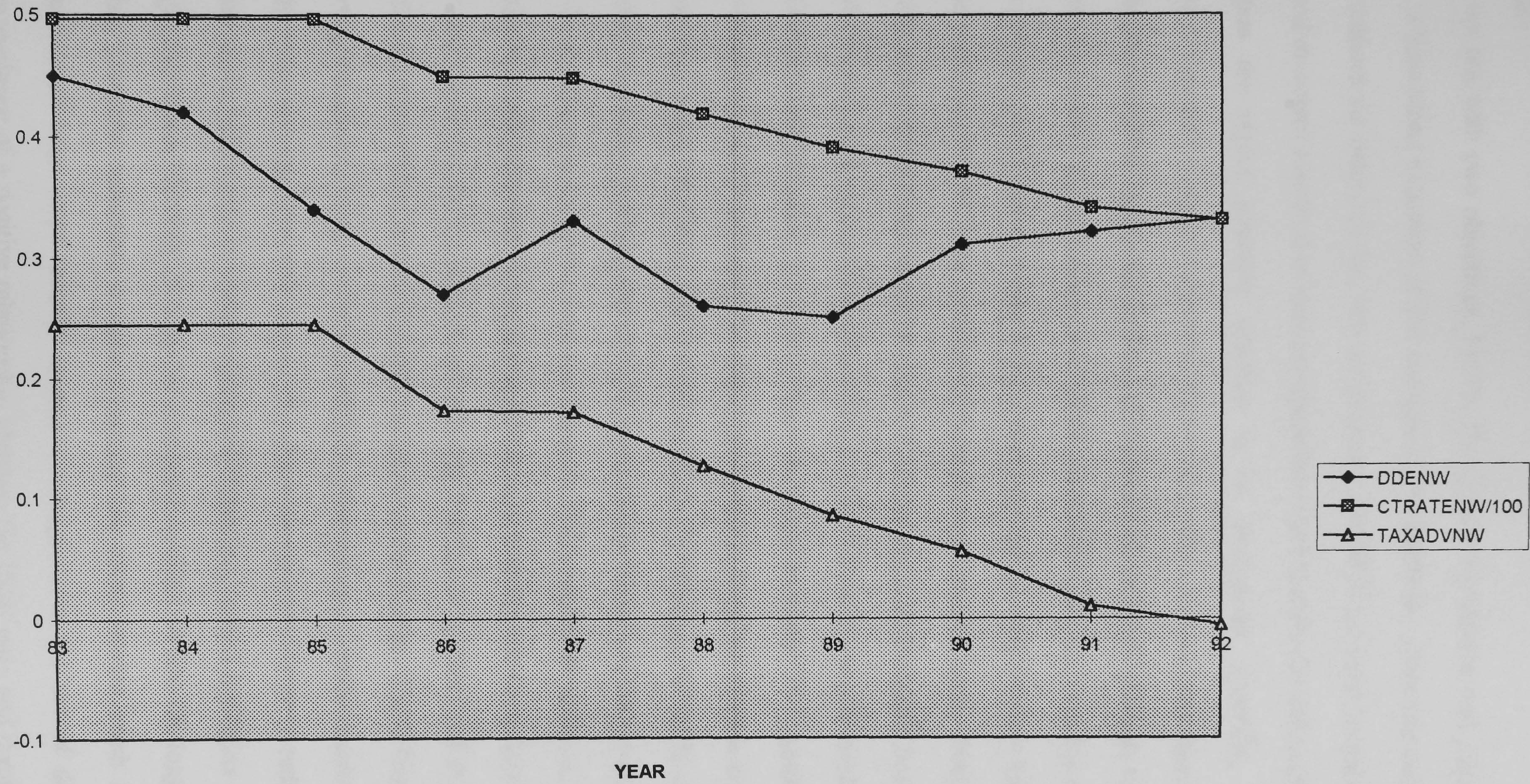


Figure 6.22
The French firm non-weighted DDE ratio and taxation factors



6.6 Summary

This chapter set out with two objectives. Firstly, the chapter introduces, and justifies the need for, a time series extension of the analysis of the European corporate capital structure. It outlines the nature of the data set analysed, identifies potential limitations of the data, and discusses a method of data manipulation which enables the influence of firm size upon the capital structure decision to be determined. Secondly, the descriptive inter-temporal analysis undertaken determines patterns in the movement of the DDE ratio and potential macroeconomic and taxation determinants through time. There is some evidence of the convergence of DDE ratios through time, possibly as a result of tax competition across Europe. Larger firms appear to employ more long-term debt as a proportion of total long-term finance than smaller firms. Various macroeconomic events have encouraged the use of debt as opposed to equity finance over the study period, such as the oil crises of the 1970's, the stock market crash of 1987, and German re-unification in 1989. There is some evidence of a positive relationship between the DDE ratio and the stock market index, long-run interest rates, and aggregate investment. However, the positive relationship between the DDE ratio and the inflation measures is weak, and there is little readily observable relationship between the DDE ratio and the gross domestic product. With respect to taxation, the most important influence upon the corporate capital structure in the last three decades has been the general switch from classical towards the imputation system, and in the last decade, the dramatic reduction in corporate tax rates across Europe. These factors have led to a significant reduction, or more recently an elimination in certain countries, of any tax advantage to corporate debt. Underlying these trends is the desire to reduce the size of the public sector and to encourage equity financing, which highlights the importance of government ideology changes on corporate markets. Whilst the longer-term trend has been the reduction in debt financing, the stock market crash and German re-unification have more recently caused a resurgence in the use of debt. There is some evidence of a positive relationship between the DDE ratio and taxation measures such as the corporate tax rate and the tax advantage to debt across the samples, although the apparent weakness of the relationship is possibly caused by the inability to adequately account for the dynamic processes inherent in such relationships. Overall, as debt and equity are no longer distinguished significantly by tax systems across Europe, characteristics of financial instruments other than their inherent tax effects, such as the riskiness of the instrument, should become more important both to investors and to firms.

However, examining relationships on a merely graphical basis may not determine the true underlying relationships or the timing of factors which exert an influence upon the corporate capital structure policy. Chapter 7 thus describes the methods necessary to examine, in a more robust manner, relationships between the variables which may not be obvious from a graphical examination alone. Indeed, the co-movement of variables may be masked by short-run fluctuations which must be taken into account before longer-term co-movements may be identified. Cointegration analysis facilitates the simultaneous examination of the short-run and long-run processes present within a capital structure relationship. Additionally, the timing of factors which exert an influence upon the capital structure policy is examined in detail in the autoregressive distributed lag modelling analysis, described methodologically in chapter 7.

CHAPTER 7

THE METHODOLOGY EMPLOYED AND HYPOTHESES TO BE TESTED IN THE BIVARIATE CORPORATE CAPITAL STRUCTURE ANALYSES

7.1 Introduction

The general objective of the time series analyses is to determine whether firm-level optimal capital structures exist in order to test the central hypothesis of this research. In order that this hypothesis might be explored in an structured manner, it is first necessary to examine the nature of the key bivariate time series relationships governing the determination of the corporate capital structure ratio. This chapter thus describes the methodology and hypotheses necessary to test the central hypothesis from a bivariate time series perspective.

Section 7.2 discusses in some detail the methods employed in the development of bivariate time series models. The methods described include: unit root testing to determine the order of integration of the time series variables; cointegration testing to identify those time series variables which are cointegrated with the DDE ratio; Granger causality analysis to determine the direction of causation within a bivariate corporate capital structure relationship; the construction and estimation of autoregressive distributed lag (ADL) models to determine the factors which influence the DDE ratio in the short-term; and the construction and estimation of bivariate error correction (EC) models to determine the short-run and long-run processes present within key capital structure relationships. Thus, this methodology section provides an econometric underpinning to the time series testing and modelling which enables the results of the analyses to be described in a more succinct and precise manner. The methodology enables the determination of the operational capital structure policies of the firm through the ADL modelling exercise, and the determination of both the operational and strategic capital structure policies of the firm through the EC modelling exercise.

Section 7.3 discusses the hypotheses to be tested by means of the methodology outlined in section 7.2. The discussion of the time series hypotheses to be tested follows the methodology section rather than preceding it as a number of the hypotheses relate to concepts of an econometric nature, such as model specification and characteristics, which may not be readily understood until the respective methods are discussed. The hypotheses are grouped into taxation, macroeconomic and corporate hypotheses, and they are presented in a manner such that they may be tested across the time series methods whilst maintaining each variable grouping. Each hypothesis is framed within the literature from which it is derived, or within the conceptual arguments which give rise to its creation, in the case of new hypotheses.

Finally, a short summary is given in section 7.4 to place the overall structure of the time series analyses within the wider context of the central research objectives of the European corporate capital structure research. The results of the bivariate time series analyses are examined in chapter 8. In addition, chapter 8 extends the time series analysis to a multivariate perspective by means of the Johansen multivariate error correction modelling approach, as well as determining which capital structure measures the European firm actually targets.

7.2 A description of the methods employed in the time series analyses towards the creation of bivariate corporate capital structure models

7.2.1 Introduction

The methodology described in this section outlines the econometric underpinning and application of each of the methods which contribute towards the construction and estimation of bivariate autoregressive distributed lag models and bivariate error correction models. The former models enable an examination of the processes which describe the operational capital structure policies of European firms whereas the latter models enable a simultaneous examination of the processes which describe both the operational <u>and</u> strategic capital structure policies of European firms.

Each method is introduced in relation to the objectives set for its application in the European corporate capital structure research. The econometric underpinning of the method is then presented, in addition to consideration of any adaptations which must be made to the method to facilitate its application in the European capital structure context. The format of the hypothesis testing approach deriving from each method is then briefly discussed. The bivariate analyses methodology is considered separately from the hypotheses and results so that the hypotheses and results can be grouped more usefully under conceptual groupings. Breaking the research down into discrete tests and models across the entire set of hypotheses may lead to a discussion of the literature and theoretical background to each hypothesis which becomes repetitive and somewhat disjointed. Thus, separation is undertaken to enable a more comprehensive and considered examination of the variables hypothesized to be related to the corporate capital structure ratio, under the conceptual factor groupings of taxation, macroeconomic and corporate variables.

Section 7.2.2 describes the method employed to determine the order of integration of the European taxation, macroeconomic and corporate time series variables. Variables must be integrated of the same order as the DDE ratio if they are to be sensibly modelled against it in the ADL models, and more notably, variables must be integrated of the same order as the DDE ratio if they are to be cointegrated with it. Section 7.2.3 describes the method employed to determine which taxation, macroeconomic and corporate factors are cointegrated with the European corporate DDE ratio. This method identifies those variables which display a significant long-run relationship with the DDE ratio, such that firms engage in strategic behaviour by continually adjusting the level of the DDE ratio in relation to the movement of the cointegrating variables, in an error correcting fashion. Section 7.2.4 describes a Granger causality analysis to determine which variables are capable of "causing" the DDE ratio, and conversely, which variables are capable of being "caused by" the DDE ratio. Section 7.2.5 describes the method employed to construct and estimate autoregressive distributed lag models. Such models enable the processes which govern the short-term or operational capital structure policies of European firms to be examined, as well as enabling the testing of specific capital structure hypotheses. Section 7.2.6 introduces the concept of error correction modelling and describes the method employed to construct and estimate bivariate error correction models, which enable the processes governing both the operational and strategic capital structure decisions of firms to be examined simultaneously. Section 7.2.7 briefly summarises the methodological approach undertaken in the bivariate time series European corporate capital structure analysis and discusses briefly how this structures the hypotheses stated in section 7.3.

7.2.2 Determination of the order of integration of European corporate, taxation and macro economic time series variables

7.2.2.1 Introduction

The objective of testing to determine the order of integration of a particular time series variable is that such testing must be undertaken before any time series modelling is attempted, as the modelling of nonstationary data produces spurious estimates. Perhaps more importantly, the variables which are to be tested for the existence of a cointegrating relationship must be integrated of the same order. However, before engaging in such testing, the key concepts of stochastic processes, time series data, stationarity, and integration are explained.

A stochastic process is defined by Charemza and Deadman (1992) as a family of real valued random variables, indexed by t, where t represents time. A time series is merely data ordered by time, and is a specific type of stochastic process. Charemza and Deadman define a stochastic process to be stationary (in a weak-form sense) if:

> "The means and the variances of the process are constant over time, while the value of the covariance between the two periods depends only on the gap between the periods, and not the actual time at which the covariance is considered." (Charemza and Deadman (1992), p.118)

If one of these conditions is not met then the time series (stochastic process) is nonstationary. If, for example a time series appears to move in a particular direction through time then that series is nonstationary as it contains a trend. For example, if a time series appears to be described by a random walk, then its variance increases over time and it is considered to have a stochastic trend. Alternatively, if the mean of a time series is a function of time then the time series has a deterministic trend, which may coexist with a stochastic trend in some circumstances.

Authors such as Phillips (1986) argue that regression models of data characterised by stochastic or deterministic trends are not robust because, for example, a relatively high "goodness of fit" statistic may merely be the result of the trends inherent in the models' variables. As most time series data contain trends, authors until recent times have used first-differencing as a method of removing the trend. Consider a time series with a stochastic trend:

$$y_t = y_{t-1} + \varepsilon_t \qquad \text{Equation 7.1}$$

Where ε_t is a series of identically distributed random variables with zero means, that is, a stationary disturbance. This trend may be removed by first differencing:

$$\Delta y_y = y_t - y_{t-1} = \varepsilon_t \qquad \text{Equation 7.2}$$

However, it is sometimes the case that a time series must be differenced more than once to achieve stationarity. Engle and Granger (1987) recognised this and defined a nonstationary time series in terms of the number of times it must be differenced before achieving stationarity:

> "A series with no deterministic component which has a stationary, invertible ARMA (autoregressive moving average) representation after differencing d times is said to be integrated of order d, denoted $x_t \sim I(d)$"
> (Engle and Granger (1987), p.252)

Thus, for example, where a variable is first differenced twice to achieve stationarity (second differenced) it is said to be integrated of order two. Banerjee et al (1993) define an integrated series in a fairly intuitive manner:

> "A series is said to be integrated if it accumulates some past effects; such a series is non-stationary because its future path depends upon all such past influences, and is not tied to some mean to which it must eventually return."
> (Banerjee et al (1992), p.136-137)

However, the differencing of time series variables before modelling them may eliminate any long-run processes within a relationship between the variables, and it is thus only through cointegration analysis that the both short-run and long-run processes within a time series relationship may be modelled concurrently.

Therefore, determination of the order of integration of the variables in the European data set is an essential precursor to statistically robust time series modelling as both series in a bivariate relationship must be of the same order of integration to permit the possibility of cointegration.

7.2.2.2 The method employed to determine the order of integration of the European time series variables

The method employed to determine the order of integration of the European time series variables is the Dickey and Fuller (1979) test, hereafter known as the DF test or unit root test.

Before the DF test is undertaken, all of the variables are tested to determine whether a deterministic trend is present within a variable, that is, whether the time series variable is generated by a stochastic process wherein the mean of that process is a function of time. The test for the presence of a deterministic trend involves the regression of the differenced dependent variable on a constant, a time trend, and the variable lagged one period, as given in equation 7.3.

$$\Delta y_t = a + bT + cy_{t-1} + \varepsilon_t \qquad \text{Equation 7.3}$$

The null hypothesis is that $b = c = 0$, that is, that there is no deterministic trend, only a stochastic trend. The alternative hypothesis is that $b \neq c \neq 0$, that is, that a deterministic trend is present. Each variable is tested in turn against the critical value of 10.61 for 25 observations at the one per cent level (Dickey and Fuller (1981), p.1063, table 6). If the F-test for equation 7.3 is greater than the DF critical value then the null hypothesis of no deterministic trend is rejected, and thus a deterministic trend is present.

Once the deterministic trend test is undertaken, the DF test be may computed for each of the time series variables. The DF test is analogous to a Student-t test of the autoregressive coefficient in equation 7.4:

$$y_t = \rho . y_{t-1} + \varepsilon_t \quad \text{Equation 7.4}$$

If $\rho = 1$ in equation 7.4 then the process generating a variable, y_t, is nonstationary, whereas if the ρ coefficient is $|\rho| < 1$ then the variable y_t is integrated of order zero, that is, it is stationary. However, testing the order of integration by estimating the autoregressive coefficient in this equation using ordinary least squares regression may produce a biased estimate of ρ, Charemza and Deadman (1992) argued, and furthermore the Student-t test distribution is not known where the variable tested is nonstationary.

Alternatively, then, the DF test gauges the negativity of δ in equation 7.5, which is equivalent to equation 7.4, expressing the time series in a differenced form, where $\rho = (1+\delta)$:

$$\Delta y_t = \delta . y_{t-1} + \varepsilon_t \qquad \text{Equation 7.5}$$

The null hypothesis of the DF test is that the variable is nonstationary, that is, that $\delta = 0$. The alternative hypothesis is that the variable is stationary, that is, that $\delta < 0$ (and thus $\rho < 1$). Initially, if the null hypothesis is rejected, then, the variable, y_t, is integrated of order zero and is thus stationary. If the null hypothesis is not rejected then the variable, y_t, is integrated of some order above zero and is thus nonstationary. Therefore, if the null hypothesis is not rejected in the first DF test then the variable must be differenced and retested, as shown in equation 7.6.

$$\Delta\Delta y_t = \delta . \Delta y_{t-1} + \varepsilon_t \qquad \text{Equation 7.6}$$

If a variable achieves stationarity after differencing once and retesting then it is integrated of order one. If the variable achieves stationarity only after differencing n times then it is integrated of order n. Testing for the order of integration is thus a sequential process of testing and differencing until the variable in question achieves stationarity. However, it is possible that a variable might not be integrated at all and thus cannot achieve stationarity by any amount of differencing, although Charemza and Deadman (1992) note that it is rarely the case that economic time series variables are integrated of an order greater than two. Variables integrated of a higher order than the DDE ratio variable are expressed in percentage change terms and retested, as it is essential in the analyses to follow that each variable to be tested for the existence of a cointegrating relationship with the DDE ratio is of the same order as that ratio.

Again, the Student-t distribution may not be employed to test the DF statistic, δ, because, where for example y_t is an I(1) variable, equation 7.5 involves the regression of an I(0) variable, Δy_t, upon an I(1) variable, y_{t-1}, for which the Student-t distribution is not known. Charemza and Deadman (1992) note that due to the specification of equations such as that of equation 7.5, the t-ratio does not have a limiting normal distribution, but has instead a negatively skewed distribution with most of its mass below zero. The distribution for the DF test must therefore be simulated, and simulations have been conducted by authors such as Mackinnon (1991). Mackinnon produced a formula and a table of coefficients to enable critical values from the distribution to be computed. The formula is presented in equation 7.7 below:

$$\hat{C}(P,T) = \hat{\beta}_{\infty} + \hat{\beta}_1 T^{-1} + \hat{\beta}_2 T^{-2} \qquad \text{Equation 7.7}$$

The critical values are thus computed by substituting the coefficient values, $\hat{\beta}_{\infty}$, $\hat{\beta}_1$, and $\hat{\beta}_2$ from Mackinnon's tables into equation 7.7, where T equals the number of observations. The tables from which critical values are taken for the DF unit root testing are presented in appendix D, which includes critical values for variables with and without trends. The Mackinnon coefficients are given at the head of each table and the total critical value for a particular number of observations is calculated. It is noted that no upper and lower bounds are computed for the DF statistic critical values because the standard errors with which they are calculated are very small and may be considered negligible. Indeed, the DF statistics produced in the unit root tests are rarely, if at all, marginal between acceptance and rejection of the null hypothesis and therefore the omission of bounds in preference for a single critical value in no way compromises the validity of the tests.

The null hypothesis of non-stationarity is rejected if the DF statistic estimated is lower than the Mackinnon critical value for the number of observations, T. If the DF statistic is higher than the Mackinnon critical value, then the null hypothesis may not be rejected, and the variable must be of some higher order of integration, or possibly may not be integrated at all. In cases where DF tests do not reject the null hypothesis, the variable is differenced and then tested, in a sequential manner, until it becomes stationary, that is, until the null hypothesis may be rejected.

The level of significance for the hypothesis test of the unit root testing is the 1 per cent level. Although this is more stringent than the 5 per cent level which is used more generally throughout this research, it is found that, as discussed above, the DF statistics are rarely marginal with respect to the acceptance or rejection of the test and therefore it does not appear to be important which of these levels of significance are employed.

In cases where a deterministic trend is seen to be present in the deterministic trend tests conducted, the DF unit root tests must be estimated with a trend positioned in the right hand side of equation 7.5, that is:

$$\Delta y_t = \mu + \alpha . T + \delta . y_{t-1} + \varepsilon_t \qquad \text{Equation 7.8}$$

Therefore, if a trend is present in the variable tested, a DF test including a trend is the correct test to determine the true order of integration of the variable.

Some authors employ a more refined version of the DF test known as the Augmented Dickey Fuller test, which allows for autocorrelation in the error process, ε_t, by including additional lagged dependents to the right hand side of equation 7.5. This test is not employed in the European corporate capital structure unit root testing as none of the variables modelled are integrated of order zero and furthermore differencing removes any autocorrelation present in the vast majority of cases, as confirmed by the Durbin Watson test statistics. However, ADF tests are later used for the purposes of testing for the existence of cointegrated variables because the sequential differencing to remove autocorrelation is not part of the cointegration testing procedure.

The Durbin Watson (DW) test for autocorrelation, then, is computed at each stage of the sequential DF test. The null hypothesis of the test is that there is no residual autocorrelation. The alternative hypothesis is that residual correlation is significant. The null hypothesis is rejected if the DW statistic is less than the lower bound DW critical value and is accepted if the statistic is greater than the upper bound. If the DW statistic falls between the lower and upper critical bounds then the inference concerning residual autocorrelation is inconclusive. To support the results of the DF test, the null hypothesis must not be rejected, that is, an autocorrelation coefficient which is not significantly different from zero supports a stationarity result.

To summarise, each variable is tested to determine the order to which it is integrated in a regression equation of 7.4. The Durbin Watson statistic is also calculated every time the DF statistic is computed. Additionally, each variable is tested for the presence of a deterministic trend using the DF F-test of equation 7.7, and if such a trend is found then the DF unit root test is repeated, including a trend in the right hand side of the equation, as in equation 7.8. After this exhaustive process is completed, those variables integrated of the same order as the DDE ratio may go to form part of either the autoregressive distributed lag short-run models or may be employed in the error correction models, the results of which are given in chapter 8.

7.2.2.3 Summary and implications of the method for the structure of the hypotheses

The unit root testing method described enables the order of integration of the time series variables of this study to be determined. This is important as the modelling of time series of differing orders of integration may produce spurious estimates, and variables which are to be tested for the existence of a cointegrating relationship with the DDE ratio must be of the same order of integration as that capital structure ratio.

As this section describes a method which is merely a preparatory stage towards the time series modelling which follows, there are no explicit hypotheses to be tested other than the hypotheses implicit in the unit root tests themselves. Thus, the objective is to determine the order of integration of a particular time series variable so that explicit hypothesis testing and modelling may then be undertaken.

7.2.3 The determination of the taxation, macro economic, and corporate factors which are cointegrated with the European corporate DDE ratio

7.2.3.1 Introduction

The unit root testing identifies those variables which are integrated of the same order as the corporate DDE ratio within each sample. Although two variables must be integrated of the same order as an essential pre-condition of a cointegrating relationship, this is only one of the essential conditions. A cointegrating relationship only exists when variables are integrated of the same order and the residuals from a static regression of those variables are integrated of order zero, that is, the residuals must be stationary. The objective of the cointegration testing is therefore to identify those bivariate relationships which fulfil the second condition, in addition to the first.

As this section discusses a testing procedure to identify cointegrating DDE ratio relationships across the European samples, it is essential that the concept of cointegration be formally defined. Engle and Granger (1987) define the conditions necessary for a cointegrating relationship to exist:

> "The components of the vector x_t are said to be *co-integrated of order d,b*, denoted $x_t \sim CI(d,b)$, if (i) all components of x_t are $I(d)$; (ii) there exists a vector $\alpha(\neq 0)$ so that $z_t = \alpha' x_t \sim I(d-b), b > 0$. The vector α is called the co-integrating vector."
> (Engle and Granger (1987), p.253)

The vector x_t in this research is a linear function of the DDE ratio and each variable hypothesized to influence it, considered in turn. Where the variables are integrated of the same order, and the special case, $d = b$ holds, they may be transformed by the cointegrating vector to become stationary. The parameters of this cointegrating vector are defined by the long-run estimated relationship between the variables, the residuals of which are known as the error correction mechanism. Therefore, if the error correction mechanism computed from the residuals of a long-run estimated equation between the variables is integrated of order zero then those variables are cointegrated.

Where cointegrating relationships are found to exist between variables, those relationships may then be modelled within an error correction model, which describes both the long-run and short-run processes present within the overall relationship between the variables. The purpose of the cointegration testing, then, is to identify occurrences of cointegrating relationships containing the DDE ratio so that error correction models of corporate capital structure determination may be constructed and estimated.

A cointegrating relationship between two variables implies that those variables "drift together" through time, as if there is some correction process which continually restores the relationship between the variables. The error correction mechanism contains information about the long-run relationship between the variables, and if a long-run relationship exists between the variables then the error correction mechanism will be stationary, as the disequilibrium errors fluctuate around zero through time. If the disequilibrium errors do not fluctuate around zero then this will cause the error correction mechanism to be integrated of an order higher than zero and there is no long-run relationship between the variables. For example the disequilibrium errors may be integrated of order one.

It is thus essential to identify occurrences of those relationships where the corporate capital structure measure, the DDE ratio, is cointegrated with the corporate, taxation, and macro economic variables within the European time series data set.

7.2.3.2 The method employed to determine the occurrence of cointegrating relationships between the DDE ratios of European firms and the taxation, macro economic and corporate variables

The test for the existence of a cointegrating relationship between two variables, in this case the DDE ratio and a taxation, macro economic, or corporate variable, is analogous to the DF unit root test. There are two main methods of testing for the existence of a cointegrating relationship between two variables: the ADL approach (Phillips and Loretan, 1991) and the Engle and Granger (1987) approach. The ADL approach involves the testing of the residuals from an ADL model of the variables, whereas the Engle and Granger approach involves the testing of the residuals from a static long-run model of the variables.

The chosen Engle and Granger (1987) method involves two stages. Firstly, the order of integration of both the DDE ratio and the time series variable upon which it is to be modelled are determined. Only those variables integrated of the same order may proceed to the second stage of the procedure. Secondly, either a Dickey-Fuller or Augmented Dickey-Fuller test is computed upon the residuals of a static long-run regression model of the bivariate relationship between the DDE ratio and the influencing variable.

However, as in the case of unit root testing, before this second stage is undertaken, the residuals of the estimated static long-run regression model must be tested for the presence of a deterministic trend. The test for the presence of a deterministic trend involves the regression of the differenced residuals of the estimated static long-run regression model (the error correction mechanism or ECM) upon a constant, a trend, and the error correction mechanism lagged one period, as given in equation 7.9.

$$\Delta ECM_t = a + bT + cECM_{t-1} + \varepsilon_t \quad \text{Equation 7.9}$$

The null hypothesis is that $b = c = 0$, that is, that there is only a stochastic trend present within the ECM. The alternative hypothesis is that $b \neq c \neq 0$, that is, that a deterministic trend is present. Each error correction mechanism is tested in turn against the critical value of 10.61 for 25 observations at the one per cent level (Dickey and Fuller (1981), p.1063, table 6). If the F-test for equation 7.9 is greater than the DF critical value then the null hypothesis of no deterministic trend is rejected, and thus a deterministic trend is present.

Once the deterministic trend test is undertaken, stage two of the Engle and Granger procedure is undertaken. As the cointegrating vector is not known, a priori, it must be estimated by conducting a regression of a static long-run model of the variables to be tested for cointegration. The exact nature of the long-run equation for each bivariate relationship is not known because the coefficients of the independent variables in the bivariate relationships are not predicted by the underlying capital structure theory. This renders the cointegration testing procedure more of an experimental exercise rather than a strict exercise in hypothesis testing. The long-run relationship between the two variables is estimated, as shown in equation 7.10.

$$y_t = \mu + \beta_1 x_t + v_t \qquad \text{Equation 7.10}$$

Where:

y_t = the dependent variable, in this case, the DDE ratio

x_t = the independent variable, in this case, a taxation, macro economic, or corporate factor

The estimated residuals from this equation, $\hat{v}_t$, are the deviations of the DDE ratio from its long-run path, that is, $\hat{v}_t$ represents the error correction mechanism or ECM.

The estimated residuals are then tested using the Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF) tests, in a similar manner to the tests computed to determine the order of integration of the variables. The Augmented Dickey-Fuller test differs from the standard Dickey-Fuller test in that it takes account of possible autocorrelation, ensuring that the estimates of the DF test are efficient by introducing lagged dependent variables to the left hand side of the test equation to approximate the autocorrelation. Thus, the DF statistic is computed for the non-lagged ECM and the ADF statistic is computed for the ECM lagged up to 5 years, the lag length depending on the data time-span available, as given in equations 7.11 and 7.12 respectively.

$$\Delta\hat{v}_t = \delta.\hat{v}_{t-1} + \xi_t \qquad \text{Equation 7.11}$$

$$\Delta\hat{v}_t = \delta.\hat{v}_{t-1} + \sum_{i=1}^{k} \delta_i.\Delta\hat{v}_{t-i} + \xi_t \qquad \text{Equation 7.12}$$

Where:

$\hat{v}_t$ = the ECM, which equals the residuals from the static long-run equation, given in equation 7.10

δ = the DF or ADF statistic

The null hypothesis of the DF or ADF test is that the ECM is nonstationary (that $\delta = 0$), and thus that the variables tested are not cointegrated. As only those cases where the ECM is stationary are of interest, the test does not need to be conducted in a sequential manner until the order of integration of the ECM is determined. If the null hypothesis is rejected, then the DDE ratio and the variable tested are cointegrated as the ECM from an estimated long-run model of the variables is stationary. If the null hypothesis is not rejected then the DDE ratio and the variable tested are not cointegrated as the respective ECM is nonstationary.

The critical values with which to compare the DF and ADF statistics are again computed using the Mackinnon (1991) formula given by equation 7.7 of section 7.2.2. The critical values are computed by substituting the relevant β coefficients into equation 7.7. The tables from which the critical values are taken for the cointegration testing are presented in appendix G, which includes critical values for variables with and without trends. As discussed in the unit root testing, a single critical value is presented for each number of observations, as the difference between the upper and lower bound values is insignificant in this research. The particular Mackinnon distribution used in the majority of the cointegration tests is the 10 per cent significance table for two variables. The two variable table is computed as there are two variables in the cointegrating equation, in contrast to the one variable tables in the unit root testing. Where there is evidence of a deterministic trend, the equivalent table with a trend is used as the distribution for the critical values.

The significance level employed in the cointegration testing is the 10 per cent level, which is less stringent than the 5 per cent level generally employed elsewhere in this research. Banerjee et al (1986) found that the cointegrating regression estimator in such testing can exhibit very large biases and that the tests have low power to reject non-cointegration. Therefore, taking this into consideration, a less stringent 10 per cent significance level is chosen for the critical values to guard against rejecting relationships (accepting the null hypothesis of no cointegration) which actually contain cointegrating variables. The validity of this approach is later re-examined in the testing of the significance of the ECM in the error correction modelling exercise, in which the more stringent 5 per cent level is again applied.

The null hypothesis of no cointegration is rejected if the DF or ADF statistic is lower than the Mackinnon critical value for the number of observations, T. If the statistic is higher than the Mackinnon critical value, then the null hypothesis may not be rejected, and the relationship tested reveals no evidence of cointegration. In cases where a deterministic trend is present, the cointegration testing must be performed with a trend in the right hand side of equation 7.11 and 7.12, that is:

$$\Delta\hat{v}_t = \alpha.T + \delta.\hat{v}_t + \xi_t \quad \text{Equation 7.13}$$

$$\Delta\hat{v}_t = \alpha.T + \delta.\hat{v}_t + \sum_{i=1}^{k} \delta_i.\Delta\hat{v}_{t-i} + \xi_t \quad \text{Equation 7.14}$$

Where: T = the deterministic trend

If a deterministic trend is found within the residuals then this weakens the cointegrating relationship, though whether it refutes it altogether is unclear. Thus, the estimation of equations 7.13 and 7.14 should identify occurrences of cointegration, even in the presence of a deterministic trend.

The Durbin Watson (DW) test for autocorrelation is also computed for each lag of the ADF test as well as for the non-lagged ECM of the DF test. The null hypothesis of the test is that there is no residual autocorrelation, and the alternative hypothesis is that residual autocorrelation is significant. The null hypothesis is rejected if the DW statistic is less than the lower bound DW critical value and is accepted if the statistic is greater than the upper bound. If the DW statistic falls between the lower and upper critical bounds then the inference concerning residual autocorrelation is inconclusive. For those bivariate relationships where cointegration is found to exist in the DF/ADF tests, such a result is strengthened if the null hypothesis of the DW test is not rejected.

7.2.3.3 Summary and implications of the method for the structure of the hypotheses

The DF/ADF cointegration testing enables those variables which are cointegrated with the DDE ratio to be identified, which is an essential pre-condition if those variables are to later form part of an error correction model.

As the cointegration testing is again merely a preparatory stage towards the time series modelling to follow, the only explicit hypotheses are those which constitute the tests themselves. However, the procedure does enable the identification of those variables which exhibit a long-run relationship with the DDE ratio. Greater importance should be attached to such relationships as they are indicative of some long-run equilibrating mechanism which must be underpinned by a capital structure policy which is strategic in nature. The nature of the coefficients of each static equation estimated is neither hypothesized nor discussed in the results, as the information contained within such equations is implicit to the autoregressive distributed lag models, which are to be discussed in some detail later in the time series analyses.

7.2.4 Granger causality analysis to determine the direction of causation within a bivariate corporate capital structure relationship

7.2.4.1 Introduction

The objective of the Granger causality analysis is to determine the direction of causation within a corporate capital structure relationship. The direction of causation has not been formally tested in the modelling conducted up to this point in the European corporate capital structure research, although the results of the models in chapter 5 suggest that "circular" or "two-way" causation may be common in bivariate corporate capital structure relationships. This result contrasts with much of the existing literature which assumes that the factors which are related to the corporate capital structure are in fact its determinants. It is possible that most authors assume the DDE ratio to be the dependent variable in any model because the theoretical underpinning of the converse is not well established.

However, consideration of causation on a purely theoretical basis quickly descends into the realms of philosophy and mere "chicken and egg" arguments. To elevate the causation issue from such arguments requires both a formal definition of causality and a method by which causality might be tested, both of which are provided by Granger (1969).

7.2.4.2 The Granger causality testing method

Granger (1969) produced both a formal definition of causation and created a fairly simple statistical test of causality to be applied to bivariate time-series relationships. Granger defined causality by arguing that one variable "Granger-causes" another variable if the current value of the latter can be predicted with greater accuracy by using past values of the former rather than by not doing so, ceteris paribus. The method employed to test causality between two variables is, then, the Granger test, which is modified by Sargent (1976). The starting point for the method is to express the two variables concerned in an autoregressive distributed lag (ADL) model, as explained by Charemza and Deadman (1992) and shown in equation 7.15.

$$y_t = A_0 D_t + \sum_{j=1}^{k} \alpha_j y_{t-j} + \sum_{j=1}^{k} \beta_j x_{t-j} + \varepsilon_t \quad \text{Equation 7.15}$$

Where:

y_t = the variable to be tested as a dependent

$A_0 D_t$ = the deterministic part of the equation ie. the intercept in this case

$\sum_{j=1}^{k} \alpha_j y_{t-j}$

= the autoregressive component of the equation ie. lagged dependent variables

$\sum_{j=1}^{k} \beta_j x_{t-j}$

= the distributed lag component of the equation ie. lagged independent variables

ε_t = the model error

The objective of the Granger causality test is to determine whether the coefficients of all of the independent variable coefficients are zero. If all of the β's are statistically equal to zero then the independent variable does not Granger cause the dependent variable under consideration. The test used to determine the significance of coefficient differences from zero is the Lagrange Multiplier F-test, known as the LMF test. The LMF test is computed by a two stage regression process.

Firstly, the dependent is regressed upon the intercept and past values of the dependent. The residuals from this estimated equation are computed. Secondly, the residuals from the first regression are regressed upon the intercept, the past values of the dependent variable, and the past values of the independent variable. The coefficient of determination is then computed, and is used to calculate the LMF statistic, as in equation 7.16. Under the null hypothesis, the LMF statistic has an $F(k,(t-h))$ distribution.

$$LMF = \frac{T-h}{k} \cdot \frac{R_0^2}{1-R_0^2} \qquad \text{Equation 7.16}$$

Where:

LMF = the Lagrange Multiplier F statistic
T = the sample size
h = the number of variables in equation 7.15
k = the order of the distributed lag process tested
R_0^2 = the coefficient of determination of the second regression, with the residuals as dependent

The Granger causality testing method is fairly easily applied to the corporate capital structure data in an attempt to resolve incidences of causation uncertainty arising in this research. An autoregressive distributed lag (ADL) model such as that of equation 7.15 is constructed for each bivariate relationship which contains the DDE ratio. The order of the ADL is two for the UK, the Dutch and German samples, and one for the French sample for reasons of data availability. The Granger two-stage regression procedure, as described above, is undertaken for each bivariate relationship, with both the DDE ratio as dependent variable and as independent variable. Tests are thus undertaken for both possible causation directions for weighted and non-weighted firms from the UK, Dutch, German, and French samples in turn. For each bivariate relationship, if the LMF statistic is greater than the critical F value then the null hypothesis that the independent coefficients are all zero is rejected. If the null hypothesis for an individual Granger test is rejected, then, the independent variable "Granger causes" the dependent, that is, the independent variable is a determinant of the dependent variable. Therefore the independent variable explains a significant part of the residual variation unaccounted for by its own past behaviour.

7.2.4.3 Summary and implications of the method for the structure of the hypotheses

The Granger causality testing enables the direction of causation to be established within each bivariate corporate capital structure relationship.

As the Granger causality analysis seeks only to determine the strength of any causal relationship between the DDE ratio and another variable, the analysis gives rise only to one key hypothesis which is that the DDE ratio is best expressed as the dependent variable in any econometric corporate capital structure model. Test results for individual variables provide only a suggested causal orientation for the later modelling of such variables in relation to the DDE ratio.

7.2.5 The construction and estimation of autoregressive distributed lag models describing the determination of the European corporate capital structure in the short-term

7.2.5.1 Introduction

The objective of the autoregressive distributed lag modelling analysis is to produce models of the processes which govern the short-term or operational determination of the European corporate capital structure. Whilst it would be possible and indeed logical to model the DDE ratio as both a dependent and an independent variable within the time series research, only the former is discussed in this section. There are three reasons for this. Firstly, it would be a trivial exercise, though of radically different meaning, to merely repeat each test for the opposite direction of causation. Secondly, as lag structures are generally introduced in the modelling process, the conventional wisdom that 'the future cannot cause the past' resolves, at least in part, any causation uncertainty within each separate model. Thirdly, and most importantly, the one-way causation bias of the existing empirical literature, whereby the DDE ratio is consistently expressed as the dependent variable, demands that the models be expressed as such to enable testing of hypotheses deriving from the literature.

The modelling of the corporate capital structure up to this point has concentrated upon the cross-sectional and marginal perspectives. The former perspective enables the modelling of the DDE ratio within a country sample, to determine those influences which cause most of the variation in this ratio. The latter perspective enables the issue decision of the firm to be modelled, seeking to determine those influences which cause the firm to choose debt rather than equity, or vice versa. The construction and estimation of autoregressive distributed lag (ADL) models, examined in this section, enables the modelling of the DDE ratio to determine those influences which cause most of the variation in the ratio as it moves through time. The time series perspective modelled here represents the factors that influence the inter-temporal variation of the DDE ratio rather than the factors that influence the intra-country variation in the capital structure, as modelled in the cross-sectional and marginal models.

The short-term time series perspective gained should allow the year-to-year determination of the corporate capital structure to be analysed. Such a year-to-year planning of the capital structure mix encompasses a series of decisions by the finance manager to raise external funds for the operational needs of the firm. The strategic financial management policy of the firm may not directly be reflected in the short-term external financing models because both the long-term and dynamic capital structure determination processes are contained within any relationship modelled. The error correction modelling of this research enables these two processes to be separately modelled. However, the short-term modelling discussed in this section enables any lag structures present to be modelled, thus enabling the timing factors which characterise the short-term processes to be examined. Timing factors are an influence upon the DDE ratio in their own right, as it is recognised that there may be time lags between corporate, taxation and macro economic events and the subsequent collection of information describing such events. Additionally, there may be time lags between the receipt of such information and the actual capital structure adjustment. Changes in corporate factors may exhibit the most immediate effect on the DDE ratio owing to the efficiency of modern accounting systems and the ready availability of such data, whereas taxation factor changes may exhibit a longer lagged effect owing to the lags in the liability incurrence/payment procedure. Changes in macro economic factors may have a far longer lagged effect as the whole economy necessarily takes time to adjust to such changes, producing a series of indirect "knock-on" effects before the full effect of a change upon the DDE ratio of the firm is known. Thus, the short-term perspective produced by the ADL models allows analysis of the operational financial decision-making process of the firm, as well as the timing effects which influence that process.

The models are simple bivariate models as the objective of this method is to test existing literature hypotheses rather than to create all-encompassing multivariate empirical models. This method models only those variables within each sample which are integrated of the same order as the DDE ratio, thereby enabling the construction and estimation of statistically more robust models, as discussed in the unit root testing method.

A further reason why only bivariate and not multivariate ADL models are produced here is that the estimation of bivariate short lag models allows enough degrees of freedom to enable valid testing of the models estimated. The addition of even a small subset of variables, along with their respective lag structures, would reduce the number of degrees of freedom so severely that tests of variable coefficients and diagnostic tests would become invalid as the critical values become large and the number of available observations become very small. This would cause the model estimators to become unstable.

Although the method applied is ADL modelling, the framework within which the method is applied is known as "general-to-specific" modelling, pioneered by authors such as Davidson et al (1978). The framework is a relatively new approach in econometrics, involving the construction of large general models which are reduced in size by means of various restrictions to produce specific models. The other time series models of this research also employ the general-to-specific framework, and it is thus necessary to explain the basic tenets of the approach in this section.

7.2.5.2 The autoregressive distributed lag modelling method within a 'general-to-specific' framework

Application of autoregressive distributed lag models to economic time series within a general-to-specific framework is a relatively recent approach in econometrics, and it represents a departure from the wide range of model-building techniques prevalent in the empirical literature of the last few decades. Before explaining the ADL model and the general-to-specific framework, the reasons for this departure must be very briefly discussed, to justify the methodology applied here.

Tinbergen (1951), in his pivotal work in the development of econometric theory, argued that safeguarding against incorrect variable omission and incorrect regression coefficient signs and lag lengths was essential to robust model inference, and could be considered as important as the strength of model correlation. Charemza and Deadman (1992) argued that, as a result of this influential work, empirical researchers concentrated mainly on the theoretical consistency of regression coefficients and goodness of fit measures to judge the success of a modelling exercise. However, they argued that the resulting methodology meant that more than one theory could often be supported by the data, thus qualifying any inference from a particular model upon the correctness of the underlying theory. Furthermore, economic researchers in the 1960's and 1970's engaged in widespread "data-mining", choosing models from a whole series of alternatives, merely on the basis of the Student-t ratio and the coefficient of determination.

Charemza and Deadman derive proofs that adding a new variable to a model will always improve the goodness of fit measure, R^2(the coefficient of determination), and will improve the $\overline{R}^2$ measure (R^2 adjusted for the number of independent variables) where the t-statistics of new variable coefficients exceed unity (Dhrymes, 1970). They also demonstrate that the t-ratio is not a robust statistic as a criterion for new variable inclusion, particularly where the pre-testing of model components has occurred.

In the European corporate capital structure research, general-to-specific modelling is introduced to reduce the potential errors inherent in conventional econometric approaches. The approach is defined by Charemza and Deadman (1992):

> "By general to specific modelling we mean the formulation of a fairly unrestricted dynamic model herewith called a general model, which is subsequently tested, transformed and reduced in size by performing a number of tests for restrictions." (Charemza and Deadman (1992), p.80)

A general model consists of a very wide model specification approximating the data generating process, and as such may contain variables and lag lengths in excess of that required to adequately model a given dependent variable. Thus some of the variables and/or lags may be eliminated from the general model by the imposition of linear (and occasionally non-linear) restrictions, producing a restricted, or specific, model which is still consistent with the initial general model.

The approach is advantageous in a number of respects. Firstly, a far more simple model is eventually produced, enabling a more intuitive interpretation. Secondly, the problems of incorrect variable omission and pre-testing are eliminated by the initial statement of theory and subsequent linear restrictions, in addition to the fact that it is better to have an overspecified model than an underspecified model. Thus, bias in model estimators is avoided. Finally, the specific model is a reduced-form model and thus "saves" degrees of freedom which should reduce the incidence of incorrect test statistic results within both the linear restrictions process and the final model diagnostics.

The method central to this modern approach to econometric modelling is the autoregressive distributed lag (ADL) modelling method. The general model to be tested for linear restrictions is an ADL(2) model, that is an autoregressive distributed lag model of lag order two, which may be expressed as in equation 7.17.

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \beta_1 x_t + \beta_2 x_{t-1} + \beta_3 x_{t-2} + \varepsilon_t$$

Equation 7.17

In the capital structure perspective, y_t is the DDE ratio measure owing to the assumed one-way causation required to test the hypotheses arising from the existing literature, and y_{t-1} and y_{t-2} represent the DDE ratio lagged one and two years respectively. x_t, x_{t-1} and x_{t-2} represent the independent or explanatory variables to be modelled in the bivariate ADL models lagged zero, one and two years respectively. The general model is of lag order two as it is believed that the short-term, year-to-year capital structure decisions are made on the basis of relatively recent corporate, taxation and macro economic variables. The time-span paucity which characterises the European data set necessitates only a short lag length, otherwise degrees of freedom are lost, thus increasing the possibility of statistically unsound models. A longer lag order is not chosen because it is argued that a two year time-span should be adequate to capture the decision making behaviour of most firms.

A constant is included in each general model for various theoretical reasons. If no constant is included then many of the general models would become nonsensical. For example, say a particular country sample produces a model whereby the DDE ratio is estimated upon inflation alone, with no lagged dependent or independent variables. If inflation were zero, then by definition, the amount of debt in the firm's capital structure must also be zero. Although the UK, for example, experienced inflation rates in 1994 approaching zero, it has not experienced gearing levels approaching zero as a result. Thus, by implication, if a constant is not included in a bivariate ADL corporate capital structure model then zero gearing is logically implied by zero valued independent variables. A constant thus reflects the fact that firms are expected to engage in corporate gearing regardless of the magnitude of any separate influencing factor, no matter how significant that factor is. Additionally, statistics such as R^2, the coefficient of determination, requires redefinition and re-interpretation when a regression contains no constant.

Before linear restrictions of a general model are tested for a particular corporate capital structure determinant, the theoretical specific models which are to be developed from the hypotheses in section 7.3 must be compared with the general model to note the restrictions that are implied. The statistic employed as the criterion for model reduction is the t-test. Although the F-ratio statistic is used by many researchers to jointly test linear restrictions on a general model, the t-test is employed here for a number of reasons. Firstly, the theoretical models of corporate capital structure determination are extremely general, often implying merely the sign of a static regression coefficient, with no lag structure expectations. Sequential reduction by means of a t-test should improve upon a general specification by introducing important timing effects in lag structures. Secondly, the F-ratio statistic may only sensibly be computed for general and specific models estimated upon identical numbers of observations. As this research is conducted upon very small data time-spans, each observation is extremely valuable and thus the t-test (and not the F-ratio statistic) enables the "released" observations arising from sequential reduction to be used in the estimation of the specific model. Thirdly, the t-test enables each stage of the sequential reduction process to be tested for validity, an advantage not inherent in the F-ratio test which jointly tests linear restrictions. Finally, a joint test of linear restrictions using the F-ratio test is not essential to the reduction process in the situation where only a bivariate ADL model is gradually restricted, as the possibility of a specific model with an erroneous lag structure is less serious than a specific model with erroneously omitted variables, as in the case of a multivariate model.

The actual process of the linear restriction of a general model is best illustrated with an example of the general-to-specific modelling approach using the ADL method. Table 7.1 exhibits the sequential stages of the linear restriction of an ADL (2) model with the DDE ratio as the dependent variable and the long-term interest rate, LRINT, as the independent variable, estimated upon the UK weighted sample data.

Table 7.1
An example of the sequential linear restriction and reduction of an autoregressive distributed lag model of the DDE ratio regressed upon the long-term interest rate for the UK weighted sample
(t-statistics are shown in parentheses)

stage	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	LRINT variable	LRINT variable lagged 1 year	LRINT variable lagged 2 years	R-squared (t-critical value)
(1) general model	0.13345 (1.399)	0.43325 (1.754)	-0.013979 (-0.054)	0.026211 (1.931)	-0.012620 (-0.597)	-0.010953 (-0.745)	0.46368 (2.110)
(2)	0.13451 (1.482)	0.42549 (2.170)	eliminated	0.025926 (2.130)	-0.012153 (-0.647)	-0.011378 (-0.941)	0.463586 (2.101)
(3) specific model	0.14307 (1.618)	0.38001 (2.109)	eliminated	0.020230 (2.445)	eliminated	-0.017512 (-2.367)	0.45111 (2.093)

Stage 1 involves the specification and estimation of the general model, which is merely an ADL(2) model including a constant. The variable with the least significant coefficient is eliminated. In this case, the autoregressive lagged two year component is eliminated, as its coefficient is only -0.054 standard errors away from zero, which is insignificant when compared to the critical t-value of 2.110 in a two-tail t-test at the 5 per cent level (for 17 degrees of freedom). Stage 2 then involves the estimation of the stage 1 model with the least significant component eliminated. The next variable eliminated is the long-term interest rate measure lagged one year, as its coefficient is only -0.647 standard errors away from zero, and is insignificant when compared to the critical t-value of 2.101 in a similar t-test for 18 degrees of freedom. Finally, stage 3, which is the final stage in this particular example, involves the estimation of the stage 2 model specification with the elimination of the long-term interest rate measure lagged one year. This is the final stage as all of the non-constant regressors are significant, because their t-values are all in excess of 2.093 standard errors away from zero. The stage 3 model is, then, in this case, the specific model for the UK weighted sample, representing the short-term time series relationship between the DDE ratio and the long-term interest rate.

In the above example, all of the non-constant regressors in the final specific model are significant. However, this need not be the case. Models are reduced by means of linear restrictions until all of the remaining non-constant regressors are significant or until further reduction would result merely in an autoregressive model. Therefore, some of the models summarised in appendix K contain no significant regressors, but are still presented as they contain valuable information concerning the coefficient signs and lag structures of the hypothesized relationships.

The example given in table 7.1 also demonstrates that the specific model remains entirely consistent with the general model, as coefficient signs are unchanged and the coefficient values are very similar. It is noted that the model experiences a slight reduction in the coefficient of determination, though this may be expected as the number of variables is reduced (as explained earlier by Charemza and Deadman (1992)). However, the specific model is certainly an improvement upon the general model because all of its non-constant components are significant.

Owing to the constraints of space, only the specific models are presented in this report, that is, the final stage of the model reduction process, otherwise a vast number of tables such as table 7.1 would be required, in addition to a similar number of additional diagnostic statistics tables. The specific models are given in appendix K.

Once the final specific models are estimated, various diagnostic tests are computed to examine the statistical robustness of the models. The statistics computed, in addition to the F-test and R^2 tests of appendix K are: the overall model F-test; the LM test for autocorrelated residuals; the autoregressive conditional heteroscedasticity (ARCH) test; the Chi-square test for normality; the F-test for heteroscedasticity; and the regression specification (RESET) test. These tests are defined in appendix L, and the results of the tests are summarised in appendix M.

Therefore, the general-to-specific modelling approach is not strictly applied to the ADL modelling of the European corporate capital structure decision, as the linear restriction is sequential rather than joint. The final specific models may differ from those postulated, as the latter are often based upon the dynamics of naive theory rather than clearly defined theoretical expectations. Thus, the approach adopted here is a hybrid approach, drawing from the benefits of the general-to-specific approach and statistical experimentation, whilst removing most of the deficiencies from the latter. Indeed, although the general-to-specific approach is widely explored in econometric literature, the actual methodological mechanics are not consistent across applications of the approach, and thus some adaptation to the peculiar circumstances of European corporate capital structure modelling appears warranted.

7.2.5.3 Summary and implications of the method for the structure of the hypotheses

The construction and estimation of autoregressive distributed lag models enables an examination of the processes which govern the operational (short-term) capital structure policies of European firms.

Taxation, macroeconomic and corporate hypotheses arising from the existing literature as well as new hypotheses deriving from the development of the European capital structure research are tested by comparing the final specific ADL models to the general models which are governed by the hypotheses. In addition to the hypotheses dictating the expected coefficients in the specific models anticipated, the nature of each bivariate capital structure relationship is discussed to predict the dynamics of each specific model. Thus, the general-to-specific approach provides the framework within which the bivariate ADL models are estimated, whilst their construction derives from the hypotheses to be tested and a careful consideration of the expected dynamics.

7.2.6 The construction and estimation of error correction models to determine the short-run and long-run processes present within key capital structure relationships

7.2.6.1 An introduction to error correction modelling

The objective of the bivariate error correction modelling analysis is to model and study the processes governing both the long-run and short-run capital structure policies of European firms simultaneously, thus enabling the relative importance of such processes to be determined.

The advantages of the error correction model (hereafter known as the EC model) are numerous. Firstly, such models enable both short-run (dynamic) and long-run processes present within a relationship between two (or more) variables to be taken into account within a single model. Secondly, they enable measures such as the coefficient of determination to be computed without the fear that it is measuring a spurious regression relationship. Thirdly, as the variables within an EC model are in levels and first-differenced forms, multicollinearity is not a problem, and thus the models may be built by means of linear restrictions using the "general-to-specific" approach.

Only a subset of the time series data set (data set 3) is modelled using this method, as the EC models are estimated only for those variables which evidence a cointegrating relationship with the DDE ratio.

7.2.6.2 An introduction to bivariate error correction modelling

The objective of this method is to develop bivariate error correction models (EC models) for those variables which are found to be cointegrated with the DDE ratio. The reason why cointegrating variables must be examined within EC models is that:

> "Such models currently represent the most common approach to situations where it is wished to incorporate both the economic theory relating to the long-run relationship between variables and short-run disequilibrium behaviour." (Charemza and Deadman (1992), p.154-5)

Thus, EC models enable the economist to examine the long-run and the dynamic processes within a relationship between two (or more) cointegrating variables. Engle and Granger (1987) developed the Granger Representation Theorem, which states, in its simplified form, that time series variables which are cointegrated must have an error correction (EC) representation.

To understand how error correction models are used to model simultaneously long-run and short-run processes within a bivariate relationship, it is necessary to derive a basic EC model to examine its statistical foundations as well as to establish the importance of disequilibrium errors to the mechanics of the model. Such a derivation is given by Thomas (1993).

Two variables in equilibrium, Y_t and X_t, may be expressed in a simple multiplicative form given by equation 7.18.

$$Y_t = KX_t^{\gamma_2} \qquad \text{Equation 7.18}$$

Where:

γ_2 = a constant
K = a constant

If equation 7.18 is transformed by computing natural logarithms of its constituent variables, then a linear form given by equation 7.19 results.

$$y_t = \gamma_1 + \gamma_2 x_t \qquad \text{Equation 7.19}$$

If the variables, Y_t and X_t, are not continuously in equilibrium, then the extent of any disequilibrium is given by $y_t - \gamma_1 - \gamma_2 x_t$. The presence of disequilibrium errors means that the relationship in equation 7.18 is not readily observable at any moment in time. However, past values of Y and X which describe the disequilibrium can be employed to produce a disequilibrium relationship such as that of equation 7.20.

$$y_t = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + \alpha y_{t-1} + u_t \qquad \text{Equation 7.20}$$

However, in this model, the components are expressed in levels and are therefore likely to be non-stationary. Reparameterisation of equation 7.20 yields a more useful representation, termed an error correction model.

$$\Delta y_t = \beta_1 \Delta x_t - (1-\alpha)[y_{t-1} - \gamma_1 - \gamma_2 x_{t-1}] + u_t \quad \text{Equation 7.21}$$

Where:

$\gamma_1 = \beta_0 / 1 - \alpha$

$\gamma_2 = (\beta_1 + \beta_2)/(1-\alpha)$

$[y_{t-1} - \gamma_1 - \gamma_2 x_{t-1}]$ = the disequilibrium error from the previous period

The EC model shows that a change in the dependent variable depends upon a change in the independent variable and upon the disequilibrium error from the previous period. The further away the dependent is from its equilibrium value relative to the independent, the greater is the immediate increase in the dependent to correct the error, and thus the model is known as an <u>error correction</u> model, or EC model. Since the ECM is integrated of order zero, y_t and x_t must be integrated of order one for this to be a valid model.

The coefficient $(1-\alpha)$ in equation 7.21 measures the extent to which the disequilibrium of the previous period is corrected for in the current period. The disequilibrium term consists of the variables x_{t-1} and y_{t-1} as well as the parameters γ_1 and γ_2, and thus information describing the long-run relationship between the levels and the parameters of that relationship is included in the EC model. β_1 measures the immediate effect of a change in y given a change in x, and is therefore a short-run parameter, as is α.

7.2.6.3 The bivariate error correction modelling method

The error correction modelling method is conducted within the general-to-specific framework to enable the existing and new hypotheses to be tested, as well as to enable the short-run (dynamic) and long-run processes to be modelled simultaneously. The EC models are estimated using the Engle and Granger (1987) two-stage procedure. Firstly, the time series variables to be modelled are regressed upon each other in static long-run equations, with the DDE ratio expressed as the dependent and then the independent variable in each bivariate relationship. If the residuals of such regressions are found to be stationary in the DF/ADF tests then the Granger Representation Theorem states that the variables must have an error correction representation. Secondly, the lagged residuals from the cointegrating bivariate regressions are substituted into a general bivariate differenced dynamic ADL model. Each general model is then reduced using sequential linear restrictions to produce specific-form bivariate EC models.

In the first stage, then, cointegration testing is conducted upon those bivariate relationships which evidenced a cointegrating relationship with the DDE ratio expressed as the dependent variable. However, the bivariate EC analysis seeks to determine whether cointegration also occurs in the opposite direction of causation. For example, although dividend cover and the DDE ratio may form a cointegrating relationship when the DDE ratio is expressed as the dependent variable, it may not be assumed that the variables are also cointegrated when the DDE ratio is expressed as the independent variable. Thus, all of the incidences of cointegration with the DDE ratio as dependent variable are tested to determine whether cointegration also occurs with the DDE ratio expressed as the independent variable in the static long-run regression equations. The static long-run equations are reported for each pair of bivariate relationships, though the standard errors (and thus t-values) of the model coefficients are not reported because they are not consistent in a static regression of non-stationary variables, meaning that the standard errors are not close to the respective standard deviations for the independent coefficient of the underlying model.

As undertaken in the cointegration analysis discussed earlier, deterministic trend tests and Durbin Watson tests are also computed, and where evidence is found of occurrences of the former then a trend is included in the cointegration test equation.

Phillips and Loretan (1991), as an alternative to the Engle and Granger method, suggested that the EC models should be computed using the residuals of ADL models for each bivariate relationship so that the dynamics of any long-run equation are represented in the error correction mechanism. However, as the data time-spans of the European capital structure research are relatively short, this alternative method is not employed as it greatly reduces the number of data observations available for estimation.

In the second stage of the approach, the lagged residuals from each static long-run equation form part of the error correction models to be estimated and tested for linear restrictions. Relating the application to the underlying theory of the EC model, the lagged residuals from the static equation correspond to the term in the square brackets in equation 7.21, and thus the residuals may be described as the disequilibrium errors in the long-run equation. The general form of the EC model to be reduced by linear restrictions is basically a first-differenced ADL (1) model plus a lagged ECM, as given in equation 7.22. Equation 7.22 is merely a simplified, though lag-expanded, version of the EC model in equation 7.21. Initially, each bivariate model is estimated in its full general form. The models are then sequentially and linearly restricted using the two-tail t-test at the five per cent significance level to reduce the specification to a specific form. Models are reduced only up to the point where they still represent a basic EC model, that is, up to the point where the right hand side of the model contains at least one differenced independent variable plus the lagged ECM.

$$\Delta y_t = c_1 + c_2 \Delta y_{t-1} + c_3 \Delta x_t + c_4 \Delta x_{t-1} + c_5 ECM_{t-1} + u_t$$

Equation 7.22

Where:

$\Delta y_t, \Delta y_{t-1}$ = the first differenced dependent variable, lagged zero and one years, respectively

$\Delta x_t, \Delta x_{t-1}$ = the first differenced independent variable, lagged zero and one years, respectively

ECM_{t-1} = the error correction mechanism, or disequilibrium error, from the static long-run equation

u_t = the disturbance

For each bivariate relationship, an EC model is estimated with the DDE ratio as the dependent and the independent variable in turn, but only if the direction of causation for each relationship produces a cointegrating relationship. Once the specific-form EC models are estimated, various diagnostic tests are undertaken to test for model power, autocorrelation, autoregressive conditional heteroscedasticity, and model mis-specification, and the results of these tests are presented in appendix N.

The specification of each final specific model is then compared with specific models proposed by the existing literature hypotheses and the hypotheses of this research, as discussed in section 7.4. Differences and consistencies are both discussed to enable the understanding of the short-run and long-run corporate capital structure processes to be developed.

7.2.6.4 Summary and implications of the method for the structure of the hypotheses

The construction and estimation of bivariate error correction models enables the examination of the processes governing both the long-run and short-run capital structure policies of European firms.

The hypotheses to be tested consist mainly of existing literature hypotheses and new hypotheses deriving from the development of the European capital structure research. The issue of causality in a bivariate capital structure relationship is studied by means of hypotheses relating to the one-way or two-way causation of such relationships and hypotheses relating to the endo-exogeneity of a particular time series variable with respect to the DDE ratio. Thus, the hypothesis testing seeks to extend the examination of model coefficients and dynamics to also consider causality and the endo-exogeneity of variables which demonstrate a relationship with the DDE ratio.

7.2.7 A summary of the methodological approach undertaken in the bivariate time series European corporate capital structure analyses

The time series analyses are designed to determine whether there exist European firm-level optimal capital structures by modelling the inter-temporal variation in the DDE ratio in relation to the inter-temporal variation in various potential taxation, macroeconomic and corporate influences. The analyses examine the short-term (operational) capital structure policies of firms as well as the more important long-term (strategic) policies. Therefore, as well as studying the disequilibrium of the DDE ratio in relation to its key determinants, equilibrium relationships are also determined by studying the long-term error-correction mechanisms by means of cointegration analysis.

The bivariate time series analysis methodology represents a structured progression towards bivariate modelling, whereby the unit root testing, cointegration testing and Granger causality analysis are all preparatory analyses which are essential to the bivariate modelling. The unit root testing and Granger causality analysis enable more robust ADL and EC models to be constructed and estimated. The cointegration testing enables the identification of the most important long-term equilibrating capital structure relationships which may then be focussed upon in the bivariate EC models.

Overall, the methodological approach extends the testing of the central hypothesis to encompass not only short-run disequilibrium relationships but also those long-run equilibrating relationships which characterise the strategic determination of the European corporate capital structure.

7.3 The hypotheses to be tested in the bivariate time series analyses

7.3.1 Introduction

The objective of this section is to introduce the hypotheses to be tested in the bivariate time series analyses of the European corporate capital structure research. The hypotheses are discussed with respect to their theoretical underpinning, which derives both from the existing literature detailed in chapters 2 and 3 and from the new theoretical developments of the European corporate capital structure research. Firstly, the general hypotheses to be tested in the bivariate analyses are discussed, as these may not easily be placed in one particular theoretical grouping of determinants. The sections that follow proceed to develop hypotheses which relate to the taxation, macroeconomic, and corporate environments of the firm. The reason why the hypotheses are grouped by determinant type rather than by the econometric method employed to test them is that it is far easier to discuss the hypothesis linkages with the existing literature across all of the bivariate time series analyses when hypotheses are grouped by determinant type. The grouping of hypotheses by econometric method employed does not facilitate such strong linkages and may also lead to some repetition. Additionally, employing the determinant-grouping approach for the statement and development of hypotheses enables a useful progression from an examination of dynamic right through to a long-run perspective. After the hypotheses are discussed within their determinant groupings, a brief summary is made of the contribution of the set of time series hypotheses towards the testing of the central hypothesis of the existence of firm-level optimal capital structures.

7.3.2 General hypotheses to be tested in the bivariate time series analyses

7.3.2.1 Hypotheses to be tested in the analysis to determine the order of integration of European corporate, taxation and macroeconomic time series variables

There are no explicit hypotheses arising from the existing literature to be tested within the integration testing procedure because the integration tests are performed only as a preparatory stage towards time series model construction and estimation, and such tests produce few insights into the firm's determination of its capital structure. However, it is useful to state a number of expectations concerning the results before the unit root testing is undertaken. Such expectations arise from consideration of the corporate capital structure literature and consideration of the limitations of the data set to be analysed. Firstly, it is expected that most of the variables identified as key variables in the capital structure models up to this point in the European research should be integrated of the same order as the corporate capital structure measure, the DDE ratio, otherwise such key determinants would not have formed significant capital structure relationships. Secondly, it is expected that the weighted sample variables may be integrated of lower orders than the non-weighted variables in certain cases, merely because the former samples give a high weighting to larger European firms within each country whose behaviour is less erratic through time than the sample population as a whole due to their long establishment and diversification. Thirdly, it is anticipated that the short time-span samples, particularly the French sample, may in certain cases contain variables integrated of higher orders than the respective variables in the other samples, as the paucity of the data-span may mean that a trend is identified which proves to be merely a fluctuation over the longer term, and which would have little importance if a longer data-span were available. Therefore, there are no explicit hypotheses to be tested in the unit root testing analysis, as the analysis seeks merely to identify those variables which may be further tested for the existence of a cointegrating relationship with the DDE ratio. There are, however, expectations to be tested which relate to the order of integration of variables of different types and the order of integration of variables from different samples.

7.3.2.2 Hypotheses to be tested in the cointegration tests

There are generally no explicit relational hypotheses to be tested within the cointegration testing of this section, as such testing is conducted only as a preparatory stage towards the construction of error correction models. However, one new hypothesis that is to be tested is that concerning the effect of scale factors, or firm size, upon the occurrence of cointegrating capital structure relationships. Hypothesis H35 states that the weighted data samples are more likely to contain cointegrating relationships than the non-weighted data samples. The reason for this expected phenomenon is that the larger firms across Europe, which are given greater weighting in the weighted samples, are more sophisticated and have access to better quality information, both with regard to their own organisations and in relation to the overall environment of the firm. As a result of this the finance managers of such firms are more likely to adjust their DDE ratios to changes in influencing factors, rapidly adjusting any divergence from a desired capital structure path to again reach an equilibrium. Smaller firms, which do not have access to the same level of information often may not realise that their capital structures are in disequilibrium with the desired capital structure path, given the prevailing influencing factors, and are thus less likely to exhibit cointegrating capital structure relationships because the disequilibrium errors are not continually adjusted to regain an equilibrium capital structure, and thus such errors do not have a mean of zero, producing an error correction mechanism which is non-stationary. Therefore, for the smaller firms these disequilibrium errors are allowed to drift, producing an "error correction mechanism" which does not have a mean of zero and thus is not stationary, but is integrated of some higher order or not integrated at all.

In addition to this new hypothesis, two additional results are expected to arise from the tests. Firstly, it is expected that the majority of the time series will not be cointegrated with the DDE ratio, because it is argued that the finance manager will find it extremely difficult to adjust the desired path of the DDE ratio in the long-run to more than a few important long-term influences. Secondly, it is expected that the shorter the data time-span, the less likely are occurrences of cointegrating relationships to be found, as there may be an insufficient number of observations to produce a significant cointegrating relationship.

Therefore, hypothesis H35 and the two expected results discussed are tested in the cointegration analysis. More importantly, the precise nature of anticipated cointegrating relationships is discussed in more detail when the nature of the error correction models to be estimated is examined.

7.3.2.3 Hypotheses to be tested in the Granger causality tests

The Granger causality testing procedure does not generally enable the hypotheses of this research to be tested individually, as it examines the strength of a particular causal relationship rather than setting out to construct and estimate carefully specified time series models. However, one hypothesis implicitly predominant in the existing empirical literature is that the DDE ratio is the dependent variable in a statistical model containing other capital structure variables, and thus a new hypothesis, H36, is tested in this section. Hypothesis H36 states that the corporate debt-equity ratio is best expressed as a dependent variable in any model containing significant time series capital structure variables. The hypothesis is a general one, to be tested on the basis of the results of the entire set of Granger causality tests. The results of tests for individual time series are discussed and employed later in this research, to support the results of the empirical models constructed and estimated.

7.3.2.4 Hypotheses to be tested in the bivariate autoregressive distributed lag models

The nature of the models expected to result from the ADL modelling analysis derives from the hypotheses underpinned by the existing literature and from the theoretical developments of the European corporate capital structure research. Whilst the empirical literature generally does not suggest the form of lag structures that might appear in any of the bivariate ADL models to be estimated, it does suggest, in conjunction with the theoretical literature, the coefficient sign which forms the basis for each general model. However, it may be that a certain lag structure is anticipated for econometric or theoretical reasons which arise from the development of the European corporate capital structure research, and thus the anticipated lag structure is discussed and included in the general model specification where appropriate. The hypotheses to be tested for the taxation, macroeconomic and corporate determinants of the capital structure are framed within expectations for the overall model specification for each determinant tested. Thus, both hypotheses and model specification expectations are tested when the ADL models are estimated.

7.3.2.5 Hypotheses to be tested in the bivariate error correction models

As discussed in the general hypotheses to be tested in the bivariate ADL models, the existing literature generally produces hypotheses which merely propose the sign of the coefficient of the influencing factor in a bivariate EC model with the DDE ratio expressed as the dependent variable. Therefore, the theory and evidence of the existing literature produces general models with the DDE ratio as dependent variable, whereas it often does not consider the opposite direction of causation, that is, where the DDE ratio is expressed as the independent variable. This may not be problematic, however, as the EC models with the DDE ratio as independent variable are likely to be less common and generally less significant than the EC models with the DDE ratio as dependent variable. This is because the cointegration testing concentrates on identifying cointegrating influences upon the DDE ratio, and thus the EC modelling seeks to discover whether cointegration works in the opposite direction only for those variables for which there is already evidence of a cointegrating relationship with the DDE ratio as dependent variable. Additionally, some of the variables, particularly the taxation and macro economic variables, are by definition strongly exogenous and therefore most likely produce an insignificant EC model when the DDE ratio is expressed as an independent variable. Therefore, the EC models expand upon the hypotheses arising from the existing literature by considering both possible directions of causation in addition to a simultaneous examination of potential short-run and long-run processes.

The general model forms to be discussed throughout sections 7.3.3 to 7.3.5 are differenced ADL models of lag length one year, including the error correction mechanism lagged one year. The specific model proposed draws upon the hypotheses of the existing literature in addition to the results of the testing and modelling of the European corporate capital structure research. The scope for reducing the general model is restricted by the basic form that an EC model must take, as the final specific model should contain a differenced dependent variable, a differenced independent variable, and the lagged ECM as a minimum specification.

To aid specification of the form of the specific models to be tested, two new hypotheses are proposed. Hypothesis H37 states that the European firm responds rapidly to exogenous influence changes, whereas there is a delayed response to changes in endogenous influences. The firm responds rapidly to exogenous changes, such as taxation and macro economic changes, because these generally apply to the whole economy, and if the firm does not adjust for such changes then it may be disadvantaged with respect to it competitors. Such changes are also generally more permanent in nature than changes in endogenous variables, which consist of mainly corporate-level variables, at least with respect to the EC models. The firm may not respond immediately to endogenous variable changes because the finance manager may wait until changes in the internal structure and environment appear to be sustained before adjusting the firm's capital structure. As the DDE ratio may be classed as a fairly endogenous variable, EC models with the DDE ratio as the independent variable may exhibit delayed dependent variable response. Therefore, hypothesis H37 suggests that the greater the degree of exogeneity of the independent variable in each EC model, the more rapid will be the response of the dependent variable to changes in that independent variable. If the hypothesis holds, EC models with an exogenous variable as the independent variable should exhibit little evidence of a lag structure whereas models with an endogenous variable as the independent variable should exhibit greater evidence of a lag structure.

Hypothesis H38 states that the greater the degree of exogeneity of a particular corporate capital structure influence, the more likely that variable is to be a determinant of, and not determined by, the DDE ratio. This hypothesis is based upon the concept of "causal inequality" which proposes that certain variables are so exogenous that there is no way in which changes in another variable may affect the exogenous variable. If hypothesis H38 holds, EC models with a highly exogenous variable as the dependent variable are likely to be very much less significant than EC models with the exogenous variable expressed as the independent variable.

Therefore, the general hypotheses tested in the bivariate EC modelling exercise are generated to aid specification of the specific models to be tested. These hypotheses seek to facilitate an examination of the effect of the endo-exogenous division of variables with respect to the DDE ratio, so that a greater insight may be gained into the dynamics and causal inequality present within the EC models estimated.

7.3.3 The taxation hypotheses to be tested

7.3.3.1 Introduction

Before discussing the specific taxation hypotheses and the theoretical and empirical literature which underpins them, it is useful to re-examine the main conclusions drawn from the taxation literature in addition to the developments of the European corporate capital structure research up to this point, towards a greater understanding of the interaction between the capital structure and the tax environment.

The main conclusion arising from the theoretical and empirical capital structure literature is that there may indeed be a distinct tax advantage to debt. However, this conclusion appears somewhat bold without further explanation and qualification. Firstly, although there may be a distinct tax advantage to corporate debt, there are some key influences of a taxation nature which have the effect of significantly reducing the tax advantage to debt from that proposed in the MM (1963) model, or even eliminating it altogether. Secondly, once it is understood that the tax advantage to debt might in reality be quite small or even insignificant, there may further exist factors which cause a breakdown in any relationship between the tax advantage to debt and the actual gearing employed by firms at a particular point in time.

The Modigliani and Miller (1963) model was the first coherent model to correctly account for the influence of corporate taxes, although it logically implied that firms should employ 99.9 per cent debt in their capital structures to maximise their value. As such extreme gearing positions are not observed across firms, many authors sought to determine what factors might reduce this tax advantage to debt, possibly to the extent that any such advantage is eliminated. Probably the most influential development following the 1963 paper was the Miller (1977) model which proposed that the inclusion of personal taxation in the capital structure model reduced the tax advantage to debt for the individual firm to zero, even though there still occurred an optimum for the market as a whole. Perhaps the next most important influence which reduces the tax advantage to debt is the occurrence of corporate tax exhaustion, whereby the firm's ability to claim the full, nominal tax advantage to debt is "crowded out" by non-debt tax allowances. Authors such as DeAngelo and Masulis (1980), Mayer and Morris (1982), Mayer (1984), and Dammon and Senbet (1988) all produced theoretical models which suggest that the tax advantage to debt is impacted upon differently for different firms as each firm is likely to incur different non-debt tax allowances which produce firm-level optimal capital structure solutions. Other authors such as Franks and Broyles (1979), Pointon (1981), Mayer (1984), Rutterford (1988), and Ashton (1989) sought to determine the influence of the tax system upon the corporate capital structure decision, and proposed that the tax system employed in a particular country exerts a significant impact upon the corporate capital structure, generally reducing significantly, and at times eliminating, any tax advantage to debt. Classical tax systems appear to favour debt finance most, followed by partial imputation systems, although full-imputation systems eliminate any tax advantage to debt altogether. Finally, the structure of tax rates may reduce or eliminate the corporate tax advantage to debt. For example, if the gap between the corporate tax rate and the imputation rate is reduced then the tax advantage to debt is also much reduced. Therefore, although there may be a tax advantage to debt in theory, the effect of personal taxation, corporate tax exhaustion, the tax system in place, and the structure of tax rates may reduce that advantage or even eliminate it.

Whatever the size of the "residual" tax advantage to debt after the additional taxation influences discussed above have been accounted for, there are many factors which may cause a breakdown in a potential positive relationship with the actual DDE ratios employed by firms. One such factor is the stickiness of tax regimes within each country. If the structure of tax rates within a country is constant for many years and then changes suddenly, it may take some time for firms to gauge the effect of this on their optimal capital structures, and therefore the relationship between gearing and the tax advantage to debt breaks down until the equilibrium relationship is again established. Related to this, the general stickiness of tax rates across countries may mean that there is not enough variation in the gearing and the related tax variables to enable a clear relationship to be established. Another factor which may cause a breakdown in an observable relationship between corporate gearing and the tax advantage to debt is the fact that no single measure (such as the tax advantage to debt) can reflect all of the taxation changes in an economy which impact upon such a relationship. For example, the theoretical tax advantage to debt measure does not take into account the firm-specific nature of non-debt tax allowance changes or changes in the personal tax rates of investors in different firms. Finally, non-tax factors such as macroeconomic and corporate influences may be extremely important influences upon any breakdown in a relationship between the tax advantage to debt and observed gearing. Whilst such factors are considered separately in the hypothesis groupings that follow this section, their precise influence upon the relationship between gearing and individual taxation factors is not explicitly considered until the multivariate EC models of chapter 8 are constructed, estimated and interpreted.

As this section describes only those tax hypotheses which are testable, it concentrates on examining those taxation factors which should exhibit a relationship with gearing when they are expressed in their "nominal" or theoretical form and those taxation factors which should exhibit a relationship with gearing when they are expressed in their "effective" form. Therefore, the influence of the nominal tax advantage to debt and the nominal corporate tax rate upon corporate gearing is discussed and expressed in hypotheses to enable such relationships to be tested. The influence of effective tax rates upon gearing is then discussed and hypotheses are expressed to test such relationships.

7.3.3.2 Hypotheses to test the relationship between corporate gearing and nominal taxation variables

The theoretical developments summarised in this section lead to taxation hypotheses of a relationship between the European corporate DDE ratio and the nominal (theoretical) tax advantage to debt and the nominal corporate tax rate, respectively.

MM (1963) argued that a distinct tax advantage to debt exists, resulting from the tax-deductibility of debt interest payments, a model that is supported by evidence from MM (1966), Hamada (1972) and Masulis (1980, 1983). However, the supporting empirics are questioned by Boness and Frankfurter (1977), Freear (1980) and Sametz (1964), mainly on the basis of the shortcomings of the data and method employed. Although Miller (1977) questioned this firm-level optimal capital structure solution, stating that there exists a market equilibrium capital structure ratio in aggregate but no optimum for the individual firm, the assumptions of his model are very restrictive and the model is strongly questioned by the empirics of Kim, Lewellen and McConnell (1979). Therefore, a distinct tax advantage to debt may indeed exist although it is unlikely to be of the magnitude proposed by MM (1963) for European firms, unless the country in which they are positioned employs a classical tax system and a similar structure of tax rates. Franks and Broyles (1979) and Ashton (1989) both note that the tax advantage to debt is different for countries (such as the UK) which have tax systems which do not tax dividends twice - once at the corporate level and then at the personal level, as embodied in the classical tax system. In countries such as the UK, part of the tax advantage can be replicated by the equity holder through home-made borrowing, and thus the net tax advantage to debt represents only that part of the tax advantage which cannot be replicated by equity holders. Therefore, the literature suggests that a tax advantage to debt may exist, but where non-classical tax systems are employed, and depending on the degree of imputation in place, the actual tax advantage to debt is likely to be much less than it is for US firms. It might be expected that this tax advantage to debt, although less than for US firms, should still be highly positively correlated with actual corporate gearing ratios observed across countries, particularly as the capital structure literature of the last few decades has focussed upon taxation as the major determinant of the corporate capital structure. Although King (1977) and Rajan and Zingales (1994) found evidence of such a positive relationship for a range of countries and Norton (1991) found that firms perceived such an influence to be important, the wider ranging studies of Rutterford (1988) and Mayer (1990) found little evidence of a positive relationship. Thus evidence on the relationship between corporate gearing and the tax advantage to debt is mixed although the latter studies which question the relationship are static in nature.

The literature therefore suggests that a tax advantage to debt may exist which is likely to be much less for firms in those European countries which employ some form of imputation tax system, but that little research has been undertaken to investigate the time series relationship between gearing and the tax advantage to debt. Therefore, it is essential to establish whether a positive relationship does exist between the DDE ratio and the tax advantage to debt whilst taking account of the differences in tax systems across the European countries studied in the time series analyses. Hypothesis H6, then, states that the corporate debt-equity ratio increases as the tax advantage to debt increases.

The Miller (1977) formula is customised to produce a tax advantage to debt expression for each of the four countries to be analysed. The original tax advantage to debt expression in the Miller paper is given in equation 7.23.

$$\text{Tax advantage to debt} = \left[1 - \left(\frac{(1-T_c)(1-T_{ps})}{(1-T_{pb})} \right) \right] . B$$

Equation 7.23

Where: T_c = the corporate tax rate

T_{ps} = the tax rate on investor income from equity investment

T_{pb} = the investor tax rate on debt income

B = the market value of the firm's debt

As tax systems and the degree of imputation vary across the countries studied, the tax advantage to debt expressions differ. The tax advantage to debt expressions for UK and French firms are given by equation 7.24, whereas for the Netherlands the expression is merely the corporate tax rate, T_c, multiplied by the market value of the firm's debt, B, and in Germany the tax advantage to debt is zero due to full imputation.

$$\text{The tax advantage to debt in UK and French firms} = \left(\frac{T_c - b}{1 - b}\right)$$

Equation 7.24

Where:

T_c = the corporate tax rate

b = the imputation rate (which equals the basic rate of income tax (INCTAX) in the UK and equals the constant 1/3 for France)

In the ADL models to be estimated, the key model component should be the positive coefficient independent variable (labelled TAXADV in the analysis). As the current DDE ratio is strongly influenced by the current and past tax advantage to debt measures because the tax advantage has both stock and flow dimensions, then there may be lag structures present for the independent variable to represent this phenomenon. Another factor which may influence the strength of the DDE ratio response to a change in the nominal tax advantage to debt is the scale of the firm. As smaller firms do not have the sophisticated information systems in place to enable them to gauge the current and expected effective tax advantage to debt, they may exhibit a greater relationship between gearing and the nominal tax advantage to debt than larger firms. Larger firms are likely to better understand that they should adjust their capital structures only to changes in the effective tax advantage to debt, taking account of factors such as current and expected tax exhaustion. Therefore, a behavioural dichotomy may be exhibited in the estimated ADL models whereby the nominal tax advantage to debt models are stronger for the non-weighted than for the weighted samples. In summary, the nominal tax advantage to debt ADL models should exhibit positive coefficient independent variables, weak autoregressive processes, independent variable lag structures, and the estimated models should be stronger for the non-weighted than for the weighted samples.

As the nominal corporate tax rate is a good proxy for the nominal tax advantage to debt, the theoretical and empirical underpinning of its relationship with the DDE ratio is only briefly discussed. Most of the theory discussing this relationship merely forms part of the wider tax advantage to debt theoretical models which dominate the capital structure literature. Few studies discuss the separate relationship between gearing and the nominal corporate tax rate alone. DeAngelo and Masulis (1980), however, argued that firms will substitute debt for equity financing as the corporate tax rate is raised, although Litzenberger and Talmor (1989) argued that corporate tax rate changes exert a neutral effect as investors can hedge against such changes. Evidence supporting a relationship between gearing and the corporate tax rate is mixed, as Taub (1975) finds evidence of a negative relationship (1975), Zwick (1977) finds no evidence of a relationship and Holland and Myers (1977) find evidence of a positive relationship. The casual empirics of chapter 4 suggest that no such relationship exists, at least in a cross-sectional perspective. Therefore, the theory and evidence related to the relationship between the DDE ratio and the nominal corporate tax rate is mixed, although both intuition and the vast body of "tax advantage to debt" literature would advocate a positive relationship as the nominal corporate tax rate is a good proxy for the nominal tax advantage to debt.

Hypothesis H8, then, states that the corporate debt-equity ratio increases with the corporate tax rate. In the ADL models to be estimated, the model specification should be very similar to that of the tax advantage to debt models discussed in this section. Indeed, for the Dutch samples, the tax advantage to debt measure equals the nominal corporate tax rate anyway, due to the classical tax system in the Netherlands, and for the UK and French models the nominal corporate tax rate proxies the nominal tax advantage to debt. However, it may be argued that the nominal corporate tax rate is a more direct measure for firms to understand than any computed tax advantage to debt, and thus the capital structure response to changes in the corporate tax rate should be fairly immediate, and not lagged. Therefore, the nominal corporate tax rate (CTRATE) ADL models should exhibit positive coefficient independent variables with no lags, weak autoregressive processes, and the estimated models should be stronger for the non-weighted than for the weighted samples.

The bivariate EC model extends the analysis to examine not only the short-run, but also the long-run relationship between the corporate capital structure and the nominal corporate tax rate. As the nominal corporate tax rate is a readily available and easily understood taxation determinant of the corporate capital structure because it is a good proxy for the more complex nominal tax advantage to debt measure, it is far more likely that this measure forms an equilibrating long-run relationship with the DDE ratio than a computed tax advantage to debt measure. It is noted that, even though there may be a two-way cointegrating relationship between the DDE ratio and the nominal corporate tax rate measure, any model with the tax rate measure expressed as the dependent variable is not underpinned by theory and is not logical due to the super-exogeneity of the tax rate measure with respect to the DDE ratio. Therefore, such a model is not specified or discussed in this section. As the nominal corporate tax rate measure does not take account of the complex factors which are necessary to compute the effective corporate tax rate measure, it is expected that such a measure is more likely to be monitored by smaller quoted firms which do not have in place the sophisticated information systems necessary for such a computation. Therefore, it is expected that a long-run cointegrating relationship should be observed only for the smaller firm, given greater representation in the non-weighted samples. The nominal corporate tax rate EC model, then, should exhibit a positive coefficient dynamic independent variable, a significant ECM (error correction mechanism), and it is expected that such a model would be observed for non-weighted rather than weighted samples.

Therefore, the existing theoretical and empirical literature, consideration of the developments of the European research, and the nature of the econometric techniques to be employed lead to hypotheses of the relationship between the DDE ratio and the nominal tax advantage to debt and the nominal corporate tax rate, respectively, and to specific-form models which embody these hypotheses. As the nominal taxation variables do not contain the information required to render them useful to more sophisticated (generally larger) firms, it is expected that, in general, smaller firms will demonstrate clearer bivariate relationships between their corporate capital structures and such nominal taxation variables.

7.3.3.3 Hypotheses to test the relationship between corporate gearing and effective taxation variables

This section discusses the theoretical underpinning of hypotheses to test a relationship between the European corporate DDE ratio and the effective corporate tax rate and the effective total tax rate, respectively. The effective tax rate measures take into account those factors which reduce the nominal tax advantage to debt to the effective tax advantage to debt. However, as the effective tax advantage to debt is extremely complex to compute across the samples and the time spans studied, the effective tax rates are instead modelled as proxies to the effective tax advantage to debt. Indeed, the lower is the effective corporate tax rate to the firm, the lower will be any effective tax advantage to debt as factors such as tax exhaustion reduce the firm's tax bill and thus "crowd out" its ability to utilise the tax benefits associated with debt.

Many of the factors which are likely to reduce the tax advantage to debt from that proposed by the MM (1963) paper have already been accounted for in the nominal tax measure hypotheses discussed in the previous section. Indeed, the nominal tax advantage to debt measure computed takes into account the tax system, structure of tax rates, and the effects of personal taxation, whilst the nominal corporate tax rate measure takes into account the corporate tax rate applicable through each sample period. However, what is not taken into account in the "nominal" taxation measures is the possibility of corporate tax exhaustion, and thus it is useful to examine the actual tax bills paid by European firms to gauge the effective corporate tax rate and the effective total tax rate. It might be argued that the relationship between the corporate capital structure and the effective corporate tax rate (CTAXRATIO), and the effective total tax rate (TAXRATIO), also measure the interaction of the corporate capital structure and the magnitude of the relative tax bill, thus rendering such measures important to any strategic tax reduction policies.

However, before the hypotheses concerning these two effective taxation measures may be stated and employed as the basis for any econometric modelling of bivariate corporate capital structure relationships, the theory underpinning the differential between the nominal and the effective tax rate (or tax advantage to debt) must first be reconsidered. This theory centres upon the influence of corporate tax exhaustion upon the gearing decisions of the firm. The occurrence of tax exhaustion may limit any tax advantage to debt by "crowding out" the ability of the firm to claim the full nominal tax advantage. Tax exhaustion occurs where a firm has a surplus of capital (or other) allowances or losses carried forward over taxable profits. DeAngelo and Masulis (1980) argued that the mere presence of non-debt tax shields was sufficient to overturn the Miller capital structure irrelevancy proposition, and that tax exhaustion occurs well before bankruptcy costs might act as an offset to any tax advantage. Mayer and Morris (1982) extended this concept, arguing that the tax allowances which produce such tax offsets depend on the asset structure, activity and earnings of the firm. Mayer (1984) introduced uncertainty to the analysis, arguing that the tax deductions of the firm depend on both the financial and investment policies of the firm, and thus the financial and real decisions of the firm may not be isolated as they are intrinsically linked. Indeed, the presence of corporate tax exhaustion is capable of producing a capital structure optimum which holds even in the absence of institutional constraints. Finally, Dammon and Senbet (1988) extended the DeAngelo and Masulis model, distinguishing between the income and substitution effects of investment tax shields on the tax advantage to debt. Overall, the authors propose that there is likely to be a difference between the nominal and the effective tax advantage to debt (or corporate tax rate) due to the influence of non-debt tax allowances.

DeAngelo and Masulis (1980), Mayer and Morris (1982) and the Government Green Paper on Corporation Tax (1982), provide empirical evidence that tax exhaustion is a significant phenomenon in US and UK finance markets. DeAngelo and Masulis (1980), Mayer and Morris (1982), Cordes and Sheffrin (1982), Long and Malitz (1983), Rutterford (1988), and Mackie-Mason (1990), further provide evidence that tax exhaustion is not only significant, but also significantly reduces the effective tax advantage to debt, thus reducing the demand for gearing across firms.

In summary, there is strong theoretical reasoning to suggest that corporate tax exhaustion offsets to some degree the tax advantage to corporate debt, thus placing limits on the individual firm's demand for debt. Empirical evidence suggests not only that this tax exhaustion effect is a widespread phenomenon across various countries, but also that it is negatively related to the degree of gearing held by firms.

The measures to be modelled in this section are theoretically underpinned from two similar yet distinct perspectives. The first measure to be modelled is the corporate tax ratio (labelled CTAXRATIO), which is merely the ratio of the corporation tax paid by the firm to its profits. The second measure is the total tax ratio (labelled TAXRATIO), which is the ratio of the total tax paid to profits.

The first theoretical perspective which proposes a relationship between the corporate capital structure and each measure is that underpinned by the taxation literature discussed above. There should be a positive relationship between the amount of gearing employed by the firm and the corporate tax rate, particularly where the nominal tax rate is adjusted to take account of factors such as tax exhaustion, to give the effective tax rate. This leads to the testing of hypothesis H8, this time for the effective rather than the nominal corporate tax rate. Hypothesis H8, then, states that the corporate debt-equity ratio increases with the corporate tax rate. Whilst it is the corporate tax ratio which is of main interest here, the more general total tax ratio may also exhibit a positive relationship with corporate gearing.

The second theoretical perspective which proposes a relationship between the corporate capital structure and each measure is related to the tax-reduction strategies of firms. If the finance manager observes a tax ratio which is high relative to the historical average for that particular ratio, then he or she will be more willing to engage in a tax-reduction strategy to reduce that tax bill. It is proposed that the manager might achieve such tax-reduction either by adjusting the investment policy of the firm to gain the benefits of extra non-debt allowances or by adjusting the mix of the corporate capital structure to gain the benefits of extra debt-related tax allowances. It is argued that the latter response is more likely as the former response might detrimentally affect the investment projects of the firm, whereas the latter merely causes the nature of the total claims on the firm's cash-flow to change. Hypothesis H31, then, states that the corporate debt-equity ratio increases as the relative tax bill increases. This tax-reduction perspective on the relationship between corporate gearing and the two tax ratio measures differs from the effective tax rate perspective in that the former represents a more proactive firm response to changes in the "tax-attractiveness" of gearing and the latter represents a more reactive corporate capital structure response to relatively higher than normal tax bills.

Whilst the ADL models to be estimated may not clearly distinguish between the two perspectives, they do enable the two hypotheses to be tested, at least with respect to the short-run time-frame of the firm. If hypotheses H8 and H31 hold, the coefficients of the taxation independent variables should be positive because an increase in the effective tax rate signals an increase in the tax advantage to debt thus encouraging increased gearing and because an increase in the relative tax bill should encourage increased gearing as part of a wider tax-reduction strategy. Although the bivariate models of chapter 5 question a positive relationship, showing instead evidence of a weak negative relationship, the interpretation of these earlier models was made somewhat uncertain by the causation uncertainty which characterised them. Additionally, the logistic regression models do not lend support to the positive coefficient proposed, although such models sought to examine the marginal capital structure decision, rather than the short-term decision. The two theoretical perspectives may be distinguished to some small degree by the independent variable lag structures which they imply. The first perspective implies an immediate capital structure response to changes in the attractiveness of debt, thus suggesting the absence of a lag structure. The second perspective, however, implies a delayed capital structure response to a historically high tax bill. The delay may be caused by firms taking time to assimilate the new information contained within the higher than average tax bill, a delay which may be compounded by the "lumpiness" of capital structure issues, whereby significant economies of issue costs cause firms to issue new claims on block rather than continuously. The specific ADL models for the CTAXRATIO and TAXRATIO variables, then, are expected to be autoregressive distributed lag models which exhibit positive coefficient independent variables. The length of the independent variable lag structures may provide some evidence to distinguish between the two alternative theoretical underpinning perspectives.

The total tax ratio EC model is constructed and estimated for the purpose of testing hypothesis H31 in the long-run. Indeed, if hypothesis H31 holds then tax-reduction is a long-run strategy of firms rather than a change in the relative tax bill merely giving rise to an operational capital structure adjustment. Thus, such a model is extremely important as it seeks to test whether tax-reduction is a long-run strategic objective of the firm. The results of the model should be considered in conjunction with the results of the (nominal) corporate tax rate EC model, specified in the previous section, so that it may be ascertained not only whether firms' capital structures are affected by taxation changes in the long-run, but also whether such firms react to such changes as part of a wider tax-reduction strategy. As a long-run tax-reduction strategy requires sophisticated information systems to enable the utilisation of an optimal mix of financial and investment tax allowances, it is expected that larger firms, given greater representation in the weighted samples, are more likely to track the movement of the capital structure ratio in relation to the total tax ratio in the long-run. The total tax ratio EC model, then, should exhibit a positive coefficient dynamic independent variable, a significant ECM, and it is expected that such a model would be observed for weighted rather than non-weighted samples.

In summary, the nominal tax advantage to debt and the nominal corporate tax rate are reduced in the real world by factors such as corporate tax exhaustion to give the effective tax advantage to debt and the effective corporate tax rate. To measure the latter measure, which is also a good proxy for the former measure, tax ratios are computed and are tested in bivariate capital structure models. The construction and estimation of such models enables the consideration of two theoretical perspectives which suggest such a capital structure relationship - one of which is based in the effective tax advantage to debt literature and the other which is based on the reaction of the finance manager to a higher-than-normal tax bill.

7.3.3.4 Summary

This section sought to firmly link the existing theoretical and empirical literature and the results of the European corporate capital structure research up to this point to the hypotheses to be tested by means of the specification and estimation of bivariate ADL and EC models. It is argued that the tax advantage to debt is likely to be very much less than that proposed by the MM (1963) model, due to the influence of personal taxes, the tax system in place, and the structure of tax rates. Such factors produce a reduced nominal tax advantage to debt for firms, which is then further reduced to the effective tax advantage to debt by the influence of factors such as tax exhaustion. In addition to the differential between the nominal tax advantage to debt proposed in the MM model and the effective tax advantage to debt, there are numerous other factors which cause a breakdown between corporate gearing and such tax benefit measures, the most important of which are considered in the hypothesis sections to follow. To test the relationship between the capital structure and the reduced nominal taxation measures, the tax advantage to debt and the corporate tax rate, ADL models are specified. Additionally, an EC model is also specified to test the relationship between gearing and the nominal corporate tax rate. To test the relationship between the capital structure and the effective taxation measures, the corporate tax ratio and the total tax ratio, ADL models are specified, in addition to an EC model for the total tax ratio.

7.3.4 The macroeconomic hypotheses to be tested

7.3.4.1 Introduction

It is useful to re-examine the theoretical and empirical literature underpinning the macroeconomic hypotheses to explain how such hypotheses are to be tested in the bivariate time series models. The macroeconomic hypotheses to be tested are those related to the bivariate relationship between corporate gearing and inflation, financial market performance factors, and aggregate growth factors. Each of these relationships is explored with respect to its theoretical and empirical underpinning, to enable the respective hypotheses to be developed and, moreover, to enable the resulting econometric models to be specified in such a manner that they correctly reflect the underlying theory.

7.3.4.2 Hypotheses to test the relationship between corporate gearing and inflation

Reconsideration of the underlying literature leads to three possible causes of a positive relationship between corporate gearing and inflation. The first cause is that proposed by authors such as Corcoran (1977), who argued that the relationship depends on the extent to which inflation and interest rates rise together. If they rise equally then the real cost of debt finance will fall approximately by the amount of the increased real tax deductions. Therefore, a positive relationship arises because higher inflation causes higher interest rates and thus higher tax-deductions on corporate debt interest. The second cause is that proposed by authors such as Franks and Broyles (1979), who argued that the relationship between corporate gearing and inflation depends very much on the extent to which expectations are reflected in interest rates. If inflation exceeds that expected then firms will gain at the expense of investors and if inflation is less than expected then investors will gain at the expense of firms. If inflation exceeds expectations then the firm gains as it is essentially repaying "cheaper" pounds to investors whilst not compensating them fully through adequate interest rate increases. In this perspective, a positive relationship can only exist in the long-run if investors may be consistently fooled with respect to interest rate expectations. There are, however, two reasons why this is unrealistic. Firstly, investors are usually assumed to be rational economic agents who may not be fooled consistently through time - eventually they learn from their mistakes. Secondly, investors in a number of European countries are predominantly institutions, which are surely not naive enough to be fooled consistently. Both of these reasons depend upon whether rational expectations are believed to drive financial markets. Therefore, whilst both firms and investors are making "inflation bets", only if the former tend to "win" more often than the latter is there going to be a positive relationship between corporate gearing and inflation. The third cause of a positive relationship is that proposed by authors such as DeAngelo and Masulis (1980) who argued that inflation decreases the real value of investment allowances thus reducing the "crowding out" of debt tax-deductions and encouraging extra gearing. Therefore, a positive relationship between inflation and gearing arises through the influence of inflation and non-debt tax allowances.

Whilst there are many other papers which suggest other causes of a relationship, such as the papers of Zwick (1977) and Modigliani (1982), such papers tend to present variants of the three causes discussed and even then they predominantly propose a positive relationship. However, one exception is a paper by Schall (1984) who proposed a negative relationship because, in inflationary conditions, investors sell debt in exchange for equity because the real after-tax return on equity becomes relatively higher than the return on debt, while the net return on both declines. However, Kim and Wu (1988) explained this apparently conflicting argument by suggesting that inflation decreases the demand for debt if the debt yield becomes relatively lower than the equity yield, but the supply of debt will increase if the tax-deductibility effect related to debt exceeds the tax-deductibility effect related to inflation.

Thus, there exists overwhelming theoretical underpinning for a positive relationship between corporate gearing and inflation. The empirical evidence of Zwick (1977), Corcoran (1977), Holland and Myers (1977), Rudolph (1978), and Kim and Wu (1988) supports such a relationship, and thus the hypothesis to be tested must reflect the strong theoretical and empirical support for a positive relationship. If a positive relationship is identified in the econometric time series models to follow, it may not be clear whether such a relationship exists for reasons related to the first, second or third cause discussed above. However, the second cause discussed may be strongly questioned as the demand-side of European bond markets is dominated by institutional investors who are unlikely to be consistently fooled with respect to inflation expectations. Thus, any positive relationship must be the result of either the interest rate effect (the first cause) or the reduction in crowding out effect (the third cause). Hypothesis H10, then, states that the corporate debt-equity ratio increases with increases in the inflation rate.

The ADL model is expected to exhibit a positive coefficient independent variable if hypothesis H10 holds, due to the interest rate effect or the reduction in crowding out effect. As the inflation variable (labelled INFLATE in the analysis) is extremely exogenous with respect to the DDE ratio, there is expected to be little evidence of a lag structure because the increased utilisation of any tax advantage to debt and the diminution of the crowding out effect of non-debt tax allowances will have immediate effects. As the equity component of the denominator of the DDE ratio is measured in market value terms, it may be expected that the coefficient of any relationship found is negatively biased, as an increase in the rate of inflation will reduce the DDE ratio to some extent merely due to the definition of the DDE ratio alone. However, if a positive relationship is still found to exist, given this bias effect, then this strengthens any support for the hypothesized relationship. The model seeks to determine whether there is any inflation influence on the operational (short-term) capital structure decision of the firm, or whether it is better expressed as a strategic influence. Therefore, the specific inflation ADL model is expected to be a partial adjustment model, exhibiting a positive coefficient independent variable and no lag structure.

The construction and estimation of the inflation EC models seeks to determine whether inflation is a strategic influence on the corporate capital structure as well as being an operational influence. Again, the dynamic independent variable is expected to be positive if hypothesis H10 holds. The inflation dynamic independent variable modelled in the EC models is the relative change in inflation, known as the pace of inflation. If hypothesis H37 holds, then the model dynamic variables should not exhibit lag structures as there should be an immediate capital structure response to a change in the pace of inflation. Although inflation may appear as a dependent variable in models for certain samples, the specification of such models is not discussed due to the causal inequality caused by the super-exogeneity of inflation with respect to the corporate capital structure. Therefore, the inflation EC models are expected to exhibit positive coefficient non-lagged independent variables for the pace of inflation and significant ECM's.

Therefore, there are a number of differing theoretical reasons why there should be a positive relationship between the corporate capital structure and gearing, and it is clear that the existing empirical evidence supports such a positive relationship. However, the theory which suggests that firms can consistently transfer welfare from investors appears somewhat unrealistic in the European corporate capital structure perspective as investors are predominantly institutions, which are not easily "tricked" by firms. (It is noted, however, that the strength of this assertion depends on the theoretical stance taken by the economist, as institutional economists, for example, may dispute it.) There thus remain two alternative theories which suggest a positive relationship which are termed the interest rate effect and the reduction in crowding out effect. The theories lead to the hypothesis, then, of a positive relationship between gearing and inflation which is to be examined by means of model construction and estimation. The estimation of the ADL models seeks to determine whether inflation exerts an operational influence on gearing whereas estimation of the EC model seeks to determine whether the pace of inflation seeks to exert a strategic influence on the firm's gearing decision.

7.3.4.3 Hypotheses to test the relationship between corporate gearing and financial market performance factors

The capital structure chosen by the finance manager of the firm may not be set without careful consideration of the state of the financial markets from which new tranches of debt and equity are raised. Thus, it is essential for the finance manager to gauge the strength of demand for new debt and equity claims on the firm before issuing the form of financial instrument which is most appropriate. The state of equity markets may be measured by the stock market index whereas the state of debt markets may be measured by various interest rate measures.

Many authors proposed that finance managers were more likely to issue equity when the stock market is performing strongly. Martin and Scott (1974) argued that equity issues are more likely when equity prices are buoyant and price-earnings ratios are thus high. King (1977) and Marsh (1982) argued that managers are more likely to issue equity after periods of strong equity market performance. Therefore, the authors suggest that positive signals of stock market performance are likely to encourage finance managers to issue new equity in preference to new debt. Martin and Scott (1974) and Marsh (1982) found evidence of this, although King (1977) found no such evidence.

Therefore, the theoretical and empirical literature generally support a positive relationship between the proportion of equity in total external funds and the stock market index in a particular sample. Hypothesis H12 states that the corporate debt-equity ratio is negatively related to stock market performance. This negative relationship between gearing and the stock market index arises because equity appears in the denominator of the DDE ratio.

In the ADL models, there should be a negative coefficient independent variable (labelled SMIND in the analysis) if hypothesis H12 holds. Although the stock market index (the independent variable) is extremely exogenous with respect to the DDE ratio, there may still be a lag structure present as the finance manager may wait until there is some evidence of sustained improvements in stock market performance before issuing new equity as he or she is unwilling to issue equity when its current price is depressed. The lag structure may thus be up to one or two years to satisfy the manager's confidence in a new issue. Therefore, the specific model for the stock market index is expected to be an autoregressive distributed lag model, exhibiting negative coefficient independent variables.

Theoretically, there should be a similarly strong correlation between the likelihood of the firm to issue debt and conditions in bond markets. Indeed, Marsh (1982) argued that the level of debt issuance is related to the performance of bond markets such that managers are more likely to issue debt when interest rates are low or are expected to rise, finding evidence in his empirical study to support this proposition. The key implication of Marsh's theory for the empirics of this research is that the finance manager is more likely to increase gearing when interest rates are low. Although this interest rate effect is more important at the margin, it should be observed through time even though the effect may be diluted by the examination of stock rather than flow measures. Therefore, there should be a negative relationship between the DDE ratio and the interest rate measures.

Hypothesis H13 states that the corporate debt-equity ratio increases as debt interest rates decrease. This relationship, however, gives rise to the following question: which particular interest rate measure should demonstrate a clear relationship with corporate gearing? Interest rate measures might be classified into three types: short-term, medium-term, and long-term rates. It is argued that the finance manager is more likely to adjust the long-term external funding stock measure, the DDE ratio, to longer-term interest rate measures because he or she will largely ignore fluctuations in interest rates, particularly those embodied in the short-term rate. Indeed, it would be prohibitively expensive to make adjustments to the DDE ratio as a result merely of short-term interest rate fluctuations. However, evidence of sustained lower interest rates should be signalled to the manager by reductions in medium-term and long-term rates, and thus it is these latter rates which may exhibit a negative relationship with the DDE ratio.

In the ADL models, there should thus be significant, negative coefficient independent variables in models which describe the bivariate capital structure relationship with the longer-term interest rates (labelled LRINT and LRINT in the analysis). Shorter-term interest rate measures (labelled SRINT) should form weaker estimated models. A potential problem inherent in the interest rate models is that the equity component in the denominator of the DDE ratio is measured in market value terms and may thus be highly correlated with the interest rate measures which are expressed in nominal terms. This means that any relationship found is negatively biased as an increase in the rate of inflation will reduce the DDE ratio and will increase nominal interest rates by definition alone. This bias effect may strengthen any negative relationship found and weaken any positive relationship found between the DDE ratio and the interest rate measures. The effect of this may be that the DDE ratio will appear to be related to certain interest rate variables even if the underlying relationship is poor, due merely to the effect of inflation. This effect highlights the need to qualify the results of such models carefully. The estimated models are therefore expected to be more significant for the longer-term interest rate independent variables, and should exhibit autoregressive distributed lag specifications.

Although there may be a relationship found between corporate gearing and the longer-term interest rate measures, this may be merely a significant influence on the operational capital structure decision of the firm thus exerting little influence on the strategic determination of the DDE ratio. In order to test this statement, it is necessary to construct and estimate a bivariate error correction model for interest rate measures demonstrating a cointegrating relationship with the DDE ratio. The only relationship of this nature is that between the DDE ratio and medium-term interest rates (labelled MRINT in the analysis). If hypothesis H13 holds, then, the EC model is expected to exhibit a negative coefficient dynamic independent variable. It is noted at this point that if a positive coefficient is found then this may question the supply-side bias inherent in the hypothesis, that is, why should the market for debt be "driven" by firms? From the perspective of the demand side, investors would only demand debt when interest rates are relatively high, or expected to decrease in the near future, which is the antithesis of the Marsh (1982) theorem. If hypothesis H37 holds, then the capital structure response to a change in interest rates is likely to be rapid, due to the super-exogeneity of interest rates with respect to the capital structure. The interest rate EC model should, then, exhibit a significant negative coefficient independent variable with no lag structure, in addition to a significant ECM.

In summary, the theoretical and empirical literature suggests that corporate gearing is strongly related to the performance of financial markets. Equity issues are more likely when equity markets have been performing strongly and debt issues are more likely when interest rates are low or are expected to rise. ADL models are estimated to examine the relationship between gearing and the stock market index, whereas both ADL and EC models are estimated to examine the relationship between gearing and various interest rates.

7.3.4.4 Hypotheses to test the relationship between corporate gearing and aggregate growth factors

The aggregate growth factors (or macroeconomic activity factors) are introduced to the analysis to determine what effect the economic cycle has, if any, on the gearing of firms. The two factors to be discussed and then modelled are aggregate output and aggregate investment, and these are considered not in levels form, but in percentage change form. This enables examination of the relative growth or decline of output and investment in the economy as potential influences upon corporate gearing.

The theory underpinning the relationship between corporate gearing and the growth factors is relatively underdeveloped as authors generally concentrate on the influence of other characteristics of the macroeconomy such as inflation and financial markets performance factors. However, Rudolph (1978) constructed a theoretical model of the effect of the economic environment on balance sheet items, predicting that as an economy moves from recession to recovery firms should raise their gearing ratios. However, the empirical testing that he conducted did not support this theoretical hypothesis.

Although the finance literature questions any clear relationship between corporate gearing and the aggregate growth factors, there are some intuitive reasons why such relationships might exist, in addition to some preliminary evidence supporting their inclusion as potential determinants. The discussion of section 6.4 argued that firms should greatly increase their long-term debt financing towards the perceived end of a recession to finance investments, to cope with the increased demand associated with eventual recovery. At such a stage in a recession, debt financing may be preferred to equity financing as firms may be unwilling to issue equity when equity prices are depressed. Casual evidence presented in the data plots suggests that there is little observable relationship between the DDE ratio and the percentage change in output through time, although there is some evidence of a positive relationship between the percentage change in investment whereby an increase in investment precedes an increase in gearing by one or two years. It is inferred that firms may be investing their way out of recessions, financing through retentions initially, then through long-term debt as retentions become exhausted. Thus, it is apparent from this casual empiricism undertaken earlier that it is not so much the economic cycle as a whole which determines changes in corporate financing, but the timing of recovery-phase investments which determines such changes.

The bivariate time series analyses seek to determine whether the results of the casual empirics are supported or questioned by more formal econometric modelling and testing. Hypothesis H39 states that the corporate debt-equity ratio increases with increases in aggregate output. Hypothesis H40 states that the corporate debt-equity ratio increases with increases in aggregate investment.

The ADL models to be estimated seek to determine whether aggregate output (labelled GDP or GNP in the analysis) or aggregate investment (labelled INVEST) are significant influences upon the operational capital structure decision of the firm. Both measures are expressed in percentage change forms in the analysis. It is argued that both aggregate growth factors should exhibit a positive relationship with corporate gearing if hypotheses H39 and H40 hold. If the recovery-phase investment concept is supported then the investment models estimated should be more significant than the output models estimated. As there is likely to be some lag between a recovery in aggregate investment or output and corporate gearing, whilst firms are depleting internal funds, it is expected that a lag structure of one or two years may be present within each model. The specific models for the aggregate output and investment measures, then, are expected to be deadstart models (exhibiting no significant contemporary independent variable effects), with lag structures of one or two years, exhibiting positive coefficient independent variables.

Therefore, aggregate output and investment measures are introduced to the time series analysis to gauge the sensitivity of corporate gearing to wider macroeconomic cycles. Hypotheses are developed mainly from intuitive macroeconomic theory and preliminary casual empirics, suggesting a positive relationship between corporate gearing and each measure. Such hypotheses are tested by means of ADL models to examine the influence of such aggregate growth factors on the operational capital structure decision of the firm.

7.3.4.5 Summary

The objective of this section was to discuss the theoretical underpinning of potential relationships between corporate gearing and various macroeconomic factors. There may be a positive relationship between corporate gearing which does not rely on a "inflation tax" effect, as it may be caused by other factors such as an "interest rate effect" or a "reduction in crowding out effect". Such a relationship is examined by means of both ADL and EC models. Corporate gearing may be negatively related to stock market performance and negatively related to longer-term interest rates, due to the desire of finance managers to raise additional external finance when market conditions are favourable to the firm. To examine the former relationship, ADL models are estimated, whereas for the latter relationship both ADL and EC models are estimated for the purpose of determining the nature of the relationship as well as determining which interest rate measure is most correlated with corporate gearing. Due to the scarcity of literature, intuitive macroeconomic theory is discussed to examine any relationship between gearing and aggregate output and investment, respectively. It is anticipated that investment will be a stronger determinant of corporate gearing as the expansion of investment in the recovery phase of an economic cycle is likely to require funds exceeding the internal funds of the firm. Therefore, ADL models are constructed and estimated for the relationship between gearing and aggregate output and investment, respectively.

7.3.5 The corporate factor hypotheses to be tested

7.3.5.1 Introduction

The importance of the bivariate relationships between gearing and corporate-level factors lies in the firm-specific nature of such factors. The taxation and macroeconomic hypotheses are developed to examine the influence of external factors upon the corporate capital structure. However, there are likely to be influences upon gearing which are specific to each individual firm. For example, a firm with very low profitability is unlikely to adjust its capital structure towards an extreme gearing position as the future income streams of the firm are unlikely to cover the commitments associated with servicing the additional debt. Thus, the current accounting structure of the firm has a potentially important impact upon the firm's capital structure decisions. Indeed, without such firm-specific influences it might be argued that a unique optimal capital structure might not occur. Examination of the corporate factors, then, enables the uniqueness of any optimal capital structure solution to be considered.

Another important extension to the analysis afforded by the examination of corporate-level capital structure influences is the consideration of factors which may be endogenous with respect to the firm's capital structure. The taxation and macroeconomic factors examined up to this point have largely been super-exogenous. The endogeneity of some of the corporate-level factors means that they may be better considered in models where the DDE ratio is itself the determinant or independent variable. Thus, the DDE ratio may not only be determined by its environment, but may also radically influence that environment, at least at the corporate level. As the interaction of the capital structure with its environment may occur from either direction of causation, factors which are exogenous or endogenous with respect to the capital structure must be examined. However, it is noted that the ADL models to be specified and estimated solely to test hypotheses arising from the existing literature model corporate variables as independent variables because such literature does not consider corporate variables to be anything other than determinants of the DDE ratio. Thus, such models are estimated only where the DDE ratio is specified as the dependent variable. The EC models, however, do enable key corporate factor variables to be examined in bivariate models which are estimated for either direction of causation.

The corporate level factors are divided into three groups: those factors related to the scale of the firm; those factors related to the ability of the firm to support new debt; and those factors related to the returns from the firm's projects. The underlying theoretical and empirical literature for each variable grouping is reconsidered to enable the hypotheses to be framed within the perspective of the existing literature.The hypotheses are then employed to develop the bivariate time series corporate capital structure models to be estimated.

7.3.5.2 Hypotheses to test the relationship between corporate gearing and firm scale factors

Many authors agree that the scale of the firm has a significant influence on its capital structure decision, particularly at the margin. The scale factors which are to be modelled are firm size and firm growth, by means of ADL models and an EC model respectively. The theory and evidence underpinning a relationship between corporate gearing and firm size is discussed first, followed by that underpinning a relationship with firm growth.

Although many authors agree that firm size is an important determinant of the corporate capital structure, they do not all agree on the precise nature of such a relationship. The majority of authors propose a positive relationship between gearing and firm size, for differing theoretical reasons. Martin and Scott (1974) and Marsh (1982) propose a positive relationship as they argue that larger firms have greater opportunities in financial markets than smaller firms, in particular lower debt flotation costs. Remmers et al (1974), Taub (1975), and Rajan and Zingales (1994) all argue that larger firms are less risky and thus have greater ability to support higher gearing than smaller firms due to their reduced probability of bankruptcy risk, greater diversification, and stronger assets base. All of the authors except Remmers at al found evidence to support the positive relationship, and even Remmers et al accept that the reason they did not find such a relationship may be related to the fact that they only examined the very largest firms in each of the populations they studied.

However, Gupta (1969), Titman and Wessels (1988), and Remolona (1994) all propose a negative relationship between gearing and firm size, because, for example, it is argued that smaller firms are less likely to issue equity than debt at the margin as they are reluctant to lose further control to external equity holders. Whilst they found evidence to support this negative relationship in their empirical testing, they note that it is likely that the higher debt levels of smaller firms may be short-term rather than longer-term debt. As the European corporate capital structure research seeks to focus on the long-term financing mix of the firm, evidence of a negative relationship between short-term debt and firm size does not weaken the positive relationship proposed between long-term gearing and firm size.

Therefore, the larger the firm is, the more likely it is to have higher gearing levels due to the greater opportunities for larger firms in debt markets and their reduced risk. Hypothesis H18, then, states that the long-term corporate debt-equity ratio increases with firm size.

The firm size ADL models are specified and estimated to determine whether firm size significantly influences the operational capital structure decision of the firm. The casual empirics of chapter 4 suggest that smaller firms have higher DDE ratios, whereas the static bivariate regression models of chapter 5 reveal a positive relationship in only a few of the countries modelled. However, in the ADL modelling, the purpose is to determine whether a positive relationship exists on an inter-temporal rather than a cross-sectional basis. If hypothesis H18 holds, the firm size independent variables (labelled ASSETS in the analysis) should exhibit positive coefficients. As the size of the firm is a cumulative variable, or a stock variable, it is expected that it will demonstrate a fairly immediate relationship with the DDE ratio. This is because firms do not in general become large-scale within a short period of time, but evolve over the longer-term. There should exist little evidence of an independent variable lag structure, then, because large firms today have generally been established as such for many years and thus finance managers and debt markets do not require a lag of a number of years before they orientate firms' capital structures to reflect firm size. Therefore, the firm size ADL models should exhibit positive coefficient independent variables and no significant lag structures, thus resulting in partial adjustment specifications.

Before the bivariate EC models of the relationship between corporate gearing and firm growth are specified, it is necessary to examine the theoretical and empirical literature underpinning such a relationship as firm growth is related to corporate gearing in a slightly different manner than firm size. Most authors propose a positive relationship between gearing and firm growth. Gupta (1969) argues that a positive relationship may exist as high growth firms desire the greater flexibility offered by debt, particularly the relative ease with which it may be liquidated when required. Toy et al (1974) and King (1977) argue that growth is a proxy for the need to finance externally, and in particular the need for debt finance. Martin and Scott (1974) argue that high growth firms are likely to be more willing to accept higher financial risk funding and thus higher gearing. The empirical evidence of these authors supports a positive relationship between gearing and firm growth. However, Titman and Wessels (1988) argue that equity-dominated firms are likely to attempt to invest sub-optimally to transfer wealth from debt holders, and that if such firms are high growth firms then this effect is stronger, meaning that such firms will employ less gearing through time. It is noted that they found no empirical evidence to support this argument.

Therefore, there exists fairly strong theoretical and empirical underpinning to a positive relationship between corporate gearing and firm growth. Hypothesis H20, then, states that the corporate debt-equity ratio increases with the rate of firm growth. As the firm size variable (labelled ASSETS in the analysis) is expressed in its relative change form in the EC models to be estimated, the models examine the long-run relationship between gearing and firm growth, rather than firm size. The EC models are specified and estimated to determine primarily whether firm growth exerts a significant influence upon the strategic corporate capital structure decision of the firm. As it is questionable whether gearing is more exogenous than firm growth, or vice versa, it is necessary to estimate bivariate EC models from both directions of causation. If hypothesis H20 holds, the model with the DDE ratio as dependent variable should exhibit a significant positive coefficient independent variable. Such a relationship exists due to higher growth firms requiring the greater flexibility afforded by debt, their need for additional external funds, and their willingness to accept higher risk financing during their growth phase. As there may be a lag between increased growth and the need for extra gearing whilst the firm exhausts its retentions, there may exist a short independent variable lag structure.

For the opposite direction of causation, where the firm growth variable is expressed as the dependent variable, the theoretical underpinning is unclear due to the strong bias in the literature which predominantly expresses the DDE ratio as the dependent variable in any model. However, intuitively, gearing may exert an important influence on firm growth. It is argued above that higher growth firms are likely to seek additional external funds, particularly debt due to its flexibility and ease of liquidation. This may imply that debt is an "enabler" for higher growth and thus higher geared firms may find themselves better able to expand their operations more rapidly. Conversely, higher gearing also increases claims on the future income streams of firms, possibly displacing marginal future investment projects, thus suggesting a negative relationship between firm growth and corporate gearing. Therefore, the bivariate EC model may exhibit either a positive or a negative coefficient independent variable depending on whether increased gearing is beneficial or detrimental to long-term growth.

The models discussed are to be estimated to determine whether the scale of the firm exerts a significant influence on either the operational or strategic capital structure decision of the firm. ADL models to determine the influence of firm size on corporate gearing are expected to exhibit positive coefficient independent variables as larger firms enjoy greater opportunities in debt markets and reduced risk, enabling them to employ higher gearing. The EC models to determine the relationship between corporate gearing and firm growth are complicated by the possibility of two-way causation. The long-run influence of firm growth on gearing is expected to be positive if higher growth firms need new external funds to expand further, are attracted by the greater flexibility of debt, and are less risk-averse than smaller firms. The long-run influence of gearing on firm growth is unclear, as it may be argued that additional gearing may be either beneficial or detrimental to long-term growth.

7.3.5.3 Hypotheses to test the relationship between corporate gearing and those factors describing the firm's ability to support debt

Although the taxation and macroeconomic environments within which the firm is positioned determine the firm's interactions with the financial markets and the direct costs of new external finance adjustments, the finance manager will not even consider approaching such markets if the firm cannot support the servicing of the new funds required. The servicing of debt is a legal commitment of the firm whereas the servicing of equity is a quasi-commitment as dividend payments are not mandatory. The risk of not being able to cover the commitments of debt servicing is perhaps better described as the risk of bankruptcy, along with the costs associated with such a risk. It is possible that these costs are of such a magnitude as to counterbalance any tax advantage to debt. Thus, bankruptcy risk is one of the most widely discussed causes of a breakdown in the relationship between corporate gearing and the tax advantage to debt.

Authors who contribute to the argument that bankruptcy costs may counterbalance the tax advantage to debt to produce firm-level optimal capital structures include Robichek and Myers (1966), Baxter (1967), Hirschleifer (1970), Stiglitz (1972), Kraus and Litzenberger (1973), Scott (1976), and DeAngelo and Masulis (1980). However, other authors such as Stiglitz (1969), Miller (1977), and Haugen and Senbet (1978, 1984) argue that the corporate capital structure remains irrelevant to the firm even when bankruptcy costs are accounted for, although they do employ some fairly restrictive assumptions to support this argument. Evidence from authors such as Van Horne (1976), Baxter (1967), and Warner (1977), suggests, on balance, that the direct costs of corporate bankruptcy may be small, although the indirect costs may significant but extremely difficult to measure. It is clear, then, that most authors agree that bankruptcy costs are capable of counterbalancing any tax advantage to debt, although evidence on the magnitude of such an offset is inconclusive. As the magnitude of the full costs of bankruptcy remains largely unknown, other authors have instead studied the influence of bankruptcy risk on the corporate capital structure chosen by firms. Empirical studies by Stonehill et al (1975), Marsh (1982), and Mackie-Mason (1990) suggest that bankruptcy risk variables are significant determinants of corporate gearing. Thus, although bankruptcy costs may not be of the same magnitude as the tax advantage to debt, it is clear that they do in fact restrain finance managers from choosing the extreme gearing position apparently advocated by the MM (1963) model. Bankruptcy costs or bankruptcy risk, then, are capable of causing a breakdown in the relationship between corporate gearing and any tax advantage to debt.

The literature demonstrates that it is extremely difficult to measure the costs of bankruptcy. Additionally, for the individual firm the risk of bankruptcy is a more important determinant of corporate gearing. Two measures of bankruptcy risk introduced are interest cover (labelled INTCOVER in the analysis) and dividend cover (labelled DIVCOVER). If the firm is in a position of financial distress, with a relatively high probability of eventual bankruptcy, then it is unlikely to be able to adequately cover either the interest payments on its debt (a debt-servicing commitment) or the dividend payments on its equity (an equity-servicing quasi-commitment). Therefore, when interest cover or dividend cover are low, the firm is in greater danger of defaulting on debt and becoming bankrupt. Hypothesis H15 states that the degree of bankruptcy risk increases as the corporate debt-equity ratio increases. Although there may be a two-way causal relationship between the coverage ratios and gearing, the DDE ratio is imposed as the dependent variable in the ADL models, although this assumption is relaxed in the EC models.

In the ADL models, where the DDE ratio is imposed as the dependent variable, there should be positive coefficient independent variables (INTCOVER and DIVCOVER).

This is because an improvement in financial safety (a reduction in bankruptcy risk) should encourage the firm to increase its gearing. It is noted that this implies a negative relationship between bankruptcy risk and gearing, which conflicts with hypothesis H15, but only because the opposite direction of causation from that discussed in the literature is to be tested in the ADL models. As there may be a delay before an improvement in the firm's financial safety is perceived by the finance manager to warrant an increase in gearing, the models may exhibit a lag structure for the independent variables. If, however, the ADL models are merely measuring a static relationship between gearing and coverage, such that increased gearing reduces the coverage ratios, then negative coefficient independent variables are expected. Therefore, the specific ADL models of the bivariate relationship between the DDE ratio and the coverage ratios (inverse bankruptcy risk measures) are expected to exhibit positive coefficient independent variables with lag structures of one or two years.

The EC models express the DDE ratio as either the dependent variable or the independent variable in a bivariate relationship with the coverage ratio, dividend cover (labelled DIVCOVER in the analysis). The two-way causation arises from the fact that the DDE ratio and dividend cover are both internal accounting structure measures and thus one measure is unlikely to be more exogenous with respect to the other. The purpose of the model is to determine whether bankruptcy risk is a significant determinant of the strategic corporate capital structure decision, and conversely whether gearing greatly affects financial risk in the long-run. As in the ADL models to be estimated, hypothesis H15 is not tested directly in the EC model with the DDE ratio as dependent variable as the hypothesis implies that the DDE ratio is the independent variable in a particular model. When the DDE ratio is expressed as the dependent variable, it is expected that an increase in financial safety encourages further gearing, implying a positive coefficient dynamic independent variable.

When the DDE ratio is expressed as the independent variable in the dividend cover EC model, hypothesis H15 may be tested directly. If hypothesis H15 holds, dividend cover (an inverse bankruptcy risk measure) should decrease as the DDE ratio increases, that is, the firm becomes riskier as gearing increases. Increased gearing in the firm's capital structure, then, brings with it extra debt-financing commitments which may reduce the probability of the firm being able to pay future dividends. The dynamic independent variable in the model should thus exhibit a negative coefficient.

Therefore, models are to be estimated for the inverse bankruptcy risk proxies (interest cover and dividend cover) to test the proposition that increased financial safety leads to firms expanding their gearing, both on an operational and strategic capital structure decision-making basis, whereas increased gearing should feedback in the long-run to increase the financial risk of the firm (and reduce its coverage ratios).

In addition to financial risk determining the firm's ability to support debt, and in turn impacting upon corporate gearing, the liquidity of the firm places a constraint on the ability of the firm to support new debt. A highly liquid firm will have no difficulty meeting debt-servicing commitments whereas a firm with low liquidity or a liquidity which fluctuates greatly through time may consider it prudent not to extend its gearing. Van Horne (1974) argued that the greater the firm's projected liquidity posture, the greater is its debt capacity. Martin and Scott (1974) argue that firms with higher liquidity are more likely to issue debt rather than equity at the margin. Evidence from Martin and Scott (1974) and Stonehill et al (1975), however, questions the existence of any such relationship. Therefore, although firms with higher liquidity are intuitively more able to support increased gearing than firms with lower liquidity, the few empirical studies that have been undertaken provide little evidence to support this.

Hypothesis H21, then, states that the corporate debt-equity ratio increases with the degree of liquidity. As liquidity is determined within the firm, there is likely to exist a two-way causal relationship with respect to corporate gearing. A firm which experiences an improvement in liquidity also experiences an improvement in its debt capacity, which encourages that firm to increase its gearing. Conversely, a firm which increases its gearing is likely to experience a reduction in its liquidity due to the increased servicing commitments associated with the extra debt. Therefore, the nature of the relationship between gearing and liquidity depends upon the direction of causation considered.

In the ADL models, however, the DDE ratio is imposed as the dependent variable to expressly test hypothesis H21 in a time series perspective. It is noted that a negative relationship is found in the bivariate regression models examined in chapter 5, although such models merely describe the static perspective. The logistic regression models, however, do produce some evidence of a positive relationship, as the perspective they describe is marginal and thus inter-temporal in nature. If hypothesis H21 holds, then, the liquidity independent variable of the models (labelled WCRATIO in the analysis) will exhibit a positive coefficient, demonstrating that an improvement in liquidity should lead to increased gearing. However, there may be a time lag between the improvement in the firm's liquidity and the increased gearing as finance managers may require evidence of a sustained improvement before adjusting the long-term capital structure mix. Therefore, the specific model for liquidity is expected to be an ADL model exhibiting a positive coefficient independent variable with a lag structure of one or two years.

The EC models extend the study to examine the influence of liquidity upon the strategic, in addition to the operational, capital structure decision of the firm, whilst also enabling the potential two-way causation discussed to be modelled and thus better understood. The EC model with the DDE ratio as the dependent variable is expected to exhibit a positive coefficient dynamic independent variable if hypothesis H21 holds. Therefore, if improved liquidity leads to increased debt capacity, thus encouraging increased gearing, then this should be reflected in the dynamics of the model. The EC model with the DDE ratio expressed as the independent variable is specified and estimated to determine whether increased gearing has a detrimental effect upon firm liquidity both in the short-run and the long-run. If such an effect occurs in the short-run then the gearing dynamic independent variable should exhibit a negative coefficient.

Thus, liquidity may be considered a proxy for the debt capacity of the firm, and as such is an alternative measure to bankruptcy risk to gauge the ability of the firm to support increased debt. The influence of liquidity upon the operational and strategic capital structure decisions of the firm is examined by means of ADL and EC models whereas the detrimental feedback effect of increased gearing on future liquidity is examined by means of an EC model.

Overall, firm coverage ratios and liquidity describe the ability of the firm to support increased debt, which the finance manager considers before even approaching the finance markets for new funds. Both types of measure describe factors which may counterbalance any tax advantage to debt in the real world and thus the short-term and long-term influence of such factors must be examined in ADL and EC models, in addition to the feedback effect of increased gearing on these important accounting structure measures.

7.3.5.4 Hypotheses to test the relationship between corporate gearing and those factors related to the returns of the firm's projects

The returns of the firm's projects influence the financing of its future investment projects in numerous ways. The firm that has a record of consistently high returns is likely to benefit from greater financing opportunities, although such higher returns also change the finance manager's preference for one type of claim on the firm's income streams over another.

Two measures are considered as factors related to the returns of the firm's projects which may impact upon the corporate capital structure decision. The first is the profitability of the firm, or the return on capital employed. The second is a q-ratio proxy, which measures the value of the firm over and above the replacement cost of its assets. Profitability is likely to exert a more direct influence upon the corporate capital structure because it is essentially another measure of the firm's ability to support new external funds. However, the q-ratio proxy essentially measures the firm's incentive to conduct additional investment, which impacts less directly upon its capital structure.

Although most authors agree that profitability is likely to be a significant determinant of corporate gearing, there is some disagreement concerning the precise nature of such a relationship. Martin and Scott (1974) and Drury and Bougen (1980) argue that a positive relationship may exist between gearing and profitability because more profitable firms can obtain debt at a lower price and are able to support more fixed-interest debt than less profitable firms. However, authors such as Toy et al (1974), Martin and Scott (1974), Drury and Bougen (1980), Jensen (1986), Titman and Wessels (1988), and Rajan and Zingales (1994) argue that a negative relationship may exist as highly profitable firms rely more on retained earnings and thus demand less debt; lower profitability firms may find it extremely difficult to attract new equity funds and thus must engage in additional gearing; firms with higher equity returns will find it relatively easy to expand their equity base; and more profitable firms may wish to avoid the disciplinary role of debt, choosing additional equity finance instead. Therefore, there exists a theoretical underpinning to either a positive or negative relationship between corporate gearing and profitability. However, these conflicting arguments may be resolved by examining the empirical evidence which considers such a bivariate relationship. Toy et al (1974), Martin and Scott (1974), Drury and Bougen (1980), Marsh (1982), Titman and Wessels (1988), and Rajan and Zingales (1994) consistently found evidence of a negative relationship between corporate gearing and firm profitability.

Therefore, whilst there are conflicting theoretical arguments underpinning the relationship between corporate gearing and profitability, the empirical evidence consistently supports a negative relationship. Furthermore, evidence from the bivariate and logistic regression models of chapter 5 supports a negative relationship. The time series models thus seek to determine whether the negative relationship found at the cross-section also holds on a longer-term inter-temporal basis. Hypothesis H22, then, states that the corporate debt-equity ratio increases as firm profitability decreases. Although the ADL models impose the DDE ratio as the dependent, there is likely to be a two-way causal relationship between gearing and profitability. An increase in corporate gearing might reduce future profitability by means of the greater demands placed on future income streams for debt servicing, leading to a negative relationship for the opposite direction of causation.

The ADL models are estimated to determine the nature of the influence of profitability upon the operational capital structure decision of the firm. If hypothesis H22 holds, there should be a negative relationship between corporate gearing and profitability through time, as finance managers are likely to demand less debt and find it relatively easier to attract new equity funds when their profitability is high. Thus, the coefficient of the profitability independent variable (labelled ROCE) in the models should be negative. There may be a lag between an improvement in the firm's profitability and increased equity financing (reduced gearing) as finance managers may be wary of increasing the equity base unless the firm's improvement in fortunes is perceived to be sustained. The profitability model specification, then, should exhibit a negative coefficient independent variable with a lag structure of one or two years.

The EC models are specified and estimated to determine whether profitability exerts an influence on the strategic capital structure decision of the firm, and vice versa, as well as determining the relative significance of the strategic influence compared to the operational influence of profitability on corporate gearing.

The EC model with the DDE ratio expressed as the dependent variable is expected to exhibit a negative coefficient dynamic independent variable if hypothesis H22 holds. The relative strength of the profitability model with the DDE ratio as dependent variable and the model with the DDE ratio as independent variable depends upon whether profitability is a stronger determinant of corporate gearing than gearing is a determinant of profitability. The EC model with the DDE ratio as the independent variable should also exhibit a negative coefficient dynamic independent variable if increased gearing exerts a detrimental effect on firm profitability.

Therefore, the theoretical underpinning to the influence of profitability changes on gearing is unclear, although the empirical evidence strongly supports a negative relationship. The bivariate relationship is further complicated as it is likely that gearing changes also impact upon firm profitability through time. ADL and EC models are specified for the former hypothesized relationship, whereas an EC model only is specified for the latter relationship to enable the relative strengths of the two possible directions of causation to be examined and compared.

The q-ratio proxy is a measure which approximates Tobin's q-ratio, given the data constraints of the European corporate capital structure research. Badrinath and Kini (1994) define Tobin's q as the ratio of the firm's market value to the replacement costs of its assets. If the q-ratio is greater than unity then financial wealth holders on the stock market are prepared to pay more for a claim to a unit of real capital than it costs the firm to buy and install it. However, Tobin (1969) argues that if the q-ratio is less than unity then there will be an increase in acquisition activity since assets can be acquired directly in the market. The key relationship hypothesized in the literature is that a positive relationship exists between the q-ratio and corporate investment. This relationship is supported by the theoretical developments of Tobin (1969), Summers (1981), Dornbusch and Fischer (1990), Backhouse (1991), Turner (1993), Badrinath and Kini (1994), and Bond and Meghir (1994). Firms will invest, then, as long as each pound spent purchasing capital increases the market value of the firm by more than one pound. Although there is a theoretically strong underpinning to a positive relationship between the q-ratio and investment, there is no clear relationship between the q-ratio and the corporate capital structure. Why should increased demand for investment lead to a preference for one financial instrument over another, ceteris paribus? To address this question requires a somewhat lateral approach. As the q-ratio basically measures the value added by the firm over and above the cost of its assets, it may be argued that the q-ratio is merely another form of profitability ratio. Once this assumption is made, the propositions arising from the profitability literature discussed earlier in this section may be applied and thus a negative relationship should exist between the q-ratio and corporate gearing as firms with higher q-ratios are more profitable and have higher retentions, thus reducing their demand for external debt. Additionally, higher q-ratio firms should find it relatively easier to attract new equity funds than lower q-ratio firms due to the attraction of their high value-added potential. Hypothesis H41, then, states that the corporate debt-equity ratio increases as the q-ratio proxy decreases.

ADL models are specified and estimated to determine whether the q-ratio proxy exerts a significant impact upon the operational capital structure decision of the firm. If hypothesis H41 holds then the models should exhibit negative coefficient independent variables, such that firms experiencing an increase in their q-ratio (value-added) will find equity-financing relatively more attractive than debt-financing. Therefore, the bivariate q-ratio proxy specific model is expected to be an autoregressive distributed lag model, exhibiting negative coefficient independent variables.

In summary, profitability changes cause changes in the external financial preferences of finance managers. It is proposed that firms which experience improvements in profitability are more likely to finance by means of new equity issues rather than debt issues, because of the relative ease for such firms of issuing new equity, the reduced reliance of highly profitable firms on gearing generally, and the desire of successful firms to avoid the disciplinary role of debt. Negative relationships are thus expected between corporate gearing and the profitability ratio and the q-ratio proxy, respectively, which should compose the central elements of the ADL and EC models to be estimated.

7.3.5.5 Summary

The objective of this section was to discuss the theoretical underpinning of potential relationships between corporate gearing and key corporate environment factors. Whereas the taxation and macroeconomic models developed are to be estimated to examine the exogenous influences on corporate gearing through time, the results of such models are unlikely to suggest firm-level optimal capital structure solutions. It is only through the development of corporate factor hypotheses that circumstances unique to the individual firm may be taken into account, albeit on an aggregated basis, to demonstrate how such unique capital structure solutions may result. The influence of the scale of the firm, its ability to support debt, and its profitability are all hypothesized to impact upon the capital structure decision, both at the operational and the strategic level. ADL models are specified from the hypotheses, expressing the DDE ratio as dependent variable only, whereas the EC models are generally specified such that two-way causation may be examined, as the endo-exogenous division of variables proposed for the taxation and macroeconomic variables discussed earlier does not apply to the corporate environment.

7.3.6 A summary of the objectives set for the bivariate time series hypotheses and the resulting models

The objective of this section was to set in place the hypotheses to be tested in the bivariate time series analyses and to employ these hypotheses as the basis for the models to be specified. The hypotheses are firmly underpinned by the theoretical and empirical literature reviewed in chapters 2 and 3, although such literature is reconsidered in this section within a time series rather than merely the static perspective discussed to develop the earlier models. The salient results of the European corporate capital structure research are also briefly reviewed, wherever they aid the specification of the time series models. Therefore, the literature and empirical results arising from this research and the research of other authors underpins the hypotheses to be tested, and the hypotheses developed are then utilised to underpin the model specifications proposed.

Whilst a wide range of detailed hypotheses are developed to examine specific bivariate capital structure relationships, their collective purpose is to examine the central hypothesis of the existence of firm-level optimal capital structure solutions. The hypothesis has already been examined from a static perspective which provides an insight into the year-to-year operational capital structure decisions of the firm. However, only evidence of a cointegrating relationship between corporate gearing and its determinants may be considered synonymous with full optimisation behaviour employed by the finance manager to make strategic capital structure decisions for the firm.

The hypotheses to be tested in the bivariate time series analyses should provide clarification of whether a tax advantage to debt measure actually influences the gearing decision of the European firm. It may be that effective tax measures impinge upon this decision to a greater degree than nominal tax measures. Factors which may lead to a "breakdown" in a relationship between corporate gearing and the tax advantage to debt are examined by specifying and estimating bivariate capital structure models which consider the effect of macroeconomic and taxation variables. If such variables appear to be more important as determinants of corporate gearing than the taxation measures, then it may be implied that those variables are key causes of the breakdown effect.

The taxation and macroeconomic hypotheses are tested to determine whether aggregate influences upon corporate gearing decisions are important. This may suggest that optimal capital structures exist, but implies nothing about unique firm-level solutions. However, if the effective taxation measures prove to be key determinants of corporate gearing then this implies that the influence of taxation is firm-specific in nature, thus implying firm-level optimal solutions. If corporate-level measures are also found to be important influences then this more strongly suggests that optimal capital structure solutions exist for individual firms.

If there is found to exist a great variety of influences upon the operational and strategic capital structure decisions of the firm, which derive from the taxation, macroeconomic and corporate environments, then this alone implies optimising behaviour. This is because the finance manager who adjusts the capital structure mix to a number of key influences through time is by definition engaging in at least weak-form optimising behaviour. Strong-form optimising behaviour additionally requires evidence of strategic capital structure decision-making behaviour, which, as discussed earlier, is synonymous with cointegrating capital structure relationships.

Finally, the presence of significant two-way causal capital structure relationships, expected mainly in relation to the corporate environment factors, may suggest that whilst the corporate capital structure decision is a key part of the firm's planning strategy, the capital structure ratio is also monitored as a determinant of other strategic decisions. Indeed, it may be determined that the firm's capital structure decision is of marginal importance compared to other long-term strategic decisions to be made by the finance manager.

7.4 Summary

The econometric methods employed in the bivariate time series analyses are briefly discussed in section 7.2 in relation to their application to the European corporate capital structure research. Unit root testing, cointegration testing and Granger causality testing are undertaken merely as preparatory stages towards the construction and estimation of bivariate autoregressive distributed lag models and error correction models. The methodological approach extends the testing of the central hypothesis to encompass not only short-run disequilibrium relationships but also those long-run equilibrating relationships which characterise the strategic determination of the European corporate capital structure.

Section 7.3 reconsiders the theoretical and empirical underpinning of the hypotheses to be tested, within an inter-temporal perspective. The hypotheses are then employed as the basis for the specification of the bivariate econometric models to be estimated. General hypotheses are stated which derive from the underlying econometrics of the methods used, a recognition of the constraints of the data, and general financial economics concepts. Specific hypotheses are defined and developed from the existing theoretical and empirical literature as well as the developments of the European corporate capital structure research. Consideration is then given to the contribution of the collective set of hypotheses towards addressing the central hypothesis of the existence of firm-level optimal capital structure solutions.

Chapter 8 presents the results of the bivariate time series analyses, comparing actual model coefficients and specifications with those hypothesized and anticipated. The models lead to a greater understanding of the operational and strategic capital structure policies of European firms, particularly where cointegrating relationships point towards full-optimising behaviour. It is expected that full-optimising capital structure behaviour is undertaken mainly in those larger firms which have the sophisticated information systems in place to facilitate such optimisation. The examination of the bivariate capital structure relationships which govern the strategic policies of firms is then further extended to the multivariate perspective, by means of the Johansen multivariate EC modelling procedure. In order that the capital structure behaviour of smaller firms might also be examined in a comprehensive manner, the concept of intra-ratio targeting behaviour is introduced and tested empirically, as it represents a form of bounded, rather than full, optimisation. The salient results of the analyses are then to be summarised and brought together towards a final examination of the central hypothesis.

CHAPTER 8

RESULTS OF THE BIVARIATE TIME SERIES ANALYSES, A MULTIVARIATE EXTENSION OF THE ANALYSIS, AND AN EXAMINATION OF BOUNDED OPTIMISATION BEHAVIOUR

8.1 Introduction

The main objective of this chapter is to address the central hypothesis of the existence of firm-level optimal capital structure solutions. To achieve this objective, the European capital structure research is extended and developed in a number of respects. Section 8.2 presents and discusses the results of the bivariate corporate capital structure time series analyses, following the detailed discussion concerning the methods employed and hypotheses to be tested in chapter 7. Section 8.3 extends the bivariate error correction modelling exercise to the multivariate perspective to enable a greater understanding of the interaction of the capital structure ratio with the environment within which it is determined. Section 8.4 describes a cointegration analysis to determine whether smaller European firms engage in a different form of capital structure setting behaviour from larger firms, referred to as intra-ratio capital structure targeting, which is a form of long-run bounded optimisation behaviour. Section 8.5 summarises the salient results of all of the time series analyses to address the central hypothesis and to determine the nature of the operational and strategic capital structure policies employed by firms to facilitate some degree of optimisation.

8.2 Results of the bivariate time series analyses

8.2.1 Introduction

The objective of this section is to describe and discuss the results of the bivariate time series analyses. Firstly, the general results arising from the various analyses are discussed to provide a general perspective within which the more specific results are presented. Secondly, results which describe the relationship between the corporate DDE ratio and influencing factors from the taxation, macroeconomic and corporate environments are described. Finally, the salient results from the analyses are drawn together to determine how such results contribute towards addressing the central hypothesis of the existence of firm-level optimal capital structure solutions. The results should also enable the identification and consideration of the operational and strategic policies employed by firms to help them achieve an optimal capital structure solution, as well as identifying differences in the degree of optimisation across firms.

8.2.2 General results arising from the bivariate corporate capital structure time series analyses

In this section, the general results arising from the unit root tests, cointegration tests, Granger causality tests, ADL models and bivariate EC models are discussed in turn.

The objective of the unit root testing was to determine the order of integration of each variable within the different samples which comprise the European time series data set. Appendix E gives the results of the deterministic trend tests, appendix F gives the results of the unit root tests, and tables 8.1 and 8.2 of this section summarise the results.

Table 8.1
Summary table showing those variables integrated of the same order as the debt-to-debt-plus-equity ratio for the different weighted and non-weighted country samples

(figures in parentheses give the order of integration of the variable, and 'N' means that the variable may not be integrated)

	UK weighted sample	UK non-weighted sample	Netherlands weighted sample	Netherlands non-weighted sample
order of integration of the DDERATIO	I(1)	I(1)	I(1)	I(1)
variables integrated of the same order as the DDERATIO	ASSETSchange CTAXRATIO CTRATE DIVCOVER GDPchange INCTAX INFLATEchange INTCOVER INVESTchange LRINT MRINT QRATIO ROCE SMIND SRINT TAXADV TAXRATIO WCRATIO	ASSETSchange CTAXRATIO CTRATEchange DIVCOVER GDPchange INCTAX INFLATEchange INTCOVER INVESTchange LRINT MRINT QRATIO ROCE SMIND SRINT TAXADV TAXRATIO WCRATIO	ASSETSchange CTRATE INFLATEchange INTCOVER LRINTchange MRINTchange QRATIO ROCE SMIND SRINT TAXRATIO	ASSETSchange CTRATE DIVCOVER INFLATEchange LRINTchange MRINTchange QRATIO ROCE SMIND SRINT TAXRATIO WCRATIO
variables integrated of different order from the DDERATIO	ASSETS (2) GDP (2) INVEST (2)	ASSETS (2) CTRATE (2) GDP (2) INVEST (2)	ASSETS (2) GDP (4) GDPchange (3) INFLATE (2) INVEST (3) INVESTchange (2) INVESTchch (0) LRINT (2) MRINT (2) WCRATIO (2)	ASSETS (2) GDP (4) GDPchange (3) INFLATE (2) INTCOVER (2) INTCOVERchange(0) INVEST (3) INVESTchange (2) INVESTchch (0) LRINT (2) MRINT (2)
order of integration of variables in unit root test including a trend	INFLATE (3)	INFLATE (3)	DIVCOVER (0) GDPchch (1) WCRATIOchange(3)	GDPchch (1)

Table 8.2
Summary table showing those variables integrated of the same order as the debt-to-debt-plus-equity ratio for the different weighted and non-weighted country samples (cont.)

(figures in parentheses give the order of integration of the variable, and 'N' means that the variable may not be integrated)

	German weighted sample	German non-weighted sample	French weighted sample	French non-weighted sample
order of integration of the DDERATIO	I(1)	I(2)	I(1)	I(2)
variables integrated of the same order as the DDERATIO	ASSETSchange DIVCOVER INVESTchange LRINT MRINTchange QRATIO ROCEchange SMIND SRINT WCRATIOchange	ASSETS GNPchange INFLATEchange MRINT ROCE	CTAXRATIO CTRATEchange DIVCOVER INTCOVERchange LRINTchange MRINTchange QRATIO ROCEchange SMINDchange SRINTchange TAXRATIO WCRATIOchange	DIVCOVER LRINT MRINT ROCE SMIND SRINT TAXADV
variables integrated of different order from the DDERATIO	ASSETS (2) GNP (3) GNPchange (2) GNPchch (0) INFLATE (3) INFLATEchange (2) INFLATEchch (0) INTCOVER (2) INVEST (3) MRINT (2) ROCE (2) TAXRATIO (2) WCRATIO (2)	DIVCOVER (1) GNP (3) INFLATE (3) INTCOVER (1) INVEST (3) INVESTchange (1) LRINT (1) QRATIO (1) SMIND (1) SRINT (1) TAXRATIO (1) WCRATIO (1)	ASSETS (N) ASSETSchange (N) ASSETSchch (N) CTRATE (2) GDP (N) GDPchange (N) GDPchch (N) INFLATEchange (N) INFLATEchch (0) INVEST (N) INVESTchange (N) INVESTchch (0) LRINT (2) MRINT (2) ROCE (2) SMIND (2) SRINT (2) TAXADV (2) TAXADVchange (0) WCRATIO (2)	ASSETS (N) ASSETSchange (N) CTAXRATIO (1) CTRATE (0) GDP (N) GDPchange (N) GDPchch (N) INFLATEchange (N) INFLATEchch (0) INTCOVER (1) INVEST (N) INVESTchange (N) INVESTchch (0) QRATIO (1) TAXRATIO (1) WCRATIO (N) WCRATIOchange(N)
order of integration of variables in unit root test including a trend	INTCOVERchange (0) TAXRATIOchange (0)		INFLATE (N) INTCOVER (N)	INFLATE (N)

The results suggest that many of the variables are integrated of the same order as the capital structure ratio, and those which are integrated of a higher order tend to become integrated once they are expressed in relative change form. The DDE ratio is generally integrated of order one, though is integrated of order two in the German and French non-weighted samples, perhaps because such non-weighted samples are characterised by short data time-spans and thus the DDE ratio may be exhibiting accelerating or even cycling behaviour through time. It appears that the data from the non-weighted samples are generally integrated of higher orders than the data from the weighted samples, which lends some support to the proposition that the latter samples give greater representation to larger, better diversified and longer established firms than the former samples, producing more stable accounting ratios generally. In particular, larger firms are likely to make more frequent issues of debt or equity than smaller firms, thus enabling the DDE ratio to remain more stable through time.

It is argued that the paucity of data time-spans impacts significantly upon the results such that, for the German and French samples, the short time-span analysed may represent merely a fluctuation in the long-run path of the DDE ratio which would become negligible if the longer run path could be tested. These results are consistent with the expectations discussed in section 7.3.2.1, resulting both from characteristics of the firms within the data set and from statistical phenomena related to data constraints. Those variables which are found to be integrated of the same order as the DDE ratio within each sample are then tested for the existence of a bivariate cointegrating relationship with the capital structure ratio.

The objective of the cointegration testing was to identify those time series variables which exhibit a cointegrating or equilibrating long-run relationship with the DDE ratio. Appendix G presents the Mackinnon critical values employed in the cointegration testing, appendix H presents the deterministic trend tests of the error correction mechanisms of the long-run static equations, and appendix I gives the final cointegration test results. Table 8.3 summarises the salient results of the bivariate cointegration tests.

Table 8.3
Summary table exhibiting occurrences of cointegrating corporate capital structure relationships

sample	cointegrating variable	ADF test significant at lags:
UK weighted	INFLATEchange	lag 0
UK non-weighted	INFLATEchange	lag 0
NL weighted	INFLATEchange	lag 0
UK non-weighted	MRINT	lag 1
UK weighted	TAXRATIO	lag 4*
UK non-weighted	CTRATEchange	lag 1
UK weighted	ROCE	lag 0,1,4*,5*
BD weighted	ROCEchange	lag 0**
UK weighted	DIVCOVER	lag 0,1
BD weighted	ASSETSchange	lag 0**
BD weighted	WCRATIOchange	lag 0**

* = Durbin Watson statistic is in the grey area of the distribution.
** = ADF tests include a trend in the computation, and the Durbin Watson statistic is in the grey area of the distribution, thus weakening the cointegration result

Table 8.3 clearly shows that most incidences of cointegrating capital structure relationships occur within the weighted rather than the non-weighted samples. Therefore, hypothesis H35, which states that the weighted data samples are more likely to contain cointegrating relationships than the non-weighted samples, may be given some support by this casual observation result, although it is recognised that a formal statistical test of variation of the incidence of cointegration relationships between sample types is not undertaken in this research. The results thus highlight a behavioural dichotomy between the smaller and larger firms across the European countries tested, whereby the larger firm is more sophisticated and thus more rapidly responds to a capital structure ratio which is in disequilibrium with respect to its optimal long-run path than the smaller firm. Indeed, the smaller firm may not even realise that such a disequilibrium has occurred due to its relatively naive information systems, and thus a disequilibrium may be sustained, resulting in the absence of any significant cointegrating bivariate capital structure relationships with respect to key determinants. As smaller firms do not appear to engage in this long-run equilibrating behaviour with respect to key capital structure determinants, any strategic optimising behaviour must be based upon factors external to the taxation, macroeconomic, and corporate environments of the firm. This may imply, indirectly, that smaller firms set their DDE ratios in relation to other stimuli, such as the capital structure norm for the industry to which such firms belong, the capital structure of larger firms, or some other stimulus. Section 8.4 develops this implication by examining the capital structure targeting behaviour of firms as a form of bounded-optimisation. If targeting behaviour, such as industry-norm targeting, is more common in smaller European firms, the probability of the smaller firm being in disequilibrium through time is much higher than for the larger firm. Such a proposition is consistent with the cointegration testing results.

The majority of the capital structure bivariate relationships do not exhibit cointegrating relationships, a result which is consistent with the expected behaviour discussed in section 7.3.2.3. Intuitively, the finance manager of the European firm is only capable of tracking a small number of key capital structure influences in the long-run, even if he or she incrementally corrects for a larger number of influences on a year-to-year basis. Therefore, the cointegrating relationships effectively set the boundaries within which the DDE ratio may be set. A cointegrating relationship in this context suggests that there is a desired long-run path which the DDE ratio should follow which is determined by the linear relationship between the DDE ratio and the variables which are cointegrated with it. Although only bivariate cointegrating relationships are discussed in this section, it is likely that the DDE ratio is more realistically determined by a multivariate linear function of the key explanatory factors. As the cointegrating relationship is a vector, the DDE ratio is bounded by and contributes to the linear bounding of the key capital structure influences. In an estimated linear regression model the dependent and independent variables are related by the independent variable coefficient and an intercept. The independent variable coefficient is important as it effectively determines a ratio between the two variables in a bivariate relationship when the intercept is insignificant. The "boundaries" discussed are thus ratios between the DDE ratio and each cointegrating factor which constrains its movement in n-dimensional space, where (n-1) is the number of variables which are cointegrated with the DDE ratio. It is intuitive that the European firm only monitors a small set of key variables to establish its desired capital structure in the long-run, as to monitor a larger set of variables would require a far more complex trade-off of influences, many of which are conflicting.

There is some evidence to support the expectation that samples with short data time-spans are less likely to produce cointegrating relationships. If longer data time-spans were available cointegrating relationships might be found. However, such a results may also plausibly arise from country-specific effects not identified in this research, producing less incidences of cointegrating relationships in certain country samples. This result serves to highlight limitations in the availability of data for European firms.

Most of the variables of table 8.3 appear to be cointegrated in a Dickey-Fuller test with no lags, but are not cointegrated if lags are introduced. The reason for this is unclear, although it may be merely related to the degrees of freedom becoming significantly reduced as lags are introduced. Although the DF test does not account for autocorrelation, half of the non-lagged test results do not exhibit any autocorrelation anyway, at least on the basis of the DW statistic. However, some of the non-lagged test statistics suggest a potential autocorrelation problem, as the DW statistics are situated in the grey area of the distribution. It is noted though that the grey area does not enable any conclusion to be made regarding the presence of autocorrelation. Some of the lagged significant cointegration test results also exhibit inconclusive DW test results, and it is noted that the longer the lag length, the more probable that the DW test statistic appears in the grey area of the distribution. The reason why most of these inconclusive DW test results occur is merely the small number of degrees of freedom. For the German weighted sample results, the degrees of freedom are small owing to the paucity of the data time-span, and the longer-lagged test results suffer from reduced degrees of freedom merely owing to the length of the lag. When the degrees of freedom are small, the grey area is so wide as to capture most DW test results and produce an inconclusive test result. However, perusal of the DW tests in appendix I reveals that even where inconclusive results occur, the computed statistic is towards the "acceptance" end of the grey distribution area. Thus, the small number of degrees of freedom render the DW test results more difficult to interpret, although it is probably the case that autocorrelation is not a significant problem in the majority of occurrences of cointegration.

Therefore, the bivariate cointegration testing has identified those time series variables which exhibit a cointegrating or equilibrating relationship with the DDE ratio. Evidence of cointegrating capital structure relationships implies that firms within a sample are optimising their capital structure ratios with respect to key capital structure determinants. The results suggest the existence of a small firm / large firm behavioural dichotomy, such that it is mainly larger firms which undertake such optimisation with respect to key capital structure determinants. It is argued that smaller firms may not continually adjust their capital structures to changes in key determinants as their information systems are unable to signal that their capital structures are in disequilibrium. However, the paucity of sample time-spans does impact somewhat upon the results, highlighting the need to interpret them with some care and qualify them where appropriate.

The objective of the Granger causality tests was to determine the direction of causation within a bivariate corporate capital structure relationship. The results of the tests are detailed in appendix J and are summarised in tables 8.4 and 8.5. Perusal of the tables reveals that hypothesis H36, which states that the corporate debt-equity ratio is best expressed as a dependent variable in any model containing significant time series capital structure variables, must be questioned. The reason for this is that most of the variables are subject to two-way causation with respect to the DDE ratio. Indeed, one-way causation with the DDE ratio as the dependent variable alone occurs only in the case of the bivariate relationship with the dividend cover variable. In the majority of cases where only one-way causation occurs, the DDE ratio is actually best expressed as the independent variable.

Table 8.4
Summary of the Granger causality test results for the European corporate capital structure data

variable *	WEIGHTED SAMPLES					NON-WEIGHTED SAMPLES					
	UK	NL	BD	FR	general result	UK	NL	BD	FR	general result	general result across sample types
ASSETS	C	D	A		?	C	C	B		C	C
CTAXRATIO	A			C	?	A				A	A
CTRATE	A	B		D	?	A	A			A	A
DIVCOVER	B		A	B	B	A	C		B	?	B
GDP/GNP	C	D			?	C	C	D		C	C
INCTAX	A				A	A				A	A
INFLATE	A	B			?	A	A	D		A	A
INTCOVER	A	B	A	D	A	C				C	A
INVEST	A		C		?	A				A	A
LRINT	A	D	C	D	D	A	C		B	?	?
MRINT	B	D	C	D	D	A	C	D	D	D	D
QRATIO	A	B	A	C	A	A	A			A	A
ROCE	A	B	A	D	A	A	A	C	D	A	A
SMIND	A	B	C	D	?	A	A		B	A	A
SRINT	D	C	A	C	C	C	A		A	A	?
TAXADV	A				A	A			B	?	A
TAXRATIO	A	A	A	D	A	A	C			?	A
WCRATIO	A		C	D	?	C	C			C	C

KEY
* = causation test results are listed under basic variable form where variable is expressed in a percentage change or further refined form.
A = variables which exhibit two-way causation with respect to the DDE ratio.
B = variables which "Granger-cause" the DDE ratio.
C = variables "Granger-caused" by the DDE ratio.
D = variables which are neither "Granger-caused" nor "Granger-cause" the DDE ratio.
? = variables which produce mixed causation results across countries.

Table 8.5
A further summary of the results of table 8.4

i) Variables which exhibit two-way causation with respect to the DDE ratio:

corporate variables:	taxation variables:	macro economic variables:
INTCOVER	**CTAXRATIO**	**CTRATE**
ROCE	**TAXADV**	**INCTAX**
QRATIO	**TAXRATIO**	**INFLATE**
		INVEST
		SMIND

ii) Variables which "Granger-cause" the DDE ratio:

corporate variables:
DIVCOVER

iii) Variables are "Granger-caused" by the DDE ratio:

corporate variables:	macro economic variables:
ASSETS	**GDP/GNP**
WCRATIO	

iv) Variables which are neither "Granger-caused" nor "Granger-cause" the DDE ratio:

macro economic variables:
MRINT

v) Variables which produce mixed causation results across countries:

macro economic variables:
LRINT
SRINT

The majority of variables which exhibit two-way causation are either macroeconomic or taxation variables, with the majority of corporate variables exhibiting one-way causation. Two-way causation is intuitive in the case of corporate variables because it is clear that the DDE ratio has the power to influence such variables and also may be influenced by them in turn, as all are within the realms of the corporate environment and may be controlled by the finance manager of the individual firm. However, the frequent occurrence of two-way causation with respect to macroeconomic and taxation variables is counter intuitive due to "causation inequality". Clearly, there is no theoretical support for the existence of two-way capital structure relationships with respect to super-exogenous variables. The concept of causation inequality, as defined in this research, states that causation may not flow from a localised variable to an aggregate variable where the latter is determined by a vast multitude of different influences. For example, the Granger causality tests suggest that the corporate tax rate is both a determinant of, and is determined by, the DDE ratio, whilst the former relationship is theory-consistent and intuitive, the latter relationship is extremely dubious because the corporate DDE ratio is likely to be only one of thousands of potential influences upon the level of the corporate tax rate budgeted by a particular government. The interest rate variables generally produce mixed causation tests results or suggest a lack of causal relationship at all with respect to the DDE ratio. However, even for the medium-term interest rate, which evidences no causal relationship with respect to the DDE ratio overall, there is some evidence of causal relationships in certain individual samples. The results for the interest rate measures serve to highlight the inconsistency of results for separate variables across samples.

The apparent inconsistency of causation test results across samples weakens the authority of the results. It may be observed, for example, that the shorter the sample time-span gets, the more frequent "one-way causation" or "no causal relationship" test results become. Therefore, the paucity of the time series samples of this research probably biases the results of tests away from "two-way causation" towards "no causal relationship" results. If this argument is correct then it only serves to strengthen the overall result of the Granger causality exercise, thus supporting the occurrence of two-way causation of European time series variables with respect to the DDE ratio.

Therefore, there generally appears to exist two-way causal relationships between European time series variables and the corporate capital structure ratio. However, this result is weakened by the apparent two-way causal relationships observed between the DDE ratio and extremely exogenous taxation and macroeconomic variables. It is argued, then, that whilst two-way causality is common within bivariate corporate capital structure relationships, the inconsistency of results across samples and the counter intuitive nature of two-way causation in capital structure relationships involving super-exogenous variables imply that the Granger procedure may be a fairly weak power test and thus the results of this section may not be given very much weighting in the European capital structure research. The apparent weakness of the test may arise, for example, from the limited number of lags employed in the test equations due to the constraints of the European time series data set. However, the results do serve to question the perception of the DDE ratio as being the dependent variable in any capital structure model. Furthermore, the possibility of two-way causation is allowed for in the bivariate and multivariate EC models, the results of which are presented in this chapter, to address more precisely the endo-exogenous division of the European time series variables.

There are no general results of interest arising from the specification and estimation of the ADL models and thus the results of such models are better discussed in the following sections, which describe bivariate capital structure relationships with key taxation, macroeconomic and corporate determinants. The results of the ADL models are presented in the appendices. Appendix K presents the specific-form bivariate ADL models, appendix L briefly discusses the diagnostic statistic measures used to aid interpretation of the models, and appendix M gives the results of those diagnostic statistics for the ADL models.

The objective of the bivariate EC analysis was to model and study the processes governing both the long-run and short-run capital structure policies of European firms simultaneously, thus enabling the relative importance of such processes to be determined. The results of the bivariate error correction models are presented in appendix N and in tables 8.6 to 8.8 of this section. Table 8.6 presents the test results for cointegrating relationships with both the DDE ratio as dependent variable and as independent variable.

Table 8.6
Summary table exhibiting occurrences of cointegrating corporate capital structure relationships

sample	dependent variable	independent variable coefficient	ADF test significant at lags:
UK weighted	DDERATIO	INFLATEchange	lag 0
UK non-weighted	DDERATIO	INFLATEchange	lag 0
UK non-weighted	INFLATEchange	DDERATIO	lag 0
NL weighted	DDERATIO	INFLATEchange	lag 0
UK non-weighted	DDERATIO	MRINT	lag 1
UK weighted	DDERATIO	TAXRATIO	lag 0
UK non-weighted	DDERATIO	CTRATEchange	lag 1
UK non-weighted	CTRATEchange	DDERATIO	lag 0*,1
UK weighted	DDERATIO	ROCE	lag 0,1,4**,5**
BD weighted	DDERATIO	ROCEchange	lag 0***
BD weighted	ROCEchange	DDERATIO	lag 0***
UK weighted	DDERATIO	DIVCOVER	lag 0,1
UK weighted	DIVCOVER	DDERATIO	lag 0,1
BD weighted	DDERATIO	ASSETSchange	lag 0***
BD weighted	ASSETSchange	DDERATIO	lag 1
BD weighted	DDERATIO	WCRATIOchange	lag 0***
BD weighted	WCRATIOchange	DDERATIO	lag 1**

* = Durbin Watson statistic is rejected.
** = Durbin Watson statistic is in the grey area of the distribution.
*** = DF/ADF tests include a trend in the computation, and the Durbin Watson statistic is in the grey area of the distribution.

Table 8.7
Static long-run models for the European data samples

country sample	dependent variable (independent)	constant	independent variable coefficient	model R-squared
UKW	DDERATIO (INFLATEchange)	0.21412	0.70630	0.22042
UKNW	DDERATIO (INFLATEchange)	0.13859	0.64530	0.491961
UKNW	INFLATEchange (DDERATIO)	-0.057972	0.76238	0.491961
NLW	DDERATIO (INFLATEchange)	0.30754	2.0868	0.440223
UKNW	DDERATIO (MRINT)	0.050782	0.013094	0.409518
UKW	DDERATIO (TAXRATIO)	0.16065	0.0028397	0.134816
UKNW	DDERATIO (CTRATEchange)	0.20138	0.55366	0.425762
UKNW	CTRATEchange (DDERATIO)	-0.16003	0.76900	0.425762
UKW	DDERATIO (ROCE)	0.060648	0.014049	0.376678
BDW	DDERATIO (ROCEchange)	0.60611	0.23970	0.340274
BDW	ROCEchange (DDERATIO)	-0.89475	1.4196	0.340274
UKW	DDERATIO (DIVCOVER)	0.36808	-0.042004	0.235121
UKW	DIVCOVER (DDERATIO)	3.6723	-5.5975	0.235121
BDW	DDERATIO (ASSETSchange)	0.60062	-0.096793	0.0280993
BDW	ASSETSchange (DDERATIO)	0.24449	-0.29030	0.0280993
BDW	DDERATIO (WCRATIOchange)	0.59488	0.35947	0.191196
BDW	WCRATIOchange (DDERATIO)	-0.31921	0.53188	0.191196

Table 8.8
The specific error correction models for the European data samples

country sample	dependent variable (independent)	constant	Δdependent variable lagged 1 year	Δindependent variable	Δindependent variable lagged 1 year	ECM lagged 1 year	R^2 statistic/ (t-critical)
UKW	ΔDDERATIO (ΔINFLATEchange)	0.0012613 (0.080)	-	0.44556 (1.123)	-	**-0.69126 (-2.995)**	0.309702 (2.086)
UKNW	ΔDDERATIO (ΔINFLATEchange)	-0.00078120 (-0.104)	-	0.41880 (2.020)	-	**-0.70366 (-2.877)**	0.304899 (2.086)
UKNW	ΔINFLATEchange (ΔDDERATIO)	-0.00098014 (-0.145)	-	-	0.40567 (1.981)	-0.43457 (-2.002)	0.482618 (2.086)
NLW	ΔDDERATIO (ΔINFLATEchange)	-0.0049003 (-0.309)	-	2.2513 (1.879)	-	**-1.1170 (-3.383)**	0.537516 (2.228)
UKNW	ΔDDERATIO (ΔMRINT)	-0.0065519 (-1.080)	-	0.0055380 (1.384)	-	**-0.43705 (-2.358)**	0.28601 (2.131)
UKW	ΔDDERATIO (ΔTAXRATIO)	0.0030354 (0.213)	-	0.0033279 (1.324)	-	**-0.56892 (-3.016)**	0.317923 (2.074)
UKNW	ΔDDERATIO (ΔCTRATEchange)	-0.00002797 (-0.005)	-	0.15055 (1.315)	-	**-0.74672 (-4.240)**	0.540839 (2.080)
UKNW	ΔCTRATEchange (ΔDDERATIO)	0.00096188 (0.144)	**0.66186 (3.343)**	**0.80818 (3.572)**	**-0.48130 (-2.350)**	**-1.0788 (-3.619)**	0.713947 (2.101)
UKW	ΔDDERATIO (ΔROCE)	0.0025830 (0.207)	-	**0.0098713 (2.181)**	-	**-0.71140 (-3.407)**	0.475559 (2.074)
BDW	ΔDDERATIO (ΔROCEchange)	**-0.040968 (-6.122)**	**-0.84072 (-4.262)**	-	**-0.10841 (-3.290)**	-0.23819 (-1.528)	0.841334 (2.571)
BDW	ΔROCEchange (ΔDDERATIO)	**-0.15972 (-2.728)**	-	**-3.2231 (-2.568)**	**-3.7448 (-2.540)**	**-1.0975 (-4.357)**	0.830617 (2.447)
UKW	ΔDDERATIO (ΔDIVCOVER)	0.0033290 (0.212)	-	**-0.045336 (-2.476)**	-	**-0.71437 (-2.964)**	0.363941 (2.093)
UKW	ΔDIVCOVER (ΔDDERATIO)	0.046271 (0.353)	**0.43578 (2.939)**	**-3.5892 (-2.341)**	-	**-0.82956 (-4.508)**	0.611365 (2.110)
BDW	ΔDDERATIO (ΔASSETSchange)	**-0.028118 (-4.113)**	**-0.52079 (-2.909)**	-	-0.052531 (-1.806)	-0.17108 (-1.634)	0.78403 (2.571)
BDW	ΔASSETSchange (ΔDDERATIO)	**-0.10051 (-2.597)**	**1.1451 (4.325)**	-	**-2.6085 (-2.583)**	**-2.5039 (-6.503)**	0.903711 (2.571)
BDW	ΔDDERATIO (ΔWCRATIOchange)	**-0.029614 (-6.109)**	**-0.61858 (-4.774)**	**0.11950 (3.155)**	-0.080602 (-2.353)	-0.11189 (-1.133)	0.90804 (2.776)
BDW	ΔWCRATIOchange (ΔDDERATIO)	0.021240 (0.953)	**0.63177 (2.597)**	1.6924 (2.006)	-	**-1.4774 (-4.235)**	0.830808 (2.571)

It is noted that the occurrence of a significant cointegrating relationship with the DDE ratio as dependent variable does not necessarily imply a significant cointegrating relationship with the DDE ratio as independent variable. The reason for this may merely lie in the weakness of the cointegration analysis method. For example, the critical values are simulated rather than being derived analytically. (Deadman and Charemza (1992), p.132-133). Perhaps a better test of the significance of the residuals from a bivariate static long-run equation is to include them in an error correction model, where the strength of the ECM is gauged in relation to the other model components, particularly the dynamic processes. On balance, however, it is more reassuring when both the error correction mechanism arising from the bivariate static long-run equation and the coefficient of the ECM in the EC model are found to be significant.

It is noted that for the profitability static long-run equations, the profitability measure is expressed in its simple untransformed form for the UK weighted model whereas it is transformed to a relative change form if the German weighted models. This phenomenon warrants some explanation. The reason for the difference is that the untransformed profitability measure in the German weighted sample was found to be of a higher order of integration than the DDE ratio in the unit root testing of the previous chapter, thus necessitating its expression in relative change terms. The reason why the untransformed profitability measure was found to be of a higher order than the DDE ratio in the German but not the UK sample is unclear, but it may be a result of unexplained country-specific effects. Alternatively, it may merely be the result of the relative paucity of the German data sample time-span, whereby there may be insufficient observations for the profitability measure to become integrated of the same order as the DDE ratio. Whatever the reason for this phenomenon, its occurrence weakens to some extent the results of the profitability models.

Quick perusal of table 8.8 reveals that there is generally a more rapid capital structure response to changes in the exogenous macroeconomic and taxation variables than there is to the endogenously determined corporate environment variables. This result derives from the fact that models where endogenous variables are expressed as independents generally exhibit longer lag structures than models where exogenous variables are expressed as independents. Thus, there is some support for hypothesis H37, which states that the European firm responds rapidly to exogenous influence changes, whereas there is a delayed response to changes in endogenous influences. The reason for this result may be that the firm is compelled to respond rapidly to changes in exogenous macroeconomic and taxation influence changes otherwise it will become rapidly disadvantaged with respect to its competitors by not correcting for any disequilibrium. However, the firm may not respond rapidly to endogenous variable changes because the finance manager may wait until changes in the internal accounting structure and environment of the firm appear to be sustained before adjusting the firm's capital structure.

The lag length of the ADF test required to achieve stationarity is generally very similar whether the DDE ratio is expressed as the dependent or independent variable in a cointegrating relationship. The more exogenous the non-capital structure variable in each bivariate relationship, the less likely there is to be a significant cointegrating relationship when the exogenous variable is expressed as the dependent variable in the static long-run equation. This is particularly the case for the exogenous macroeconomic and taxation variables. Thus, hypothesis H38, which states that the greater the degree of exogeneity of a particular corporate capital structure influence, the more likely that variable is to be a determinant of, and not determined by, the DDE ratio, is strongly supported by the results of the "two-way" cointegration tests. Whilst the "degree of exogeneity" is not a statistic which may be measured on a statistical scale, in this context it is merely sufficient to be able to divide variables into those which are more exogenous and those which are less exogenous (or endogenously determined). Therefore, particularly with respect to macro economic factors, they are likely to exert a strong influence upon the DDE ratio, but it is counter intuitive to expect those variables to be themselves influenced by the DDE ratio. Furthermore, even where there is evidence of a cointegrating relationship with the exogenous variable expressed as the dependent variable in the DF / ADF cointegration tests, the estimated EC model may be seen to be relatively weak.

Therefore, the fact that the DDE ratio is cointegrated with a particular time series variable when the DDE ratio is expressed as the dependent variable does not necessarily imply a cointegrating relationship for the opposite direction of causation. Firms more rapidly adjust to a capital structure disequilibrium with respect to key exogenous variable changes, such as changes in the taxation and macroeconomic environments of the firm, than to endogenous corporate environment variable changes, possibly due to different perceptions concerning the permanency of such changes. Finally, the bivariate EC models clearly demonstrate that, the greater the degree of exogeneity of a time series variable, the more likely it is to be a determinant of, and not determined by, the corporate DDE ratio.

In summary, this section has identified a number of general though important results arising from the bivariate time series analyses. Firstly, full optimisation behaviour, which involves the finance manager choosing a DDE ratio which is optimal in relation to key capital structure determinants in the long-run, appears to occur mainly for larger firms. Such behaviour is evidenced by bivariate cointegrating or equilibrating capital structure relationships. This implies that smaller firms must behave in a different manner as they do not generally engage in this bivariate equilibrating behaviour, which might be described as extra-ratio targeting behaviour (as finance managers appear to target key determinants external to the capital structure ratio). It is argued that smaller firms may concentrate instead upon targeting the level of their capital structure ratios upon the DDE ratios of larger firms, firms in their industry, or on the basis of some other criterion. This form of bounded optimisation, described as intra-ratio targeting, must therefore be examined further, a task which is undertaken in section 8.4. Whilst differences in the sophistication of information systems are argued to cause such a behavioural dichotomy, the relative instability of time series data from the non-weighted (smaller firm) data sets may also form part of the cause. The corporate-level and capital structure variables of larger firms (which are given greater representation in the weighted samples) are likely to be more stable and exhibit less fluctuations than the equivalent variables of smaller firms (given over-representation in the non-weighted samples).

Secondly, it appears that two-way causation may be a fairly common occurrence in bivariate capital structure relationships. However, such causality results are inconsistent across samples, even suggesting two-way causation in capital structure relationships with taxation and macroeconomic variables, which is clearly counter intuitive. Thus, the Granger causality tests appear to be fairly weak in the determination of causality, possibly due to the constraints of the data set in this research, thus necessitating a further and more complex analysis of causality which is facilitated by the bivariate and multivariate EC models of this chapter.

Thirdly, firms appear to adjust their capital structure ratios more rapidly to changes in dynamic exogenous variables than dynamic endogenous variables. The reason for this may be that finance managers believe exogenous variable changes to be more permanent than endogenous variable changes and they are less able to exert any influence over such changes, and are thus compelled to respond more rapidly to the former than the latter.

Fourthly, the constraints of the European time series data set, particularly the paucity of the German and French data time-spans, appear to impinge somewhat upon the analytical results. For example, it is suggested that more incidences of cointegration might be determined if longer data time-spans were available. This result merely highlights the need to qualify the set of results somewhat at the interpretation stage.

Finally, although some important results are drawn from the analyses, the most important results are discussed in sections 8.2.3 to 8.2.5, which describe the bivariate relationship between the corporate DDE ratio and taxation, macroeconomic and corporate influencing variables.

8.2.3 The taxation environment capital structure models

The discussion of hypotheses in chapter 7 argued that there may be a distinct tax advantage to corporate debt which impinges upon the capital structure decision of the European firm, but that the tax advantage may be considerably less than that proposed by the MM (1963) model, due to the influence of personal taxes, corporate tax exhaustion, the tax system in place, or the structure of tax rates. Furthermore, even where there remains a distinct and significant tax advantage to debt, there are likely to be many factors which can cause a breakdown in its relationship with actual corporate gearing, such as the stickiness of tax regimes, the naivety of tax advantage to debt measures, and the important influence of macroeconomic and corporate environment factors. The models estimated concentrate upon those factors which reduce the magnitude of any tax advantage to debt in the real world, by examining nominal and effective taxation measures and their relationship with the corporate DDE ratio.

The hypotheses to be tested in the nominal taxation measure models are hypothesis H6, which states that the corporate debt-equity ratio increases as the tax advantage to debt increases, and hypothesis H8, which states that the corporate debt-equity ratio increases with the corporate tax rate. The nominal corporate tax rate is modelled as it not only represents an important aggregate taxation variable in its own right, but also proxies the tax advantage to debt measure. Intuitively, as the corporate tax rate increases, ceteris paribus, the tax advantage to debt should increase (or the tax disadvantage to debt should decrease).

The ADL models estimated to examine the relationship between the computed nominal tax advantage to debt and the corporate DDE ratio are generally highly significant and exhibit positive coefficient low-lagged variables. The lag structures present merely confirm the important influence of the tax advantage to debt as a stock concept rather than as merely a flow concept. Indeed, the stock of debt brings with it a stock of tax-deductions which benefit the firm in addition to the increases or decreases in that stock as gearing is increased or decreased at the margin. As anticipated, there is some weak evidence of a scale influence on the relationship, whereby the smaller firms (over-represented in the non-weighted samples) exhibit more evidence of a significant positive relationship. Thus, a behavioural dichotomy is apparent, whereby smaller firms react more vigorously to changes in the <u>nominal</u> tax advantage to debt whereas the more sophisticated firms may wait until the <u>effective</u> tax advantage to debt changes before adjusting their capital structures. The models, then, generally conform to expectations, exhibiting positive coefficient independent variables and some evidence of a behavioural dichotomy related to firm size. Hypothesis H6 is supported for the models estimated, and therefore there is some evidence that corporate gearing increases as the nominal tax advantage to debt increases, particularly for smaller, less sophisticated European firms.

The ADL models estimated to examine the relationship between the nominal corporate tax rate and the corporate DDE ratio are generally significant and exhibit positive coefficient independent variables. Such models are important as the nominal corporate tax rate proxies the tax advantage to debt measure. Indeed, for the Dutch samples, the tax advantage to debt is equal to the corporate tax rate as the Netherlands employs a classical tax system. It was argued in the hypothesis section that, as the nominal corporate tax rate represents a more direct and readily interpretable measure of the tax advantage to debt for firms generally, then the capital structure response should be more immediate than for the tax advantage to debt models. There is some weak evidence of this in the lag structure exhibited in the models. The Dutch models, however, fail the RESET test which suggests that the explanatory part of the models might be better expressed in a higher power, that is, implying a different model specification. Hypothesis H8 is supported and therefore there is some evidence that corporate gearing increases as the nominal corporate tax rate increases.

Therefore, by modelling two different nominal tax advantage to debt measures, it is clear that both larger and smaller firms react to increases in the magnitude of any tax advantage to debt by increasing their DDE ratios. This suggests that even if the tax advantage to debt is very much smaller than the MM (1963) model suggests, changes in that tax advantage do indeed impact upon the European corporate capital structure decision. However, so far this relationship has only been established as part of the year-to-year or operational capital structure policy of the firm. If the nominal tax advantage to debt, or some proxy for that measure, is to exert a significant influence upon the firm's strategic capital structure policy then there should be evidence of a bivariate cointegrating relationship between gearing and such measures.

The results of the cointegration analysis suggest that the corporate DDE ratio is cointegrated with the nominal corporate tax rate (expressed in relative change form), but in the UK non-weighted sample only. This may signal the fact that whereas most European firms adjust their capital structures to changes in the nominal tax advantage to debt as part of an operational policy, such an adjustment is generally not undertaken as part of a strategic capital structure policy. Additionally, it may suggest that the corporate tax rate measure is more readily available and understood than the more complex computed tax advantage to debt measure and thus the former may form a long-run equilibrating relationship whereas the latter may not.

The bivariate EC models estimated to examine both the operational and strategic influence of the nominal corporate tax rate upon the corporate DDE ratio are exhibited in table 8.8 for both directions of causation. However, only the model with the DDE ratio as dependent variable is discussed because the model with the corporate tax rate measure expressed as dependent variable is counter intuitive. This is because any model with the tax rate measure expressed as the dependent variable is not underpinned by theory and is not logical due to the super-exogeneity of the tax rate measure with respect to the DDE ratio. It was argued in the hypothesis section of chapter 7 that a long-run cointegrating relationship should be observed only for the smaller firm, given greater representation in the non-weighted samples. The model demonstrates that there is some support for this expectation and thus it may be argued that smaller firms are more likely to rely on the naive nominal tax measures than larger firms which monitor effective tax measures instead over the long-run. The reason for this may be that smaller firms do not have the information systems in place to enable them to accurately compute effective tax measures such as the effective corporate tax rate. The model with the DDE ratio expressed as dependent variable exhibits an insignificant positive coefficient dynamic independent variable, even though the error correction mechanism (ECM) is significantly negative. Hypothesis H8, then, is supported, but only to a weak extent for the dynamics of the model, even though the static long-run equation of table 8.7 exhibits a positive coefficient sign. Therefore, the long-run equilibrating relationship dominates any short-run dynamic relationship between the two variables, which implies that the influence of the corporate tax rate measure as a determinant of strategic capital structure policy is of far greater significance to the firm than its influence as a determinant of operational policy in the UK non-weighted sample. However, the model fails the RESET test, suggesting that the corporate tax rate variable should ideally be modelled within an alternative, unknown model specification. Therefore, the nominal corporate tax rate measure, which is a proxy for the tax advantage to debt, appears to be a significant strategic determinant of the DDE ratio.

In summary, then, the nominal tax advantage to debt and the corporate tax rate proxy measure appear to be more appropriately considered significant determinants of the operational capital structure policy than the strategic policy of the European firm. However, there is some evidence of the corporate tax rate measure exerting an influence on the strategic capital structure policy of the firm, but only for one of the non-weighted samples. Firm size also appears to influence the short-run (operational) relationship between the DDE ratio and the corporate tax rate measure. Therefore, firm size impacts upon the operational and strategic capital structure policies of firms such that smaller firms appear more likely to monitor nominal "tax advantage to debt measures" than larger firms. It is argued that such firms do not have the information systems in place to correctly compute and monitor effective-form taxation influences, and thus rely more on the more readily available and understood nominal measures when adjusting their capital structures. Hypotheses H6 and H8 are supported, then, but the significant relationships determined represent, in the main, processes governing the operational capital structure policies of European firms.

The taxation measures which should impact to a greater extent upon the capital structure policy of the firm are those measured in "effective" forms, that is, after real-world occurrences such as the offsetting effect of non-debt tax allowances are taken into account. As the effective tax advantage to debt is extremely complex to compute across samples, effective tax rates are instead modelled as proxy measures. The lower is the effective corporate tax rate to the firm, the lower will be any effective tax advantage to debt as factors such as tax exhaustion reduce the firm's tax bill and therefore crowd-out its ability to utilise the tax benefits associated with debt. The tax rate measures modelled are the effective corporate tax rate and the effective total tax rate. These measures also enable the interaction of the DDE ratio and the magnitude of the relative tax bill to be measured, thus enabling the importance of tax-reduction policies to be gauged.

As both measures may be considered proxies to the tax advantage to corporate debt, they are modelled to test hypothesis H8, which states that the corporate debt-equity ratio increases with the corporate tax rate. The other hypothesis to be tested, as discussed in the hypothesis section, is hypothesis H31, which states that the corporate debt-equity ratio increases as the relative tax bill increases. An increase in the relative tax bill should encourage the firm to react by increasing gearing as part of a tax-reduction policy.

The ADL models exhibit varied levels of significance though generally exhibit positive coefficient signs. Therefore, there is some evidence to support hypotheses H8 and H31. Thus, a positive relationship may arise either because the measures modelled are proxies for the effective tax advantage to debt, and when effective tax rates increase, the value of debt interest tax-deductions increases, or because, when the relative tax bill of the firm increases, the finance manager is encouraged to increase gearing as part of a wider tax-reduction strategy. There is some evidence of a delayed capital structure response to changes in the effective taxation variables, a result which is argued to support the tax-reduction theory rather than the effective tax advantage to debt proxy theory. Therefore, as there is a delay between a relatively high tax bill and an increase in corporate gearing, this signals a "reactive" capital structure response. If the measures were better considered as tax advantage to debt proxies, a more immediate capital structure response would have been observed as there would be a proactive response to the taxation changes, such that the models would not exhibit the lag structures observed. As discussed in the hypothesis section, the delayed response is caused by firms taking time to assimilate the new information contained within the higher than average tax bill observation, a delay which may be compounded by the "lumpiness" of capital structure issues, whereby significant economies of issue costs cause firms to issue new claims on block rather than continuously. It is also noted that the relative corporate tax bill models are generally more significant than the relative total tax bill models, which may be due to the directness of the former compared to the latter, as firms can more readily observe and understand the relative corporate tax bill as it is merely the corporation tax bill as a proportion of profits whereas the total tax bill measures all of the taxation expenses that the firm owes. Furthermore, the firm may perceive a more direct link between a tax-reduction capital structure policy and its beneficial effect in the reduction of the corporation tax bill than the effect of such a policy on the total tax bill. Perusal of the models across the samples also reveals quite clearly that the relative corporate tax bill models are more significant for the larger than the smaller firms. This is consistent with the argument that larger firms are more sophisticated and are better able to assess the likely impact of factors such as corporate tax exhaustion which reduce the nominal taxation variables to arrive at the more realistic effective levels. However, the relative corporate tax bill model for the UK non-weighted sample fails the normality test, and thus further development of this model should involve the utilisation of a modelling technique which does not require the normality assumption. Therefore, there is some support for hypotheses H8 and H31, although it is argued that firms are acting in a manner which appears to provide more support for hypothesis H31. Firms appear to react to "higher than normal" tax bills by increasing gearing as part of a wider tax-reduction strategy.

It appears, then, that the effective tax rate measures are better considered relative tax bill measures, as the European firm increases its gearing ratio in reaction to higher than normal tax bills. However, the above models only describe the influence of such effective taxation measures upon the operational capital structure policy of the firm. If such measures impact upon the strategic capital structure policy of the firm then there should be evidence of a cointegrating relationship between the DDE ratio and the effective taxation measures. Table 8.8 reveals that only the effective total tax rate (or total tax ratio) exhibits such a cointegrating relationship, and even then, only for the UK non-weighted sample. It is interesting to note that the effective corporate tax rate (or corporation tax ratio) does not appear to influence the strategic capital structure policy of the firm. One reason for this may be that a long-run tax-reduction strategy requires the monitoring of all incidences of taxation incurrence, and the minimisation of the corporation tax ratio is only part of this strategy. Therefore, the cointegrating relationship between the DDE ratio and the total tax ratio supports the argument that the level of the DDE ratio set by the finance manager is an integral part of the firm's wider tax-reduction strategy which is better measured by the total tax ratio than by the narrower corporation tax ratio. As part of its operational capital structure policy, the firm is more conscious of the effect of gearing on the corporation tax bill, whereas its long-run strategic capital structure policy dictates the use of gearing adjustments as a component of a wider range of tax-minimisation policies.

The total tax ratio (effective total tax rate) bivariate EC model is estimated to examine both the operational and strategic influence of the total tax ratio upon the corporate DDE ratio. The model supports hypothesis H31 as it exhibits a positive dynamic coefficient, even though the coefficient is insignificant. The reason for this may be that overall tax-reduction is a long-run strategic objective of the firm (exhibiting a positive coefficient in the static long-run equation), dominating any tax-reduction behaviour at the operational policy level for the sample evidencing such a cointegrating relationship. The fact that the significant EC model estimated is for the UK weighted sample only supports the argument, given in the hypothesis section, that only larger firms are likely to track the movement of the capital structure ratio in relation to the total tax ratio in the long-run, because such a tax-reduction strategy requires sophisticated information systems to enable the firm to choose an optimal mix of financial and investment tax allowances.

Therefore, firms appear to respond to changes in the effective taxation measures in a manner consistent with the interpretation of those measures as tax ratio measures, such that as the tax ratio increases firms are encouraged to increase gearing as part of a tax-reduction policy. In the short-run the corporation tax ratio impacts more significantly upon the operational capital structure policy of the firm, exhibiting a short delay so that the finance manager can decide upon the magnitude of gearing response required. In the long-run, however, there is some evidence that the total tax ratio impacts upon the firm's strategic capital structure policy, as the level of gearing is set as a component of a wider-ranging tax-minimisation strategy. The effect of the scale of the firm is pronounced as the influence of the effective taxation measures is more significant to the operational and strategic capital structure policies of larger firms than it is for smaller firms.

In summary, the tax advantage to debt, and various proxies for that measure, are likely to be far smaller than the magnitude proposed in the MM (1963) paper. Country-specific factors such as the tax system and structure of tax rates employed reduce the nominal tax advantage to debt to a fraction of that proposed in the MM paper, a fraction which is then further reduced by the action of factors such as tax exhaustion to produce an effective tax advantage to debt. One of the key results of the bivariate time series taxation models is that the scale of the firm impacts significantly upon the interaction between the European corporate DDE ratio and the taxation environment. Indeed, both the operational and strategic capital structure policies of firms differ depending upon the size of the firm, due to differences in the complexity of information systems across firms. Smaller firms, which do not have complex information systems in place, are more likely to monitor <u>nominal</u> taxation measures, such as the nominal tax advantage to debt and the nominal corporate tax rate, before making a decision to adjust their capital structures. Larger firms, however, have in place the sophisticated information systems which enable them to compute and monitor the more realistic <u>effective</u> taxation measures, such as the effective total tax ratio and the effective corporation tax ratio, before adjusting their capital structures. This key result is consistent with the discussion in the hypotheses section of chapter 7. The second key result is that, with regard to the more realistic or accurate effective taxation measures, firms appear to act in a reactive rather than a proactive manner. This is because the estimated model lag structures suggest that there is a delayed capital structure response to changes in the effective taxation measures which implies that the finance manager does not act proactively by issuing debt immediately, as soon as its tax-deduction value increases, but he or she delays a gearing adjustment in reaction to a higher-than-normal relative tax bill whilst considering whether to make an adjustment to long-term funding. The third key result is that operational capital structure / taxation policies are more common across samples than strategic capital structure / taxation policies, probably because the information system requirements to support the latter are far more demanding than those to support the former. Finally, it is noted that taxation is a key influence of both the operational and strategic capital structure policies of European firms, and thus must make a significant contribution to the firm-level capital structure optimisation process.

8.2.4 The macroeconomic environment capital structure models

The macroeconomic environment capital structure models are estimated to enable the examination of the short-run and long-run processes governing the interaction between the corporate DDE ratio and inflation, financial market performance factors, and aggregate growth factors, respectively.

The inflation ADL models estimated enable the effect of inflation upon the operational capital structure policy of the firm to be ascertained. Inflation is expressed as the relative change in the price index in the models. Most of the estimated models are significant and all exhibit positive independent variable coefficient signs, thus supporting hypothesis H10, which states that the corporate debt-equity ratio increases with increases in the inflation rate. It is argued that such a positive relationship arises from either the interest rate effect or the non-debt tax allowance effect discussed in the hypothesis section. The interest rate effect, as discussed by Corcoran (1977), arises where an increase in inflation causes interest rates to rise, leading to higher debt interest tax deductions, which is likely to encourage higher gearing. The non-debt tax allowance effect, as discussed by DeAngelo and Masulis (1980), arises where inflation decreases the real value of investment allowances, reducing the "crowding out" of debt tax deductions, and thus encouraging the finance manager to increase gearing. As these two explanations of the positive relationship are in no sense competing, it is likely that the relationship observed occurs as a result of both effects. The positive relationship found is arguably even stronger than that exhibited in the models given the "inflation bias" implicit in the DDE ratio measure which may arise because the equity component of the denominator of the DDE ratio is measured in market value terms, and thus it is expected that the coefficient of the inflation independent variables in the models is negatively biased. The fact that all of the models exhibit a positive relationship suggests that the positive relationship is strong enough even to counteract this bias. However, the diagnostic tests show that the UK weighted model fails the normality test, although that particular model has no significant constituent variables anyway, and that the Dutch non-weighted model fails the RESET specification test, suggesting that the model might be respecified by expressing the right hand side in a different functional form. Therefore, inflation appears to be a strong determinant of the operational capital structure policy of the European firm.

The bivariate EC models are then estimated to determine whether inflation is also a significant determinant of the strategic capital structure policy of the European firm. It appears that inflation exhibits the most common cointegrating relationship with respect to the DDE ratio of all the variables modelled in the bivariate time series analyses as this relationship appears in three of the eight samples modelled. As the static long-run equations of table 8.7 exhibit positive coefficient independent variables, hypothesis H10 is supported in the long-run as well as in the short-run and thus inflation is a very strong determinant of the strategic capital structure policy of the European firm. The EC models exhibit no lag structures for the dynamic independent variable, the pace of inflation, because inflation is a super-exogenous variable, as discussed in the ADL models. The ECM's of the models are all highly significant and dominate the model dynamics, implying that inflation is more important as a strategic influence of the DDE ratio than an operational influence in the samples evidencing cointegrating behaviour. However, the UK non-weighted model fails the normality and heteroscedasticity tests and therefore the normality requirement for the model disturbance is violated, the model estimators are inefficient and the standard errors of the model are biased (Wallace and Silver (1988), p.262) for that sample.

Overall, inflation impacts upon both the operational and strategic capital structure policies of European firms, though the strategic influence dominates any operational adjustments made in the samples which evidence cointegrating behaviour. There are a number of possible explanations for the positive relationship determined, although it appears most plausible that the relationship is caused partly by the interest rate effect discussed by authors such as Corcoran (1977) and partly by the non-debt tax allowance effect discussed by authors such as DeAngelo and Masulis (1980). "Expectations bets" theories, proposed by authors such as Franks and Broyles (1979) as an explanation for firms wanting to increase gearing during periods of higher inflation, cannot be argued to cause such a relationship because the European investors are predominantly institutions, which are unlikely to consistently lose such "bets" over the long-run.

The financial market performance factors are modelled to determine the effect of the state of equity and debt markets upon the capital structure policy of the European firm. Such factors are important, it is argued, as the finance manager must consider the strength of demand for new debt and equity claims on the firm before adjusting the firm's capital structure.

The stock market index ADL models are estimated to determine the influence of stock market performance upon the operational capital structure policy of the firm. The models are generally highly significant and exhibit negative independent variable coefficients. Therefore, there is strong support for hypothesis H12, which states that the corporate debt-equity ratio is negatively related to stock market performance. This result gives some support to the theories of authors such as Martin and Scott (1974), who suggest that managers are more likely to issue equity after periods of strong equity market performance. Although there is theoretically a positive relationship between stock market performance and the proportion of equity issued, because equity appears in the denominator of the DDE ratio, the stock market index exhibits a negative relationship with the capital structure ratio. There is some weak evidence of a lagged capital structure reaction to changes in stock market performance in some of the samples. This is consistent with theories proposed by King (1977) and Marsh (1982), who argued that managers are more likely to issue equity after periods of sustained strong equity market performance. However, a number of the models suffer from diagnostic test failures, although of these models, only the Dutch non-weighted estimated model results should be qualified, as the other models do not contain significant independent variable coefficients. The Dutch model fails both the ARCH test and the heteroscedasticity test, and thus appears to be fundamentally unsound as a model specification, even though it appears to be highly significant on the basis of other statistics. Therefore, some alternative, though unknown model specification is required to adequately capture the relationship between the DDE ratio and the stock market index measure for this particular sample. Stock market performance, then, is a very significant determinant of the operational capital structure policy of the European firm, as finance managers wait for evidence of a buoyant stock market before increasing the proportion of equity in the firm's capital structure.

It is interesting to note that the stock market index is not cointegrated with the DDE ratio in any of the European samples analysed. Therefore, although stock market performance is an important determinant of operational capital structure policy, it does not impact upon the strategic or long-run determination of the European corporate capital structure.

The interest rate ADL models are estimated to examine the influence of interest rates (an explicit cost of debt finance) on the operational capital structure policy of the firm. Approximately half of the interest rate models contain significant independent variables, which generally exhibit positive coefficients. Hypothesis H31 is thus rejected, as it states that the corporate debt-equity ratio increases as debt interest rates decrease, implying a negative coefficient. The positive coefficient found is strengthened further by the presence of the inflation bias which is likely to produce a negative bias in the independent variable coefficients. Thus, it is likely that the positive coefficients found would be even more significant, if it were not for the inflation bias. The positive coefficients of the interest rate independent variables question Marsh's (1982) proposition that finance managers are more likely to increase debt in the firm's capital structure when interest rates are relatively low. Instead, it appears that managers may only significantly increase the supply of bonds to the market when the interest rates they offer on their debt claims are relatively high. This suggests that debt markets may be "demand-driven", such that investors appear to maintain a more powerful bargaining stance than debt-issuers, contradicting an implicit assumption of many capital structure theories which argue that financial markets are "supply-driven" (and are best examined from the corporate perspective). Additionally, it was anticipated in the hypothesis section that shorter-term interest rate measures should form weaker estimated models than longer-term measures. However, European firms appear to react equally significantly to changes in interest rates of any term length, and thus the finance manager does not necessarily appear to "match" long-term debt finance decisions to long-term interest rate movements, believing such rates to represent the long-term trend in rates with the shorter-term fluctuations smoothed out. The diagnostic tests confirm the models to be robust, as the only test failure is for the UK non-weighted short-term interest rate model, which fails the normality test. Therefore, contrary to expectations, the market for corporate debt appears to be "demand-driven", producing a positive relationship between the DDE ratio and the interest rate measures. There does not appear to be a more significant relationship between gearing and longer-term rates than shorter-term rates, at least at the level of the operational gearing decision, suggesting that debt markets are approximately perfect and thus the level of short-term interest rates implicitly conveys information about the level of expected medium-term and long-term interest rates.

The only interest rate variable forming a significant cointegrating relationship with the DDE ratio is for the medium-term interest rate and, even then, only for the UK non-weighted sample. Neither the EC model nor the static long-run equation contains a negative dynamic independent variable coefficient, again questioning hypothesis H13. Thus, the demand-driven nature of debt markets appears capable of exerting an important influence upon the strategic as well as the operational capital structure policy of the firm in certain samples. Hypothesis H37 is supported as the dynamic capital structure response to a change in interest rates (which are super-exogenous) is rapid, exhibiting no lag structure. However, the dynamic independent variable is not significant, whereas the ECM is, and thus the influence of interest rates on the operational capital structure policy of firms in the UK non-weighted sample is dominated by their influence on the strategic policy. The diagnostic tests reveal that the overall model F-ratio is marginally insignificant at the five per cent level, even though the ECM is significant.

Overall, interest rates of all term-lengths impact upon the operational capital structure decision of the firm, whereas only medium-term rates alone impact upon the strategic capital structure decision in one of the samples modelled. The nature of the influence of interest rates contrasts markedly with the theory of authors such as Marsh (1982), as the market for debt appears to be essentially demand-driven. Even though corporate gearing is a long-term stock concept, there does not appear to be a more significant relationship between gearing and longer-term interest rates at the operational level, although such an effect may occur at the strategic level.

Thus, the financial market performance factors, the stock market index and various interest rate measures, appear to significantly influence the operational capital structure policy of the firm. It appears that both equity and debt markets are demand-driven in the short-run, as finance managers may only significantly increase their equity financing when equity markets are buoyant and may only significantly increase their debt financing when debt interest rates are relatively high. The stock market index exerts no influence on the strategic capital structure policy, whereas the medium-term interest rate exerts a significant influence upon the strategic policy in one of the samples, again evidencing a demand-driven debt market orientation.

Modelling of the aggregate growth factors, output and investment, is undertaken to determine the effect of the economic cycle on the operational capital structure policy of the European firm. In the ADL models, the aggregate investment and aggregate output independent variables are generally insignificant, although the majority of models exhibit positive coefficient signs. Therefore, there is only some very weak support for hypotheses H39 and H40, which state that the corporate debt-equity ratio increases with increases in aggregate output and aggregate investment, respectively. There is no evidence that investment models are more significant than the output models estimated, thus questioning the "recovery-phase investment concept", such that there is no evidence that the timing of recovery phase investments, rather than the position in the economic cycle as a whole, determines changes in corporate financing. However, there is some evidence of the lag structure anticipated, due to the lag between the recovery in investment or output and a corporate gearing adjustment, which may represent a time period during which firms are depleting internal funds before resorting to new external funding. The models for the UK samples, however, suffer from normality and heteroscedasticity test failures, and some of the other models also exhibit RESET test passes which are marginal, which may suggest that some unknown alternative model specification may be more consistent with any underlying relationships. Finally, there is no evidence of a cointegrating relationship between gearing and each aggregate variable across the samples studied, and thus no EC models are estimated. Therefore, aggregate output and investment are very weak determinants of the operational capital structure policy of the European firm, and there is no evidence to support the recovery-phase investment concept developed in the hypothesis section.

In summary, the macroeconomic environment capital structure models were estimated to examine the influence of key macroeconomic environment factors upon the operational and strategic capital structure policies of the European firm. Inflation is the most important macroeconomic influence on the firm's capital structure policy as it impacts upon both the operational and at times the strategic capital structure policy either through the interest rate effect of authors such as Corcoran (1977) or through the non-debt tax allowance effect of authors such as DeAngelo and Masulis (1980). The financial market performance factors, the stock market index and various term-length interest rates, also appear to significantly influence the operational corporate capital structure policy, whereas medium-term interest rates alone influence the strategic policy in one of the samples modelled. There appears to be evidence that finance markets are essentially demand-driven, such that finance managers may only significantly increase the issue of new debt and equity claims if the returns to investors are relatively high. Finally, aggregate investment and output exhibit little influence on the operational capital structure policy of the firm, although there is weak evidence of a positive relationship between the corporate capital structure and such measures. Therefore, key macroeconomic variables exert a significant influence on the operational and strategic capital structure policies of European firms.

8.2.5 The corporate environment capital structure models

Models of the relationship between the firm's capital structure ratio and the corporate environment of the firm are of great importance to the understanding of capital structure policy because such models enable the uniqueness of any optimal capital structure solution to be considered, as the corporate factors are firm-specific in nature and thus are capable of giving rise to unique firm-level optimal capital structure solutions. Additionally, such models examine variables which are generally endogenous with respect to firm capital structure policy and thus are capable of forming two-way causal relationships with the DDE ratio, which affords an interesting extension to the capital structure research. The corporate environment variables are divided into three groups: those factors related to the scale of the firm, those factors related to the ability of the firm to support new debt, and those factors related to the returns from the firm's projects.

The corporate environment factors related to the scale of the firm are firm size and firm growth, which form, respectively, ADL models and EC models with respect to the corporate DDE ratio.

The firm size ADL models do not generally exhibit significant independent variables, although such variables generally exhibit positive coefficients. Thus, there is some weak support for hypothesis H18, which suggests that the larger the firm is, the more likely it is to have higher gearing levels due to the greater opportunities for larger firms in debt markets (Martin and Scott (1974) and Marsh (1982)) and the reduced risk of such larger firms (Remmers et al (1974), Taub (1975), and Rajan and Zingales (1994). The negative relationship proposed by authors such as Gupta (1969) is generally not observed, probably because the models only examine the relationship between gearing and long-term funding and do not consider short-term funding. There appears to be an immediate response of the DDE ratio to a change in firm size, as demonstrated by the model lag structures, which supports the proposition that funding lags might only occur if growth is rapid and unexpected, whereas firm growth is generally gradual and anticipated. Thus, the firm size ADL models generally conform to the partial adjustment specifications anticipated in the hypothesis section. Overall, it is clear that the scale of the firm exerts only a weak influence on the operational capital structure policy of the firm, such that larger firms may exhibit higher gearing ratios through time.

The firm growth EC models, which are estimated only for the German weighted sample, are complicated by the potential for a two-way causal relationship between growth and gearing. The firm growth EC model with the DDE ratio as dependent variable contains an insignificant negative lagged independent variable and an insignificant ECM. Thus, growth is not an important influence upon the strategic capital structure policy of the firm and there is no support for hypothesis H20. The propositions of authors such as Gupta (1969), Toy et al (1974), King (1977), and Martin and Scott (1974) are therefore given no support, questioning their arguments that a positive relationship should exist due to growth firms requiring the greater flexibility afforded by debt, their need for additional external funds, and their willingness to accept higher risk financing during their growth phase. The weakness of the overall model may merely question the concept of a pecking order for corporate finance, as there appears to be no strong preference for one form of external finance over another as the firm grows.

The firm growth EC model with the DDE ratio expressed as the independent variable is far stronger, exhibiting a significant negative lagged dynamic independent variable and a significant ECM. The negative sign of the dynamic independent variable coefficient and the static long-run equation suggests that increased debt may be detrimental to growth in the long-term, due, for example, to the fact that it may displace marginal future investment projects as it increases claims on the future income streams of firms. Alternatively, such a negative relationship may suggest that the more restrictive debt covenants associated with higher gearing might constrain the firm's activities, thus imposing a significant agency cost on the firm, thereby reducing its profitability and its growth potential. However, the static long-run equation, given in table 8.7, is extremely weak, questioning the overall robustness of the EC model. Therefore, although gearing appears to impact more significantly upon growth than the converse in the longer-run, both causal relationships are relatively weak.

Overall, the firm scale factors exert a fairly weak influence upon the operational and strategic capital structure policies of European firms. There is some weak evidence that larger firms may employ relatively more debt due to the greater financing opportunities and reduced risk associated with such firms. Firms undergoing more rapid growth over the long-term do not appear to exhibit a clear preference for debt over equity, even though debt is argued to endow higher growth firms with greater flexibility than equity financing (Gupta, 1974), and Toy et al (1974) and many subsequent authors argued that higher growth firms are more willing to accept relatively higher risk funding. There thus appears to be no clear pecking order of external finance for growth firms. Finally, there is some limited evidence that debt may even be detrimental to European firm growth in the longer-run due to the mandatory servicing costs and agency costs with which debt is associated.

The corporate environment factors which describe the firm's ability to support new debt may be divided into inverse bankruptcy risk factors (interest cover and dividend cover) and firm liquidity. Intuitively, when interest cover, dividend cover, and liquidity ratios are low, the firm should be constrained in its ability to support new debt, as new debt may greatly increase its probability of default and thus bankruptcy.

The inverse bankruptcy risk factors modelled are interest cover and dividend cover, which basically describe the firm's ability to cover the servicing commitments to debt holders and dividend quasi-commitments to equity holders, respectively. Indeed, if such coverage ratios are low, the finance manager should not even consider approaching finance markets for new external funds. Most authors, as discussed below, agree that bankruptcy costs potentially counterbalance any tax advantage to debt, although some argue, on the basis of fairly restrictive sets of assumptions, that the capital structure remains irrelevant even after the incorporation of such costs into a capital structure theoretical model. Authors have found the direct costs of bankruptcy to be small, but argue that the indirect costs are likely to be large, although extremely difficult to measure. More directly related to the modelling exercise, authors have found empirical evidence that bankruptcy risk is a significant determinant of corporate gearing.

The ADL inverse bankruptcy models estimated, which model the DDE ratio upon interest cover and dividend cover, do not generally exhibit significant independent variables and evidence a mix of variable coefficients. Thus, the expectation of a positive coefficient is not supported by the models as it is found that an improvement in financial safety (a reduction in bankruptcy risk) does not clearly encourage the firm to increase its gearing. Hypothesis H15, which states that the degree of bankruptcy risk increases as the corporate debt-equity ratio increases, is not addressed in this instance, as this hypothesis addresses the opposite direction of causation from that represented in the ADL models. However, the models do suggest that there is little support in the European research for the conclusions of the empirics of Stonehill et al (1975), Marsh (1982), and Mackie-Mason (1990), who found that bankruptcy risk variables are a significant determinant of corporate gearing. Thus, whilst there is considerable support for the concept that bankruptcy costs may counterbalance any tax advantage to debt (DeAngelo and Masulis (1980), and numerous other authors), bankruptcy risk does not appear to impact significantly on the operational capital structure policy of the firm. It may be that bankruptcy risk is better considered an influence upon the long-term or strategic corporate capital structure policy, a conjectural statement to be tested in the EC models to follow. There is only limited evidence of a delay between a change in the firm's financial safety and a subsequent adjustment to gearing, although the lack of evidence of a positive relationship confirms that there is no adjustment process anyway whereby managers wait for a sustained improvement in financial safety before increasing gearing. RESET specification test failure is common across the models estimated, suggesting that the model specifications may be erroneous, although the precise nature of a more representative alternative specification is unknown. It appears, then, that financial safety is not a key determinant of the operational capital structure policy of the European firm.

EC models are estimated for the dividend cover variable for the UK weighted sample only, as the interest cover variable is not cointegrated with corporate gearing in any of the samples examined. There is evidence of a two-way causal cointegrating relationship, such that changes in financial safety influence the gearing decision, which further cause changes in financial safety due to changes in debt-servicing commitments. The EC model with the DDE ratio expressed as the dependent variable exhibits model component characteristics which are counter intuitive, at least on a prima facie basis, as both the static long-run model independent variable and the dynamic independent variable of the EC model exhibit negative coefficients. Such coefficients suggest, then, that a firm which experiences an improvement in financial safety, is likely to reduce its gearing, whereas it might be expected that a firm in such a situation would, intuitively, be in a better position to increase its gearing. One explanation for the negative coefficient, which draws upon intuitive information signalling theory, may be that investors who observe a firm which experiences an improvement in financial safety may purchase the firm's equity on terms more favourable to the firm as their investment is considered safer. However, this explanation is less robust than the theoretical case supporting a positive relationship. Thus, financial safety does appear to be a significant determinant of the strategic capital structure policy of the firm in one of the samples, although the precise nature of its influence in terms of underlying theory remains somewhat unclear.

The EC model with the DDE ratio expressed as independent variable enables hypothesis H15 to be tested. The model exhibits a negative coefficient dynamic independent variable and a negative static long-run equation coefficient, and thus hypothesis H15 is supported. Therefore, an increase in corporate gearing reduces the financial safety (increases the financial risk) of the firm, due to the extra servicing commitments associated with the debt which may reduce the probability of the firm being able to cover future dividend payments. This evidence lends some indirect support to the propositions of the authors such as Myers (1966), Baxter (1967), Hirshleifer (1970), Stiglitz (1972), Kraus and Litzenberger (1973), Scott (1976) and

DeAngelo and Masulis (1980), who argued that bankruptcy risk may counterbalance any tax advantage to debt.

As anticipated in the inference arising from the ADL model results, the inverse bankruptcy risk variables may be more of an influence on the strategic than the operational capital structure policy of the European firm in certain samples, although this result holds only for dividend cover and not interest cover. It is intuitive that risk-reduction is such an important aspect of firm policy that it is identified as a strategic influence upon the capital structure decision.

Overall, then, bankruptcy risk (inverse financial safety) does not appear to be a significant influence on the operational capital structure policy of the firm. Whereas bankruptcy risk may impact significantly upon the strategic capital structure policy in certain samples, the theoretical underpinning of that impact is uncertain. More intuitively, the policy of increasing firm gearing may itself raise financial risk (reduces financial safety) in the long-run, due to the increased commitments associated with servicing such debt. It might be concluded that gearing is better considered a determinant of bankruptcy risk rather than the converse, even though two-way causation might be anticipated on the basis of theory. However, apart from the estimation of the EC capital structure models, the European corporate capital structure research does not explicitly consider the direction of causation where the DDE ratio is expressed as the independent variable in econometric models as the research seeks mainly to test and model the <u>determinants</u> of the DDE ratio. The purpose of this focus is to address the central hypothesis and the numerous supporting and subsidiary hypotheses which derive from the mainstream literature.

The other corporate environment factor which describes the firm's ability to support new debt is firm liquidity. A firm with low liquidity, exhibiting a low working capital ratio, may consider it prudent not to extend its gearing any further, otherwise it may experience an increased probability of default as available liquid funds may not cover future debt-servicing commitments.

The liquidity ADL models generally exhibit insignificant independent variables with negative coefficients. This suggests that firms which experience a deterioration in liquidity appear to subsequently increase gearing, which is of course counter to accounting prudence and intuition. Hypothesis H21 is questioned, although to a weak extent due to the general insignificance of models, thus questioning the propositions of authors such as Van Horne (1974) and Martin and Scott (1974), who both argued that the greater the firm's liquidity posture is, the greater its debt capacity will be. As anticipated, there do appear to exist time lags of one or two years between a liquidity change and a gearing adjustment, although the theoretical underpinning of this unclear in the absence of the expected positive relationship. However, the UK models fail the normality diagnostic tests, which further questions any naive relationship between liquidity and the operational capital structure policy of the firm. One explanation for the lack of any clear relationship may be that because only quoted firms are analysed in the research, liquidity is unlikely to be a major issue in the capital structure policy of such firms as they are likely to be relatively stable, well-established and liquid compared to the population of UK firms as a whole.

The EC models are estimated to determine whether liquidity is better considered a determinant of the strategic capital structure policy rather than the operational policy, as well as determining whether gearing exerts a long-run impact upon liquidity. The liquidity EC model with the DDE ratio expressed as dependent variable, which is estimated for the German weighted sample alone, is a poor model, exhibiting a positive coefficient dynamic variable, a positive coefficient static long-run equation independent variable, and an insignificant ECM. Thus, although the coefficients of the static and EC model support hypothesis H21, the model is not robust as the ECM is not significant and thus evidences no significant impact of liquidity upon the strategic corporate capital structure policy. It may be that gearing is better considered a strategic influence upon liquidity rather than the converse.

The liquidity EC model with the DDE ratio expressed as the independent variable, estimated for the German weighted sample, exhibits an insignificant positive dynamic independent variable, a positive static long-run equation independent variable coefficient, and a significant ECM. This suggests that increased gearing exerts an advantageous effect on firm liquidity in the long-run which at first glance is counter intuitive. However, it may be that a relative increase in debt enables the funding of relatively more investment projects than before, leading to an increase in future cash inflows and thus increased liquidity.

Overall, the only clear relationship between gearing and liquidity suggests that increased gearing improves long-run liquidity, which, although intuitive, is a somewhat abstract conclusion when compared to the anticipated and more direct detrimental impact of increased gearing on liquidity.

To summarise, the corporate environment factors modelled which describe the firm's ability to support new debt are inverse financial risk measures and a corporate liquidity measure. It appears that inverse financial risk does not exert a significant influence upon the operational or strategic capital structure policy of the firm, although there is some evidence that increasing corporate gearing raises financial risk (reduces financial safety) in the long-run. Thus, gearing is probably better considered a key determinant of long-run financial risk than the converse. Additionally, whereas liquidity appears to exert little impact upon either the operational or strategic capital structure policy of the firm, gearing itself exerts a positive impact upon liquidity in the long-run in one of the samples, possibly because it enables relatively more investment projects to be funded, leading to increased future cash inflows and thus increased liquidity. Therefore, there is some evidence that gearing may exert a more important impact upon the ability of the firm to support new debt than the converse, a result which questions the causal orientation of analyses in the existing literature.

The corporate environment factors related to the returns from the firm's projects are the profitability of the firm and a q-ratio proxy. The profitability measure is the return on the capital employed by the firm and the q-ratio proxy is a measure of the value of the firm over and above the replacement cost of its assets.

The profitability ADL models generally exhibit positive coefficient independent variables, although only the minority of models are significant. Thus, hypothesis H22, which states that the corporate debt-equity ratio increases as firm profitability decreases, is questioned. This is a surprising result as the majority of theoretical studies and all of the empirical studies reviewed support a negative relationship. Thus, more profitable firms appear to be more likely to expand their debt rather than equity base and do not appear to be discouraged by the disciplinary role of debt, questioning the theoretical arguments of Toy et al (1974), Martin and Scott (1974), Drury and Bougen (1980), Jensen (1986), Titman and Wessels (1988), and Rajan and Zingales (1994), and the empirical evidence of these authors and that of Marsh (1982). However, the contrasting theoretical arguments given by Martin and Scott (1974) and Drury and Bougen (1980) suggest that the positive relationship may arise because more profitable firms can obtain debt at a lower price and are able to support more fixed-interest debt than less profitable firms. It is noted, however, that although most of the models suggest a positive relationship, three of the eight models exhibit negative coefficient independent variables and the models are generally insignificant. Thus, the models question, though not conclusively, a negative relationship between profitability and corporate gearing. There is evidence of a lag structure, as anticipated in the hypothesis section, although for different theoretical reasons from those suggested. Therefore, there is some evidence of a lag between an improvement in profitability and an increase in gearing, as the finance manager waits until evidence of a sustained improvement in the firm's debt capacity before the gearing adjustment is made. However, the UK non-weighted model fails the normality test, and the German weighted model fails the RESET model specification test, suggesting that an alternative estimation method is warranted for the former model and that the explanatory part of the latter model should be transformed into some unknown alternative model specification to render it more robust. Therefore, profitability exerts a fairly weak influence on the operational capital structure policy of the European firm, whereby an improvement in profitability increases the firm's debt capacity and encourages further gearing.

The profitability EC models with the DDE ratio expressed as the dependent variable vary in their significance and the signs of model coefficients. The UK weighted sample model exhibits a significant ECM and dynamic variable, which may imply that it is more robust than the German weighted sample model, which has an insignificant ECM. Interestingly, although both models exhibit positive coefficients in their respective static long-run equations, only the UK model exhibits a positive coefficient dynamic independent variable. As the UK model exhibits a significant ECM, a positive long-run static equation independent variable which is consistent with the dynamic variable of the EC model, and it is estimated upon a much longer time-span data set than the German model, it should be given commensurately greater weighting in the inference arising from such models. The positive coefficients of the underlying static long-run equations suggest that improved profitability also encourages the firm to increase its gearing over the longer-term, again questioning hypothesis H22 and the associated theoretical and empirical literature. Although the UK model is far more significant than the German model, it does appear to fail the RESET test, which suggests that some unknown alternative specification may be preferable for this particular sample. Therefore, profitability appears to exert a positive influence upon corporate gearing in both the short-run and long-run, and thus represents an influence, although somewhat weak, upon both the operational and strategic capital structure policy of the European firm.

The profitability EC model with the DDE ratio expressed as independent variable, which is estimated for the German weighted sample alone, exhibits a significant negative dynamic independent variable coefficient and a significant ECM. However, the underlying static long-run model exhibits a positive independent variable coefficient, a result which is contrary to the expectations of the hypothesis section. The apparent conflict between the negative coefficient in the dynamics of the EC model and the positive long-run coefficient which underlies that model may be resolved by consideration of the different time frames described in the EC model. In the short-run, the firm may experience mainly the costs (and few of the benefits) of the new debt finance, thus producing a negative coefficient in the model dynamics. Over the longer-run, however, as the increase in gearing may facilitate a relative increase in the number of investment projects, such projects will begin to generate returns over and above the debt costs and raise profitability, thus producing a positive coefficient in the static long-run equation which underpins the ECM. However, it is noted that such a relationship is found only for one of the samples analysed.

Overall, then, profitability appears to exert a fairly weak positive influence upon firm gearing in both the short-run and long-run, and thus contributes to the determination, to some limited extent, of the operational and strategic capital structure policy of the European firm. Thus, hypothesis H22 is questioned, in turn questioning the applicability of the underlying theory of a negative relationship proposed by Toy et al (1974) and subsequent authors to the European data set. Instead, it may be that more profitable firms can obtain debt at a lower price or exhibit a higher debt capacity than less profitable firms, supporting the propositions of Martin and Scott (1974) and Drury and Bougen (1980). The opposite direction of causation appears more robust in the longer-run, such that increased gearing facilitates faster growth whilst such an increase may reduce profitability in the short-run until the increased number of investment projects begin to generate returns.

The q-ratio proxy ADL models, only half of which are significant, generally exhibit negative independent variable coefficients. Thus, some support is provided for hypothesis H41, which states that the corporate debt-equity ratio increases as the q-ratio proxy decreases. The theoretical underpinning to such a relationship is essentially that which underpins the profitability hypothesis, H22, as it is argued in the hypothesis section that the q-ratio proxy may be considered another form of profitability ratio. Therefore, firms with higher q-ratio proxies are more profitable and thus are likely to exhibit higher retentions, reducing their demand for additional debt financing, and higher q-ratio proxy firms should find it easier to attract new equity finance than lower q-ratio proxy firms due to the attraction of their high value-added potential. Such a result thus supports the theoretical underpinning of a negative relationship by authors such as Toy et al (1974) through to Rajan and Zingales (1994). However, the UK non-weighted model fails the normality diagnostic test and the Dutch non-weighted model fails the RESET model specification test, which weakens the model inference to some extent. Therefore, the q-ratio proxy variable, which may be considered another form of profitability ratio, appears to be a determinant of the operational capital structure policy of the European firm. However, the results of EC models for the q-ratio proxy are not presented here, as this measure is not cointegrated with the DDE ratio in any of the samples and thus does not constitute a determinant of the strategic capital structure policy.

Overall, in the short-run, both the profitability measures exert an influence upon the operational capital structure policy which is fairly weak, although the return on capital employed measure exerts a positive influence and the q-ratio proxy exerts a negative influence. Combined with the weakness of the models, then, the overall influence of profitability in the short-run is uncertain. An improvement in profitability may encourage gearing due to an improvement in the firm's debt capacity, although a more profitable firm may alternatively find it attractive to expand its equity base or may wish to avoid the disciplinary role of debt, and so on. As such relationships are seen to conflict, the overall effect may be ambiguous, thus producing weak and conflicting models of short-run gearing determination. In the longer-run, however, gearing appears to exert an influence upon profitability which is stronger than the opposite direction of causation, such that increased gearing facilitates faster growth, although such a relationship is determined in only one of the samples modelled.

In summary, the corporate environment factors appear far less important as determinants of corporate capital structure policy than the taxation and macroeconomic environment factors. The scale of the firm, whether considered in terms of firm size or firm growth, exerts little influence as a determinant of the level of gearing chosen by the firm, in terms of both operational and strategic policy. However, there is some limited evidence that debt may be detrimental to firm growth in the longer-term due to the increased mandatory servicing costs associated with increased gearing. The inverse financial risk variables examined do not generally appear to significantly influence the operational capital structure policy of the firm. However, inverse financial risk exerts a weak influence on the strategic capital structure policy, such that a firm which becomes less financially risky is likely to reduce its gearing ratio, although the theoretical underpinning of this is unclear. Conversely, there is some limited evidence that an increase in corporate gearing reduces the financial safety of the firm in the long-run, which is an intuitive result. The only clear relationship between liquidity and the corporate capital structure is that increased gearing improves long-run liquidity, although this result appears counter intuitive on a prima facie basis and holds in only one of the samples modelled. It is argued that increased gearing is generally used to significantly expand the number and increase the quality of investment projects, thus increasing future cash flows and liquidity.

Profitability exerts only a weak influence upon capital structure policy, whereby an improvement in profitability encourages the firm to increase its gearing in both the short-run and long-run, as more profitable firms may obtain debt at a lower price and may exhibit a higher debt capacity than less profitable firms. Additionally, there is some evidence that increased gearing facilitates increased profitability in the long-run, which may be due to the fact that debt enables an expansion of the portfolio of the firm's investment projects. Finally, the q-ratio proxy, which is considered another form of profitability ratio, appears to be a determinant of the operational capital structure policy of the European firm such that firms with higher q-ratios are more profitable, make higher retentions, thus reducing their demand for additional debt financing, and also such firms should find it easier to attract new equity finance than lower q-ratio firms.

Overall, then, the corporate environment factors generally exert a fairly weak influence upon either the operational or the strategic capital structure policies of the European firm. One reason for this may be that, as both the capital structure policies and the corporate environment factors are endogenous to the firm, the capital structure policy decision impacts more significantly upon the corporate factors than the converse. Thus, rather than there being "causal-neutrality" amongst those variables which the finance manager controls, there is some causal inequality such that the DDE ratio is better considered a determinant of, rather than being determined by, other corporate-level factors. This may be because the capital structure ratio is the result of cumulative funding decisions over the long-run, which render the DDE ratio a stock concept. Although many of the corporate environment factors are also stock concepts, they are likely to be shorter-term in nature and thus the corporate DDE ratio may essentially be exogenous with respect to these factors.

Another explanation for the fact that such corporate environment factors are fairly weak influences on European corporate capital structure policy may be that, whereas firms may respond fairly uniformly in their gearing adjustments to shocks in exogenous variables, changes in corporate-level factors are likely to have very different effects upon gearing across firms within a sample. A simple example of this is that some firms are likely to be risk-averse whereas others are willing to risk far higher probabilities of financial distress (a corporate environment factor), resulting in different attitudes to gearing policy. Thus, when modelling aggregated firm data, the uniqueness of the corporate characteristics of each firm and its capital structure response to changes in those characteristics is argued to produce a wide range of responses which are not conducive to the estimation of highly significant models at the aggregate level.

8.2.6 Summary of the results arising from the bivariate corporate capital structure time series analysis

The bivariate corporate capital structure time series analysis produces a wealth of results ranging from specific hypothesis tests through to more general results concerning the operation of corporate capital structure policy at the operational and strategic level.

The number of significant models across the samples analysed gives a rough indication of the relative importance of different capital structure determinants to the operational and strategic capital structure policies of firms, although this is not an ideal gauge. It is argued that if longer data time-spans were available, slightly different patterns or relationships might emerge because the paucity of time-spans of the European time series data is likely to markedly reduce the incidence of significant models across the samples. The very short data time-spans for the German and French samples, in particular, means that although results similar to those arising from the longer UK and Dutch samples are anticipated, it is argued that such results are suppressed by the reduced probability of statistical significance. The strength of these data problem arguments is highlighted by the result that the UK samples generally produce models of greater significance than the models arising from the shorter data time-span samples. Thus, it may be argued that although certain capital structure determinants produce significant models in only a few of the samples, there is some justification for the careful generalisation of results across samples, with the relative significance of models across samples remaining an indication of the relative importance of taxation, macroeconomic and corporate variables as determinants of capital structure policy.

The key European capital structure relationships modelled in the bivariate time series analysis may be best summarised within the framework of: those determinants which exert an influence upon the operational capital structure policy of the firm; those determinants which exert an influence upon the strategic capital structure policy of the firm; and those cases where the corporate capital structure itself exerts an influence upon the taxation, macroeconomic, and corporate environment factors.

Those determinants which exert a significant influence upon the operational capital structure policy of the firm are predominantly taxation and macroeconomic environment variables. Both the nominal tax advantage to debt and the nominal corporate tax rate, a proxy for the tax advantage to debt, appear to exert a significant impact upon the corporate capital structure policy. Therefore, even if the tax advantage to debt across Europe is very much smaller than the MM (1963) model suggests, an increase in either tax measure encourages firms to increase their gearing in the short-run. Running parallel to the nominal tax advantage effect, European firms appear to react to a relatively high corporate tax bill (corporation tax ratio) by increasing gearing as part of a "reactive" tax-reduction policy in the short-run. Thus, taxation environment factors exert a very strong influence upon the operational capital structure policy of the European firm.

The macroeconomic environment factors which exert a significant influence upon the operational capital structure policy of the firm are the rate of inflation and financial market performance factors. An increase in the rate of inflation encourages the finance manager to increase the gearing of the firm because inflation causes interest rates to rise, thus increasing the value of tax deductions associated with debt and making debt more attractive as a form of finance, and also because inflation decreases the real value of investment allowances, reducing the "crowding out" of debt tax-deductions and thus encouraging increased gearing. Stock market performance, as measured by the stock market index, exerts a very strong influence upon corporate capital structure policy, such that an increase in the stock market index encourages firms to increase equity financing, as they are more likely to issue equity after periods of strong equity market performance. There is some evidence that various term-length interest rates influence operational corporate capital structure policy, although their effect is not quite as strong as that observed for the stock market index. Surprisingly, there is generally a positive relationship observed between gearing and interest rates, which suggests that debt markets are demand-driven, whereby finance managers may only significantly increase the supply of bonds to the market when the interest rates they offer are relatively high. Indeed, consideration of the nature of the operational influence of the stock market index reveals that this demand-driven characteristic may also apply to the equity market. Thus, finance managers may only significantly increase their supply of financial instruments to the finance market when conditions are favourable to investors.

It is clear, then, that those factors which impact most significantly upon the operational capital structure policy of the firm, that is, in the short-run, are those factors which directly impact upon the relative costs of financial instruments. The taxation factors are concerned mainly with the tax advantage to debt, which clearly impacts upon the cost of finance, and debt in particular, such that an increase in the tax advantage to debt reduces the weighted average cost of capital, rendering debt a relatively more attractive option than before. The incidences where inflation impacts upon gearing appear to be transmitted through the tax advantage to debt, as an increase in inflation increases the interest rate, thus increasing the tax advantage to debt, whilst the reduced value of non-debt tax allowances in addition enables greater debt tax allowances to be utilised, thus encouraging further gearing. The financial market performance factors impact upon the gearing decision in a very different manner, working directly on the before-tax direct costs of debt and equity finance. Thus, as finance managers may only significantly increase or reduce gearing if interest rates are relatively high or equity market performance is strong, respectively, the direct before-tax costs of finance and the timing of financial market trends in returns impinge greatly upon the firm's operational capital structure policy. Therefore, it is interesting to note that those factors which exert the most significant influence upon the capital structure policy of the European firm on a year-to-year basis are those factors over which the finance manager has no control, that is, such factors are external or exogenous to the firm.

As the exogenous macroeconomic and taxation environment factors impinge most significantly upon the operational capital structure policy of the firm, this implies that it is the more endogenous factors which are likely to impinge less significantly upon that policy. However, some of the weaker influences are also exogenous factors and thus the reason why such factors exert only a weak influence must be explored.

One of the taxation variables, the total tax ratio, exerts a fairly weak influence upon the operational corporate capital structure policy. An increase in the total tax ratio signals to the finance manager that the firm should increase its gearing as part of a reactive tax-reduction strategy. Additionally, both aggregate output and investment exert a positive though weak influence upon corporate gearing in the short-run, which suggests that corporate gearing may expand to fund boom period activity and may be reduced during recessions. These taxation and macroeconomic factors are both exogenous though exert little influence upon the operational capital structure policy. One reason for this may be that such factors, with the possible exception of the total tax ratio, are not direct influences on the relative costs of alternative financial instruments. Even the total tax ratio factor exerts an influence which is merely a reactive response of an indirect nature. Thus, it is argued that unless the factors modelled are capable of exerting an exogenous influence upon gearing which directly impacts upon the explicit costs of financial instruments in the short-run, then such factors will not be significant determinants of operational corporate capital structure policy.

The remaining factors which exert a weak influence upon the operational corporate capital structure policy are the endogenous corporate environment factors. Larger firms are more likely to exhibit higher gearing through time due to the greater opportunities for larger firms in debt markets and the reduced risk of such firms. Perhaps the most uncertain influence upon the operational capital structure policy of the firm is that exerted by the financial safety (inverse financial risk) factors. A finance manager whose firm experiences an improvement in financial safety does not appear to take the opportunity to increase gearing, as he or she appears equally likely to choose either form of new external finance. An increase in firm liquidity appears to exert a very weak influence upon gearing in the short-run, which is another surprising results as it is counter to both accounting prudence and intuition. Therefore, the ability of the firm to support new debt does not appear to significantly influence the operational capital structure policy of the firm. An explanation for this may be that, because only quoted firms are modelled in the European capital structure research, such firms are unlikely to be greatly concerned with the probability of financial distress as sample firms are generally characterised by high levels of reserves, diversified portfolios of projects, market stability, and so on. Thus, firms are unlikely to automatically adjust their capital structures to short-term movements in financial safety or liquidity, believing financial distress to be a remote possibility. The profitability measures, the return on capital employed and the q-ratio proxy, although weak influences upon operational policy, are probably the strongest influence of all the corporate environment factors upon corporate gearing in the short-run. Firms which experience an increase in profitability appear more likely to expand gearing because more profitable firms are able to obtain debt at a lower price and are able to support more fixed-interest debt than less profitable firms. Thus, of the corporate environment factors modelled, the ability of the firm to support new debt in terms of financial risk and liquidity exerts little influence upon the operational corporate capital structure policy, whereas the larger and more profitable the firm is, the greater opportunities it has to obtain debt financing at a favourable cost and subsequently support that debt out of future income streams.

To summarise, then, those taxation and macroeconomic environment factors which exert a direct impact upon the relative costs of financial instruments appear to exert the most significant influence upon the operational capital structure policy of the firm. Indeed, factors which are exogenous though have a more indirect influence upon the costs of financial instruments appear to exert a weaker influence. The corporate environment factors, which are endogenous in nature, are generally fairly weak influences upon gearing in the short-run, mainly because the quoted firms in the analysis are not greatly concerned with the risk of financial distress when setting the level of the DDE ratio, although higher growth and more profitable firms do tend to exhibit higher gearing.

Those determinants which exert an influence upon the strategic capital structure policy of the firm are a subset of those factors modelled in the bivariate analysis. The most significant influences again appear to come from the taxation and macroeconomic environments, although some corporate environment factors also significantly influence the strategic capital structure policy of the firm.

The nominal corporate tax rate is a significant long-run influence of corporate capital structure policy whereby an increase in that rate causes the firm to increase gearing in the long-run. Additionally, the effective total tax rate (or total tax ratio) is also a significant long-run influence, such that a higher than normal total tax ratio encourages the firm to increase gearing as part of a wider tax-reduction strategy. Therefore, it is clear that firms increase gearing both in response to an increase in the tax advantage to debt (as proxied by the nominal corporate tax rate) and as a reaction to a higher than normal relative tax bill. Thus, the minimisation of the weighted average cost of capital, by means of tax-reduction strategies, is not only an operational policy of the firm, but also forms a central part of its strategic policy for the setting of the capital structure ratio.

Inflation is perhaps the most significant long-run influence of capital structure policy as a cointegrating relationship is exhibited in three of the samples modelled. Corporate gearing is positively related to the rate of inflation over the long-run, which confirms that such a relationship must be underpinned by the effect on interest rates and non-debt tax allowances rather than the "inflation bets" argument, discussed in the hypothesis section, as this latter argument may not logically persist over the long-run. Of the different term-length interest rate measures modelled, only the medium-term interest rate appears to evidence some influence upon the strategic capital structure policy. Therefore, this suggests that the long-term external finance decision is influenced more by medium-to-long-term interest rates such that the finance manager plans the long-run path of the gearing ratio with respect to longer-term trends in rates rather than the shorter-term fluctuations which characterise shorter-term rates. The model also confirms that debt markets are demand-driven even in the long-run, whereby finance managers may only significantly increase their supply of bonds to the market if conditions are favourable to investors.

Finally, corporate environment factors also exert an influence upon the strategic capital structure policy of the firm. Financial safety, represented by dividend cover in the EC model, exhibits a long-run cointegrating relationship with the DDE ratio, such that a firm which experiences an improvement in financial safety is likely to reduce its gearing in the long-run. This result runs counter to intuition as it might be expected that firms which become less risky would be in a better position to increase gearing. However, an explanation for the negative relationship may be that investors who observe a firm which experiences an improvement in financial safety in the long-run may purchase the firm's equity on terms more favourable to the firm as their investment is considered safer. Therefore, it is argued that this information signalling concept underlying the financial safety factor relationship is understood by finance managers who take it into account when setting the capital structure ratio to its strategic, long-run level. Additionally, there is some evidence that profitability is a positive influence upon gearing in the long-run, such that more profitable firms clearly maintain a greater capacity for debt expansion over the long-run. Indeed, whilst a short-run increase in profitability may encourage some expansion in gearing as part of an operational policy decision, surely a long-run and sustained increase in profitability will exert a more profound reconsideration of the gearing stance of the firm.

It is interesting to note that the exogenous factors which impact directly upon the explicit costs of financial instruments are also the most significant influences of the strategic capital structure policy of the firm. However, the more endogenous financial safety and profitability factors are also key strategic determinants of corporate gearing and thus as well as considering the direct costs of the gearing policy of the firm, the finance manager also takes into account the ability of the firm to cover any increase in gearing. Thus, the manager considers the current probability of financial distress as well as the effect of longer-term profitability trends upon long-run cashflows, possibly using this as an indicator of future profitability. Although the quoted firms studied do not appear greatly concerned with financial risk on a year-to-year or operational basis as they are likely to be well diversified, stable, and backed by substantial reserves, in the longer-term, trends in risk and profitability will influence the gearing decision and may cause the finance manager to re-assess the firm's degree of financial risk aversion.

Surprisingly, a number of the corporate environment factors produce models with insignificant ECM's, even though they evidence cointegrating relationships with respect to corporate gearing. The reason for this may be that because the EC models also include dynamic variables, such variables dominate the ECM's in terms of significance, suggesting that the real underlying bivariate model process may be essentially dynamic and that the error correction process is only weak. This appears to be the case for the firm growth and liquidity factors, and even firm profitability exhibits this phenomenon in one of the models estimated.

To summarise, the exogenous taxation and macroeconomic environment factors which exert a direct influence upon the explicit costs of financial instruments appear to be the most significant influences upon the strategic corporate capital structure policy, thus dominating the short-run and long-run determination of the corporate capital structure. However, at the strategic level, finance managers also appear to take into account trends in the financial risk and profitability of the firm, thus continually re-assessing the gearing stance of the firm in terms of debt-capacity and financial risk.

In addition to the taxation, macroeconomic and corporate environment factors exerting a significant influence upon the operational and strategic capital structure policies of European firms, the level of gearing itself also exerts an influence upon the corporate environment factors. Although this converse direction of causation is tested in the bivariate EC models across all three sets of environment factors, only the relationships for the corporate factors are discussed due to the concept of causal inequality, which essentially states that gearing is unlikely to exert any measurable influence upon taxation and macroeconomic factors as they are highly exogenous. Thus, gearing is likely to be only one of a multitude of influences upon inflation, for example, and thus it is unlikely to demonstrate any explanatory power as an independent variable in a bivariate inflation model. It is clear, however, that the gearing policy of the firm is capable of significantly affecting other corporate environment variables, and the bivariate EC models reveal that gearing indeed affects firm growth, financial safety, liquidity, and profitability in the long-run.

It appears that gearing exerts a detrimental influence upon firm growth in both the short and long-run, possibly because increased gearing may displace marginal future investment projects as it increases claims on the future income streams of firms. Alternatively, it may be that the more restrictive debt covenants associated with higher gearing may constrain the firm's activities, thus imposing a significant agency cost on the firm, thereby reducing its profitability and its growth potential. Increased gearing also reduces the financial safety of the firm in the short and long-run, due to the extra servicing commitments associated with debt, which may reduce the probability of the firm being able to cover future dividend payments. Such a result provides some indirect support for the propositions of those authors who argued that bankruptcy risk may counterbalance any tax advantage to debt. Although increased gearing appears to be detrimental to both the growth and financial safety of the firm, it appears to exert an advantageous influence upon firm liquidity and profitability. Increased gearing may enable the funding of relatively more investment projects than before, leading to an increase in future cash inflows and thus increased profitability in the short and long-run and increased liquidity in the long-run.

In summary, then, although gearing may be detrimental to firm growth and may significantly increase the risk of financial distress in the long-run, it is also likely to facilitate greater investment in new projects leading to higher income streams, thus improving firm liquidity and profitability. This interesting although fairly intuitive result highlights the complex nexus of relationships focussing upon the capital structure ratio chosen by the firm. The cross-sectional models of chapter 5, which examined the short-run relationship between gearing and mainly corporate environment factors, debt was clearly shown to be characterised more by its detrimental influence on the corporate environment than any relationship for the converse direction of causation. This result is reconciled with the results of the bivariate EC models by explaining that, in the short-run, debt confers only detrimental effects as the firm experiences only the costs of that debt, whereas in the longer-run the increased number of investment projects begin to break even, thus conferring benefits upon the firm in terms of increased liquidity and profitability. Overall, it is clear that although the finance manager may expend considerable resources striving for a capital structure ratio which is optimal for the firm, he or she must also examine the likely effects of that capital structure decision as a "knock-on" effect to the corporate environment.

A number of important general results arise from the bivariate time series analysis which are briefly considered in turn.

Full optimisation, which is consistent with the presence of cointegrating corporate capital structure relationships, occurs predominantly for the larger firms, given more correct representation in the weighted samples modelled. Such full optimisation (or strong-form optimisation) involves the finance manager of the firm determining the long-run optimal path for the DDE ratio in relation to key long-run or strategic determinants of that ratio. The finance manager then maintains that optimal path by adjusting the DDE ratio when changes occur in the strategic determinants, so that any disequilibrium errors from the long-run path are continually corrected for. Hence there must be evidence of the existence of significant error correction mechanisms (ECM's) within bivariate capital structure relationships for there to be full optimisation behaviour. Larger firms are able to engage in this form of optimisation because the sophisticated information collection, analysis, and actioning systems within their finance functions facilitate such behaviour. It is intuitive that the finance functions of larger firms are going to be far better resourced and far more capable of sophisticated optimisation procedures than those within smaller firms. In the long-run, smaller firms cannot engage in full optimisation and thus do not target such "extra-ratio" strategic determinants (long-run determinants external to the capital structure environment). Instead, smaller firms are likely to engage in a form of bounded optimisation in the long-run, referred to as "intra-ratio" targeting. It is proposed, then, that the strategic long-run behaviour of smaller firms involves such firms targeting the capital structure ratios (hence intra-ratio targeting) of firms within their industry, larger firms, larger firms within their industry, or on the basis of some other criterion. This proposition is tested in detail in section 8.4, both to rationalise this type of smaller firm behaviour, explaining why such firms generally do not engage in extra-ratio targeting (consistent with cointegrated capital structure relationships), and to complete the smaller firm side of the strategic capital structure behaviour dichotomy which appears to be emerging. Thus, smaller firms do not continually adjust their DDE ratios towards an optimal long-run path because their information systems are not sufficiently complex to identify disequilibrium errors in relation to key long-run capital structure determinants.

Firms may also engage in less stringent forms of optimisation which do not require evidence of cointegrating processes, which may be termed weak-form optimisation behaviour. The operational capital structure behaviour of European firms must be considered to determine whether this evidences such weak-form behaviour. Weak-form optimising behaviour, then, may be argued to occur where the individual firm finance manager takes into account a wide range of determinants before setting the level of the DDE ratio. The European bivariate ADL models reveal that the finance managers of both larger and smaller firms appear to set the level of the DDE ratio with reference to a wide range of taxation, macroeconomic and corporate environment factors in the short-run, with the emphasis however placed upon the taxation and macroeconomic environment factors. There are significant corporate environment influences upon the operational capital structure decision of the firm, although these are not as consistent in terms of significance across samples as the more exogenous taxation and macroeconomic factors. Thus, the finance manager adjusts the level of the DDE ratio in the short-run in relation to exogenous and endogenous environmental factors, trading off their influence upon the DDE ratio in a naive manner which may be described as weak-form capital structure optimisation. Additionally, the cross-sectional and marginal analyses of chapter 5 revealed that finance managers are also conscious of the effect of operational gearing decisions upon the corporate environment, such that they will set the DDE ratio such that the costs it confers upon the firm are not damaging to the firm's continued existence. Thus, the finance manager's actions, observed in the empirical models of the European capital structure research, are consistent with weak-form optimising behaviour in the short-run. This result is supported by evidence from the operational-level bivariate ADL models as well as evidence from the cross-sectional and marginal models examined in chapter 5. In summary, then, larger firms are demonstrated to engage in strong-form optimisation behaviour whereas larger and smaller firms alike engage in weak-form optimisation.

To address the central hypothesis, however, which states that there exist firm-level optimal capital structures, the firm-specific nature of optimal solutions must be proven. At the operational capital structure policy level, the firm-specific nature of the capital structure optimal solution derives from the influence of the corporate environment, which although relatively weak, produces an optimal DDE ratio solution which is specific to the individual firm. This is because the ability of the firm to support increased gearing varies from one firm to another due to the differences in the financial risk, liquidity, profitability, the rate of growth, and so on, across firms. Additionally, individual firm finance managers realise that an increase in gearing will affect their firms in very different manners, depending upon the health of the firm, its growth prospects, and so on, again producing a DDE ratio solution which is specific to the individual firm. Thus, optimal capital structure solutions are likely to be firm-specific across the samples studied, supporting hypothesis H1 in the short-run in that weak-form optimising behaviour is capable of producing firm-level optimal solutions.

At the strategic level, the firm-specific nature of the capital structure solution potentially derives from two processes. Firstly, although the key determinants of the strategic optimal capital structure solution are taxation and macroeconomic environment factors, which are exogenous in nature and exert a direct effect which is aggregate in nature, the endogenous corporate environment factors such as financial safety and profitability which are capable of producing firm-specific optimal solutions also exert a significant influence. As firm risk and firm profitability are very much specific to the individual firm, the strategic capital structure solution is rendered firm-specific in nature. Secondly, there is an endo-exogenous interaction between variables such that, although the taxation and macroeconomic environment factors produce a long-run influence which is aggregate in nature, the fact that the precise or effective advantage to debt, for example, is also determined by the corporate structure of the firm (such as the nature of its investment projects which produce firm-specific tax allowances and thus "crowd-out" debt tax allowances to different extents) means that the resulting capital structure solution is optimal to the individual firm. Such an endo-exogenous interaction effect may also occur at the operational level, although smaller firms in particular are unlikely to fully appreciate its effect.

The effect of the scale of the firm is seen to be significant to both the operational and strategic capital structure policy. The most important incidences where the scale of the firm impacts upon the type of capital structure decision are those within bivariate relationships with respect to the taxation environment of the firm. Indeed, smaller firms are more likely to monitor nominal taxation measures such as the nominal tax advantage to debt and the nominal corporate tax rate, before making a decision to adjust their capital structures. However, larger firms have in place the sophisticated information systems which enable them to compute and monitor the more realistic effective taxation measures, such as the effective total tax rate and the effective corporation tax rate, before adjusting their capital structures. Furthermore, this dichotomous influence of taxation which depends upon the scale of the firm appears to hold for both the operational and strategic policies of European firms. Thus, only larger firms exhibit a more considered understanding of the influence of the taxation environment upon gearing such that they can assess the influence of tax exhaustion upon the tax advantage to debt, for example, before arriving at an optimal capital structure decision.

In summary, the bivariate corporate capital structure time series analysis enables the central hypothesis to be addressed in a methodological manner as well as identifying numerous other key results which constitute a framework for understanding the decisions which make up the operational and strategic capital structure policies of European firms. Firstly, there is support for the central hypothesis, H1, as both weak-form and strong-form optimisation procedures are identified within European firms and optimal results arising from both the operational and strategic capital structure policies of such firms are shown to be firm-specific in nature. Secondly, there exists a fairly distinct behavioural dichotomy between larger and smaller European firms, whereby larger firm finance managers engage in full optimisation behaviour to continually maintain the desired optimal long-run path of the DDE ratio in relation to key strategic determinants (extra-ratio targeting) by continually correcting for any disequilibrium errors from that path, whereas smaller firm finance managers engage in a form of bounded optimisation behaviour (intra-ratio targeting) by targeting their DDE ratios upon those of other firms in their industry, larger firms, and so on. The dichotomous behaviour is caused by differences between the larger and smaller firms in the sophistication of information systems present within the finance function of the firm, which is a crucial determinant in the extent of optimising behaviour undertaken.

Thirdly, the modelling exercise determined that exogenous factors which impact directly upon the explicit costs of financial instruments are the most significant influences upon both the operational and strategic capital structure policies of firms. However, at the strategic level, the finance manager also appears to consider the longer-term trends in profitability and financial risk before arriving at an optimal capital structure solution. Therefore, although this research identifies a wide range of potential influences upon corporate gearing, the most important of those influences still appears to be the cost of the external financial instruments as determined by the taxation and macroeconomic environments within which the firm is placed. It is perhaps reassuring that the finance manager still focuses upon the explicit costs of external finance when setting the optimal DDE ratio, even though both finance managers and academics have in recent years developed a far greater understanding of the implicit costs of finance. Fourthly, it is clear that the finance manager may not set the level of the DDE ratio with reference merely to the determinants of that ratio alone, as changes in the DDE ratio additionally have important implications for the environment of the firm. In the short-run, the static and marginal analyses revealed that an increase in gearing confers mainly detrimental effects upon the firm, whereas in the longer-run (examined in the bivariate EC models) the new investment projects financed by increased gearing should begin to break-even, benefiting the firm in terms of improved profitability and liquidity. Optimality must therefore encompass the two-way causation between gearing and the corporate environment, and it is clear from the bivariate models that firms do indeed recognise this phenomenon.

Finally, the bivariate analysis has identified two areas which require theoretical development and empirical testing before the European corporate capital structure research is complete. Section 8.3 thus extends the bivariate analysis to a multivariate perspective, enabling the two-way causation phenomenon to be incorporated into a system of capital structure models. Section 8.4 then develops and tests the concept of intra-ratio targeting, to explain the long-run behaviour of smaller firms.

8.3 The construction and estimation of Johansen procedure multivariate error correction models to determine the short-run and long-run processes present within key capital structure relationships

8.3.1 Introduction

The bivariate time series models identified that it is uncertain whether the firm's capital structure is better considered a determinant of, or is determined by, corporate environment variables related to it. The static models examined earlier in this research determined that gearing may often be characterised by its detrimental cost and risk effects upon the corporate environment in the short-run rather than relationships of the converse direction of causation. The later bivariate EC models identified that gearing exerts a significant influence upon corporate environment factors in the long-run, in addition to the converse causation. Thus, it is necessary to express variables which exhibit two-way causality with respect to the DDE ratio in a model form which can accommodate and augment the examination of such relationships. Only those variables which exhibit a long-run cointegrating relationship with corporate gearing are examined in this section, however, as the method employed is based in cointegration econometrics. The samples to be modelled comprise the UK weighted and non-weighted samples because the other samples are too short to enable a multivariate modelling method to be used, particularly when lag structures are introduced.

Johansen's Maximum Likelihood procedure (1988, 1989) is employed for the multivariate error correction modelling as it enables the number of cointegrating vectors to be established and estimated. The method for estimating a multivariate error correction model is based on the error correction representation of the VAR(p) model with Gaussian errors. The model given in equation 8.1 is a multivariate generalisation of a model with an error correction mechanism.

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + \ldots + \Gamma_{p-1} \Delta x_{t-p+1} + \Pi x_{t-p} + B z_t + u_t$$

Equation 8.1

where:

x_t = an m x 1 vector of I(1) variables

z_t = an s x 1 vector of I(0) variables

$\Gamma_1, \Gamma_2, \ldots, \Gamma_{p-1}, \Pi$ are m x m matrices of unknown parameters

B = an m x s matrix

$u_t \sim N(0, \Sigma)$

The Johansen maximum likelihood procedure estimates the model subject to the hypothesis that Π has a reduced rank, that is, $r < m$. Thus, the hypothesis H(r) may be written as follows:

$$H(r): \Pi = \alpha\beta' \qquad \text{Equation 8.2}$$

where α and β are m x r matrices. Johansen's 1989 paper argued that this reduced rank condition implies that the process Δx_t is stationary, x_t is non-stationary, and that $\beta' x_t$ is stationary, under certain conditions. $\beta' x_t$ are the cointegrating relations and the β matrix represents the cointegrating vectors which, after normalization, may be interpreted as long-run parameters. The α's measure the speed of adjustment of particular variables with respect to a disturbance in the equilibrium relation. The Johansen procedure, then, identifies the number of cointegrating vectors, which may be more than one in a multivariate model, and enables estimation of the error correction mechanism to be incorporated into a general ADL model in differences which is then reduced.

8.3.2 The hypotheses to be tested by the construction and estimation of the multivariate error correction models

The Johansen procedure multivariate error correction models are not constructed and estimated to further test hypotheses concerning the dynamic and long-run coefficient signs of variables influencing the DDE ratio, as such hypothesis testing is conducted extensively in the section 8.2. The Johansen procedure models are created instead to examine the interaction of endogenous/exogenous groupings of variables, and the implications of this for the determination of the European DDE ratio. To facilitate this, three model systems are constructed and estimated within a general-to-specific framework, and two new hypotheses are tested.

Hypothesis H42 states that multivariate error correction models containing a mix of exogenous and endogenous variables will exhibit less explanatory power than models in which the variables are all of the same nature. However, it might be argued that in a strict statistical sense, all variables modelled using the Johansen procedure are endogenous in the respect that they are endogenously determined. It is therefore noted that, in the context of the application of the Johansen procedure to the European research, it is the macroeconomic and taxation environment variables which are referred to as "exogenous" variables and the corporate environment variables are referred to as "endogenous variables". The reason for this hypothesis is that in a "mixed" model, the exogenous variables may be able to explain a high proportion of the variation in the endogenous variables, but the endogenous variables, by definition, should explain little or none of the variation in the exogenous variables. In the context of the UK weighted sample models, for example, models with the inflation or taxation variables expressed as dependent variable should appear significantly weaker than models with the DDE ratio, profitability or dividend cover expressed as dependent variable. Weaker models may exhibit counter intuitive coefficient signs and insignificant or incorrectly signed ECM coefficients.

Hypothesis H43 states that the DDE ratio is better expressed as a determinant of long-run corporate target ratios rather than the converse. If the hypothesis holds then models with the DDE ratio expressed as dependent variable should be relatively weak compared with models with the other corporate ratios expressed as dependent, and should thus exhibit counter intuitive coefficient signs or lack a significant ECM. This hypothesis therefore seeks to test the proposition that gearing may exert an influence upon the corporate environment which is potentially of greater importance to the firm than the converse direction of causation.

Three model systems are estimated to enable hypotheses H42 and H43 to be tested. Model system 1 contains all of the variables which are cointegrated with the DDE ratio in the UK weighted sample. Model system 2 contains only those variables which are determined within the corporate environment, that is, variables of an endogenous nature, again for the UK weighted sample. Model system 3 contains only exogenous variables (plus the DDE ratio) for the UK non-weighted sample. Thus, the models enable the examination of three scenarios, to determine the interaction of the DDE ratio with: exogenous and endogenous variables; with endogenous variables alone; and with exogenous variables alone. If hypothesis H42 holds then model system 1 should be a weak model, whereas model systems 2 and 3 should be stronger as they isolate exogenous and endogenous factors. However, model system 2 should also be more significant than model system 3, because it contains a set of variables which are all endogenously determined whereas model system 3 contains exogenous variables in addition to the endogenously determined DDE ratio.

8.3.3 The method employed to produce multivariate error correction models of the European corporate capital structure environment

The variables to be tested for the presence of cointegrating vectors are entered into the time series statistics package, MICROFIT Version 3.0 (1993). Only those variables which are cointegrated with the DDE ratio measure are modelled. The variables form a vector autoregressive (VAR) representation in which they are not divided into dependent or independent variables.

The order of the VAR is two, as most of the significant relationships within the data should occur within two years. This is because there may be a lagged reaction to corporate measures which are based upon annual accounting data, because two years is generally sufficient to take account of residual autocorrelation, and because a VAR model of order greater than two might reduce the degrees of freedom available to such an extent as to render the models invalid. Indeed, Charemza and Deadman (1992) argue that the lag length of the VAR corresponds to the length of adjustment to a deviation from a long-run path and that it is usually assumed that these corrections occur after a relatively short period of time.

Firstly, the maximum likelihood ratio test statistics are computed to determine the number of cointegrating vectors, using Johansen's (1989) maximal eigenvalue test and trace statistic test. The null hypothesis for both tests is that r, the number of cointegrating vectors, is zero. Each statistic is compared to its respective critical value at the 5 per cent level, and if the statistic is greater than the critical value then the null hypothesis of no cointegrating vectors is rejected. If the first null hypothesis is rejected then the second null hypothesis tested is that the number of cointegrating vectors is one, that is, $r=1$. The tests are conducted in a sequential manner until the number of cointegrating vectors is determined.

Secondly, once the number of cointegrating vectors present within the VAR model is determined, the cointegrating vector coefficients are computed, based on the assumption that there are r cointegrating vectors present. Thus, the coefficients are determined by the number of cointegrating vectors found. The coefficients are presented in both pure vector form and are also standardised upon the DDE ratio variable. The standardised variable coefficients should be very similar to a static long-run representation of an ADL model of order two, which provides a means of checking the cointegrating vector coefficients.

Thirdly, an adjustment matrix is also computed, the components of which provide some measure of the speed of adjustment of particular variables with respect to a disturbance in the equilibrium relation.

Fourthly, the residuals of the VAR model are saved for inclusion in the multivariate error correction models within each model system. A series of models, expressing each variable as the dependent in turn, is constructed and estimated, to contain each variable, differenced and lagged zero and one years, a constant, and the residuals from the Johansen ML procedure lagged two years. The differenced variables enable the short-run or dynamic processes to be represented, whereas the long-run EC process is measured by the residuals from the Johansen procedure. The ECM is lagged two years to produce a model consistent with the dynamic components, and, additionally, the VAR model from which the ECM is estimated, is of order two years. This produces a set of general-form multivariate EC models.

Finally, the general-form models must be reduced sequentially on the basis of the t-test, in a manner similar to the general-to-specific modelling approach used in the bivariate EC modelling. Models are reduced to the point where either or all of the remaining variables are significant, or where further reduction would involve elimination of the error correction mechanism. The constant is left in the model throughout the process, as models perform better with than without it, and its inclusion enables the coefficient of determination to be used as an easily interpretable measure of the goodness of fit of each model. The final reduced-form model is then tested for robustness using the diagnostic tests described in appendix L.

8.3.4 The results of the Johansen procedure multivariate error correction models

The detailed results of the three model systems are tabulated in appendices O, P and Q, and only the results of model system 2 are discussed in detail for reasons explained below.

Model system 1, which expresses the relationships between the DDE ratio, exogenous variables (inflation and the total tax ratio) and endogenous variables (dividend cover and the profitability ratio) is presented in table 7 of appendix O. The model system is extremely weak as the ECM's are generally not significantly negative and the coefficient signs exhibited are not consistent with the results of the bivariate models examined in section 8.2. ECM's must exhibit significant negative coefficients for there to exist an error correcting process, as positive coefficient mechanisms exacerbate any disequilibrium errors from the long-run path of the DDE ratio. It is unsurprising that the exogenous variable models are weak as the more endogenous corporate environment and capital structure variables are unlikely to exert any measurable influence upon them at all.

Even at this stage in the results, hypothesis H42 may be given some limited support because model system 1, which contains a mix of endogenous and exogenous components, is extremely weak. However support for the hypothesis is not conclusive until the results of model systems 2 and 3 are examined, because for stronger support it is essential to determine whether model systems which isolate endogenous and exogenous variables are indeed more significant than model system 1. Therefore, model system 1 appears to be a weak system because of the endo-exogenous mix of variables which comprise it, mainly because only half of the non-DDE ratio variables are capable of producing a two-way causal cointegrating relationship with the DDE ratio.

Hypothesis H43 is given some support by the results of model system 1, as the model with the DDE ratio expressed as dependent variable produces an incorrect positive ECM, whereas the dividend cover and profitability models exhibit significant negative ECM's. This suggests that if the corporate environment could be isolated, the DDE ratio might be better considered an influence of other corporate variables rather than the converse. A more precise examination of the models which comprise model system

1 is not presented in this section as the model system as a whole is not robust and thus a detailed consideration of model coefficients would produce few results of interest.

The purpose of examining the results of model system 2 is: to determine whether the isolation of endogenously-determined variables produces a more significant model system than model system 1, thus further testing hypothesis H42; to determine whether hypothesis H43 is supported and thus whether the DDE ratio is better expressed as a determinant of long-run corporate target ratios rather than the converse; and finally, to determine whether the endogenously determined model system 2 is more significant than the predominantly exogenously determined model system 3 to follow. As model system 2 is expected to be a far more significant model system than systems 1 and 3, the results of the model and the tests leading to its estimation are presented below in some detail. This also enables the Johansen procedure to be discussed in a structured manner to demonstrate how a multivariate model system is computed.

Model system 2, then, is a system of endogenous variable models alone as the exogenous factors, the inflation and taxation measures, have been removed. Tables 8.9 and 8.10 give the results of the maximum likelihood tests to determine the number of cointegrating vectors, showing the maximal eigenvalue and trace statistic tests, respectively. Table 8.9 illustrates that the first null hypothesis that there are no cointegrating vectors within the variable group is rejected as the maximal eigenvalue statistic of 24.3112 is greater than the critical value (at the five per cent level) of 22.0020. However, the null hypothesis that there is less than or equal to one cointegrating vector may not be rejected as the maximal eigenvalue statistic of 11.6843 is less than the critical value of 15.6720. Therefore, table 8.9 reveals that there is only one cointegrating vector linking the reduced group of variables.

Table 8.9
Johansen Maximum Likelihood Procedure (non-trended case) cointegration LR test based on Maximal Eigenvalue of the stochastic matrix

List of eigenvalues in descending order:				
.68578 .42673 .093235 -.0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r = 1	24.3112	22.0020	19.7660
r<= 1	r = 2	11.6843	15.6720	13.7520
r<= 2	r = 3	2.0553	9.2430	7.5250

In table 8.10, the first null hypothesis that there are no cointegrating vectors within the variable group is rejected as the trace statistic of 38.0509 exceeds the five per cent critical value of 34.9100. However, the second null hypothesis that there is less than or equal to one cointegrating vector may not be rejected as the trace statistic of 13.7397 is less than the critical value of 19.9640. Therefore, table 8.10 confirms that there is only one cointegrating vector linking this reduced group of endogenous variables.

Table 8.10
Johansen Maximum Likelihood Procedure (non-trended case) cointegration LR test based on trace of the stochastic matrix

List of eigenvalues in descending order:				
.68578 .42673 .093235 -.0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r>= 1	38.0509	34.9100	32.0030
r<= 1	r>= 2	13.7397	19.9640	17.8520
r<= 2	r = 3	2.0553	9.2430	7.5250

Table 8.11 presents the computed cointegrating vector coefficients in standardised and unstandardised form, where standardisation merely involves dividing all of the coefficients by minus the coefficient of the DDE ratio in this case.

Table 8.11
Estimated cointegrated vectors in Johansen estimation (normalized in brackets)

Variable	Coefficient	Standardised coefficient
DDERATIO	2.1458	(-1.0000)
DIVCOVER	.38242	(-.17822)
ROCE	.029486	(-.013741)
Intercept	-1.8660	(.86959)

Table 8.12 presents the estimated Johansen procedure coefficients, with the DDE ratio expressed as dependent variable, as well as the estimated coefficients of a static long-run representation of an ADL(2) model. It is noted that the magnitudes of the coefficients are somewhat different and that for the profitability ratio measure the coefficient sign differs between estimation procedures. The coefficient signs are generally consistent with the coefficients of the separate bivariate static long-run equations of table 8.7, the only exception being the profitability ratio, ROCE, which exhibits a negative cointegrating vector coefficient in the Johansen procedure model but exhibits a positive coefficient in the static long-run equation. Multicollinearity between the independent variables may cause the sign change in the multivariate perspective, as profitability and dividend cover are likely to be highly cointegrated. The adjustment matrix is given in appendix P.

Table 8.12
Long-run coefficient estimates of the Johansen procedure compared with a static long-run model of an ADL(2) representation of the same model

variable	Johansen procedure estimated long-run coefficients	coefficients of a static long-run representation of an ADL(2) model
DDERATIO	(dependent)	(dependent)
DIVCOVER	-0.17822	-0.0298
ROCE	-0.13741	+0.01114
constant	+0.86959	+0.1791

The residuals from the multivariate cointegrating vector are saved and are included, lagged two years, in each general-form error correction model. These models are then reduced sequentially using the t-test to give the model system 2 reduced-form models, given in table 8.13.

Table 8.13
The UK weighted multivariate error correction models for model system 2

Dependent variable	ΔDDERATIO	ΔDIVCOVER	ΔROCE
Constant	-0.013453 (-0.679)	0.069578 (0.760)	-0.25413 (-0.489)
ΔDDERATIO	-	-	-
ΔDDERATIO-1	-0.30268 (-1.362)	-2.8001 (-2.500)	-
ΔDIVCOVER	-0.032224 (-0.734)	-	-3.2133 (-2.835)
ΔDIVCOVER-1	-	-	-
ΔROCE	-	-0.10837 (-2.914)	-
ΔROCE-1	-	-	-0.56341 (-3.075)
ECM-2	-0.12052 (-0.645)	-3.3636 (-4.900)	-13.956 (-2.880)

The DDE ratio model is clearly a weak model, exhibiting no significant model components. Additionally, the diagnostic tests of appendix P reveal that the model has an extremely low coefficient of determination and the model is not significant on the basis of the F-test statistic. The dividend cover dynamic coefficient is insignificant although it is consistent with the bivariate EC model examined in section 8.2, as the negative coefficient suggests that investors who observe a firm which experiences an improvement in financial safety may purchase the firm's equity on terms more favourable to the firm as their investment is considered safer. However, although the model is extremely weak, it does appear to be correctly specified, as the ECM exhibits the correct negative coefficient sign and the model does not fail specification tests.

The model with dividend cover as the dependent variable is a far stronger model as it exhibits significant dynamic variable components and a significant ECM. The negative coefficient of the DDE ratio dynamic variable is consistent with the bivariate EC model for this direction of causation, and intuitively confirms that as the firm's gearing increases, its financial safety is reduced. Thus, hypothesis H15, which states that the degree of bankruptcy risk (inverse financial safety) increases as the corporate debt-equity ratio increases, is supported. The negative coefficient of the profitability dynamic variable suggests that as profitability increases, the firm is less able to cover its payments of dividends, which appears counter intuitive, or at least very difficult to explain. However, it is not the objective of this research to explain interactions between non-capital structure variables and thus it is sufficient to note that the coefficient is significant.

The model with the profitability ratio as the dependent variable is also a strong model as it exhibits significant dynamic variable components and a significant ECM. There appears to be no significant dynamic relationship between the DDE ratio and profitability. However, the significant ECM suggests that a relationship between gearing and profitability is indeed observed in the long-run. The negative coefficient of the dividend cover dynamic variable suggests that as financial safety improves, the profitability of the firm may be reduced. This may be because a firm with very high earnings experiences eroded profitability through time unless it invests more of its surpluses in new investment projects. However, the diagnostic tests reveal that residual autocorrelation may be a problem in the model.

Therefore, the profitability and dividend cover models of model system 2 are clearly far stronger than the DDE ratio model, both in terms of dynamic variable significance and the significance of ECM's. It is also clearly demonstrated that the corporate environment variables are not significant determinants of the DDE ratio either dynamically or in the long-run, whereas the DDE ratio is indeed a significant determinant of the corporate environment variables, particularly in the long-run. Hypothesis H43, which states that the DDE ratio is better expressed as a determinant of long-run corporate target ratios than the converse, is therefore given some support in the Johansen modelling analysis.

Additionally, the model system provides further support for hypothesis H42, which states that multivariate error correction models containing a mix of exogenous and endogenous variables will exhibit less explanatory power than models in which variables are all of the same nature. Thus, because endogenously-determined variables are isolated in model system 2, the resulting model system exhibits more correctly specified models which generally exhibit highly significant dynamic variables and significant negative ECM's.

Model system 3 contrasts with model system 2 in that it contains only variables which are highly exogenous in nature, for the UK non-weighted sample. The results are presented in appendix Q only as they add little to the multivariate investigation. The reason for this is that two cointegrating vectors are found to be present and thus each model system 3 component model must contain two ECM's. The models are not discussed as the interpretation of more than one cointegrating vector is not yet established in the econometric literature, at least at the time of writing. Additionally, models estimated upon different samples may not be compared, particularly where they contain different variables and different EC specifications, and thus model system 3 does not enable further testing of hypothesis H42.

8.3.5 Summary

In this section, the recently developed and somewhat sophisticated Johansen procedure was employed to construct and estimate multivariate error correction models to examine the two-way causality present between the DDE ratio and factors exhibiting a long-run relationship with it. There is fairly strong support for hypothesis H42 which states that multivariate error correction models containing a mix of exogenous and endogenous variables will exhibit less explanatory power than models in which the variables are all of the same nature. This is due to the presence of causal inequalities amongst those factors related to the DDE ratio, such that, whereas variables which are more endogenous in nature may be determined by variables which are more exogenous in nature, the opposite cannot hold. There is also some support for hypothesis H43, which states that the DDE ratio is better expressed as a determinant of long-run corporate target ratios rather than the converse. Thus, in the long-run, corporate environment variable models with the DDE ratio expressed as an independent variable perform consistently better than would be the case with the DDE ratio expressed as the dependent variable. Firms are likely, then, to maintain target corporate environment variables as well as targeting the DDE ratio in the long-run, such that they may maintain a target for profitability, financial risk, liquidity, growth, and so on.

Model systems for the UK samples only were constructed and estimated because the Johansen procedure may not be undertaken with respect to shorter time-span data samples. The results may be generalised across samples, it is argued, because they are consistent with the results of the other (bivariate) analyses of this European research which support the two-way causation result. Similar results would therefore be expected if longer data time-spans were available for the other samples. The Johansen procedure results thus may be viewed not only as an extension to the capital structure research, but also as a synthesis of causal uncertainty results arising from the whole body of the research.

The implications of the results arising from the Johansen procedure models for the European corporate capital structure research are that, although the finance manager may expend considerable resources setting the capital structure ratio to its optimal level, as embodied by the firm's operational and strategic capital structure policies, he or she must also be mindful of the long-run influence of gearing, in turn, upon the corporate environment of the firm. Indeed, in some respects, the direction of causation where the capital structure ratio is considered a determinant of, rather than being determined by, corporate environment factors, may be of equal importance to the finance manager. Thus, the finance manager sets the optimal level of the DDE ratio based mainly upon taxation factors, macroeconomic factors, and the endo-exogenous interaction effect discussed in section 8.2, whilst at the same time examining the likely effect of his or her decision upon the corporate environment, particularly in the long-run. Essentially, then, corporate capital structure policy becomes not only a matter of optimising the DDE ratio with respect to its key determinants, but also optimising it with respect to its "knock-on" effects upon the firm. This result is further rationalised when it is realised that capital structure policy is only one of the key policies implemented by firms, and furthermore, the DDE ratio target is only one of a group of corporate environment targets which the finance manager is likely to set, monitor, and strive to achieve.

8.4 A cointegration analysis to determine the existence of intra-ratio targeting behaviour within smaller European quoted firms

8.4.1 Introduction

It has been demonstrated in the corporate capital structure research, up to this juncture, that the finance manager of the firm must engage in targeting behaviour to some extent if he or she wishes to optimise the firm's capital structure. Therefore, targeting behaviour is entirely consistent with optimising behaviour. However, such an assertion must be qualified. "Full-optimisation" behaviour requires a type of capital structure behaviour which is distinct from "bounded-optimisation" behaviour. Full-optimisation behaviour requires the finance manager to monitor and fully understand the effect of the salient determinants of the capital structure, such that, given those determinants, he or she may determine the optimal capital structure for the firm. As the determinants are external to the capital structure measure targeted, which is generally expressed as a ratio, this form of full-optimisation is termed "extra-ratio" targeting. However, extra-ratio targeting behaviour may only occur where sophisticated information systems are in place within the finance function of the firm, so that all of the salient data necessary to a full-optimisation solution may be collected, transformed into information, analysed, and then acted upon. The results of the bivariate time series models revealed that extra-ratio targeting behaviour is evidenced predominantly in larger firms across the samples studied. Where the sophisticated information systems necessary to support extra-ratio targeting (full-optimisation) are not present within the firm's finance function, due to the scale of the firm, the cost, and so on, finance managers may instead engage in "intra-ratio" targeting (bounded-optimisation). Intra-ratio targeting behaviour involves the finance manager targeting the capital structure ratio of the firm upon the norm for the industry to which the firm belongs, upon the capital structure ratio of some larger firm(s), or on the basis of some other targeting criterion. It is a form of <u>bounded</u>-optimisation because the finance manager is optimising within the bounds imposed by the constraints of the firm's information systems. It is still a form of <u>optimising</u> behaviour because the finance manager is implicitly benefiting from targeting the capital structure ratio of a firm or group of firms which it perceives itself to be similar to, or has aspirations to be similar to. An example of this is where the finance manager targets the capital structure ratio norm for the industry to which it belongs. It is anticipated that intra-ratio target behaviour should be predominantly observed within smaller rather than larger firms in the analysis conducted in this section. If this expectation holds then it rationalises the lack of extra-ratio targeting behaviour exhibited by smaller firms in the bivariate models discussed in section 8.2. Whilst such intra-ratio targeting is not ideal for the individual firm, it may approximate its unique optimal capital structure ratio because the industry norm implicitly takes into account salient capital structure determinants such as the degree of business risk. Another example of intra-ratio targeting behaviour is where the finance manager targets the capital structure ratio of a larger, more successful firm, particularly a firm within the industry to which that firm belongs. The smaller firm thus benefits from the full-optimisation / extra-ratio targeting behaviour of the larger firm by targeting a capital structure which approximates to its own optimal ratio.

Therefore, the level of sophistication of the firm's information systems may logically influence the type of targeting behaviour which the finance manager of the firm engages in, and thus may ultimately influence the degree to which the capital structure is optimised. The individual firm finance manager trades-off the benefits of achieving full-optimisation against the cost of the sophisticated information systems required to achieve this aim.

Intra-ratio targeting is generally framed in the literature such that the finance manager of the firm targets the firm's capital structure ratio upon the norm (or average) of the industry to which that firm belongs. Before analysing the occurrence of intra-ratio targeting behaviour, it is necessary to place this new concept within the context of the previous studies of capital structure targeting. There are numerous theories explaining why firms might endeavour to target their capital structures on the norm (or average) of the industry to which they belong. Scott and Martin (1975) argued that the finance manager of the firm lacks a valuation formula to determine the best capital structure for his/her individual firm, relying instead on analysis and judgement. They suggested that judgement may be improved by examining the funding mixes of other firms in the same industry. Indeed, Drury and Bougen (1980) noted that any deviation from industry norms is viewed by both lenders and investors with some suspicion, further encouraging strong industry convergence. Scott (1972), however, rationalised targeting behaviour by arguing that firms choose capital structures which are consistent with their particular business risk. As firms within the same industry should have a similar degree of business risk, a range of leverage ratios will exist which firms will seek to locate within. Remmers et al (1974) argued that firms in the same industry face the same environmental and economic conditions, thus producing a clustering of capital structure ratios.

Therefore, the theory suggests that if firms target their capital structures upon the norm for their industry then optimal firm-level capital structures may exist. The reason that firms target in this way is because finance managers often look for guidance from similar firms on financial structure decisions, as they recognise that similar firms will be exposed to similar environmental factors, especially business risk, and they realise that significant departures from published industry norms will be viewed with some suspicion.

Evidence supporting the occurrence of industry norm capital structure targeting behaviour consists predominantly of simple analysis of variance tests which seek to test the hypothesis that debt-equity ratios (or other capital structure variants) vary more between industries than they do within industries. Schwartz and Aronson (1967) studied the common stock equity ratios for four US industry classes for the years 1928 and 1961 and found significant differences in the equity ratios between industries compared to differences within them. Lev (1969) conducted a regression analysis of

245 US firms from 18 industries over the period 1947-66 and found that firms in general adjusted their financial ratios to industry-wide averages in a partial adjustment manner. Scott (1972) conducted an analysis of variance test of capital structure measures in 12 US industries containing 77 firms over the period 1959-68, and found significant differences in capital structures between industries in each of the ten years studied. Scott and Martin (1975) employed a Kruskal-Wallis analysis of variance by ranks test to determine whether or not there existed a significant industry effect within the equity-to-total-asset ratios of 277 US firms from 12 industries over the period 1967-72, and found industry class to be a significant determinant of financial structure. Briscoe and Hawke (1976) conducted an analysis of variance of 120 UK firms for the periods 1965-69 and 1970-74 and found evidence of significant industry differences in gearing. Ang (1976) constructed and estimated a range of models of corporate leverage and found the best performing models to be consistent with targeting behaviour, whereby firms move in a partial adjustment process towards the target, they merely drift around their own concept of a target, or they target their capital structure on the historical average of their industry. Marsh (1982) conducted a logit analysis of 748 debt and equity issues made by UK companies over the period 1959-70, assuming that a company's choice of debt or equity was a function of the difference between current and target debt ratios, and that the target ratio was observed only through its determinants such as size, risk, and asset composition. As he found these determinants to be significant, he concluded that firms did choose to issue either debt or equity as though they strived towards target long-term debt ratios. Cordes and Sheffrin (1983) used the UK Treasury Corporate Tax Model to examine data associated with 1978 corporate returns and found that the marginal incentives to use debt varied significantly across industries, thus implying that there may be an optimal capital structure associated with each separate industry. Finally, Titman and Wessels (1988) estimated a factor analytic model of the corporate capital structure choice, using data from 469 US firms over the period 1974-82, and found that industry-type appeared to influence the corporate capital structure chosen by the firm. Therefore, there is considerable

evidence to support the concept that firms target their capital structures with respect to the norms of their particular industry.

There is some evidence questioning the occurrence of industry norm capital structure targeting behaviour. Remmers et al (1974) conducted a one-way analysis of variance of the debt-to-total-assets ratio for manufacturing industries in five countries, and found that industry norm was a significant determinant of corporate debt ratios in France and Japan, but not in the Netherlands, Norway and the US. They concluded from this that the industry influence on the capital structure is very weak, possibly because "industry" is not a good proxy for business risk. Stonehill et al (1975), in their survey of 87 firms from France, Japan, the Netherlands, Norway and the US, over the period 1972-73, found that firms did not perceive the industry norm to be an important debt ratio determinant in any of these countries. Drury and Bougen (1980) analysed 700 UK firms in 45 industries over the period 1968-77, constructing gearing distributions for each industry. They found no evidence of the clustering of firms within each distribution around a norm and thus concluded that if an industry optimal capital structure does exist then it must be spread over a very wide range. Sekely and Collins (1988) conducted a Kruskal-Wallis test upon a sample of 677 firms from 9 industries in 23 countries for the period 1979-80. They found that the differences in median rank between industries were not significant even at the 10 per cent level, and argued that the industry effect may be insignificant owing to a reduction in the distinction between industries through time, a significant increase in the use of debt across the sample, and the highly imperfect and incomplete markets that exist outside the US. However, their study did examine multinational corporations, which would be expected to complicate the results, rendering minimal any industry effect. Therefore, evidence questioning the existence of firm target capital structure ratios is far weaker than the evidence lending support to their existence. Even though authors such as Stonehill et al (1975) found that finance managers do not perceive capital structure targeting to be an important influence upon the capital structure decision, it may be that such managers are subconsciously practising such behaviour or possibly that they would not admit to "following the leader" behaviour as such an admission might be embarrassing.

On balance, evidence arising from the existing literature appears to support the proposition that individual firms target their capital structures on the norm for the industry to which they belong. This behaviour may result from the fact that firms within an industry are subject to similar business risk, tax incentives, or other factors. Furthermore, there is some evidence that firms are in a state of partial adjustment towards a capital structure target at a given moment in time, suggesting a continual state of disequilibrium.

8.4.2 Hypotheses to be tested

It is seen that there is considerable evidence in the existing literature supporting the occurrence of capital structure targeting behaviour based upon the capital structure ratio norm for the industry to which a particular firm belongs. However, this section examines intra-ratio targeting behaviour from an entirely new perspective. In a paper not directly related to capital structure theory, Marsh and Merton (1987) argue that US firms maintain a dividend-price ratio towards which they continually adjust, and that such behaviour implies that prices and dividends are cointegrated. This reasoning may be applied to capital structure theory to enable the targeting hypothesis to be tested within a time series perspective. Thus, if firms engage in intra-ratio capital structure targeting behaviour, it might be reasonably expected that the constituents of the capital structure measure are cointegrated, as firms continually adjust the proportions of different financial instruments towards their desired long-term capital structure path.

The adjustment of the constituents of the capital structure ratio to maintain a desired long-run path is distinct from the adjustment of the capital structure ratio as a whole measure towards a desired long-run path in relation to key long-run influencing factors. As already discussed, the former adjustment process is termed intra-ratio targeting whereas the latter is termed extra-ratio targeting. In the case of intra-ratio targeting, debt and equity are targeted in relation to each other and if such targeting occurs then the level of debt will track the level of equity, and vice versa, so that it appears that the amounts of the two financial instruments are drifting through time together, producing a cointegrating relationship. Therefore, cointegration analysis is employed to determine whether European firms adjust their DDE ratios as if continually tracking a desired capital structure mix. The hypothesis employed to test this, hypothesis H44, states that European quoted firms target capital structure ratios. However, hypothesis H44 may only be addressed after a number of supporting hypotheses, hypotheses H45 to H48, are tested. The supporting hypotheses relate to the type of capital structure accounting ratio targeted and the size of the firm.

The supporting hypotheses related to the type of capital structure accounting ratio targeted are hypotheses H45 to H47. It is anticipated that the DDE ratio (the debt-to-debt-plus-equity ratio) is the most important targeted capital structure ratio that is continually adjusted by European firms because it not only expresses the proportion of long-term external finance represented by long-term debt, but also expresses this measure on a scale of zero to unity, thus making it a readily interpretable measure. Hypothesis H45, then, states that the DDE ratio is a capital structure ratio targeted by European quoted firms. Commonly cited alternatives to the DDE ratio measure are the debt-to-equity ratio (DE ratio) and the debt-to-total-assets ratio (DTA ratio). The DE ratio is not such as useful a measure as the DDE ratio, because it is not bounded by unity, although it still expresses long-term debt as a proportion of equity and in this sense is a pure capital structure measure. Hypothesis H46 states that the DE ratio is a capital structure ratio targeted by European quoted firms. The DTA ratio is also not bounded by unity, and additionally, is a debt-to-firm-size measure which is less directly interpretable than a pure capital structure measure. Hypothesis H47 states that the DTA ratio is a capital structure ratio targeted by European quoted firms.

It was determined in the bivariate models that larger firms are more likely to set the level of the capital structure ratio in response to key capital structure determinants, producing cointegrating relationships which may be described as extra-ratio targeting. Smaller firms may target their capital structure ratios either upon the norm for their industry or upon the ratios of larger, more sophisticated firms. As industries are often dominated by one or two large market leaders, industry-targeting may equate to large firm-targeting in many cases. As the smaller firms are tracking a desired capital structure ratio which is externally given, they are merely adjusting the proportions of debt and equity in their capital structures to the desired capital structure ratio. In this sense, smaller firms are far more likely to engage in intra-ratio targeting than larger firms, and consequently should exhibit capital structure constituent interrelationships which are cointegrated. Thus, hypothesis H48 states that the capital structure constituents of smaller firms are more likely to be cointegrated than the capital structure constituents of larger firms.

Therefore, the capital structure targeting behaviour hypotheses, H45 to H48, are tested, as a means of testing the overall hypothesis, H44, which states that European quoted firms target capital structure accounting ratios.

The data set analysed is data set 3, the European time series data set. Three time series variables are employed in the testing of this section: the total loan capital of the firm (labelled LRLOANS), the historical market value of equity (labelled HMVEQUITY), the sum of these variables (labelled LNPLUSEQ), and the total assets employed by the firm (which is labelled ASSETS).

8.4.3 The method employed to test for the existence of intra-ratio targeting behaviour within smaller European quoted firms

The basis for the testing is that if a capital structure measure is targeted by European firms then the numerator and denominator of that measure will be cointegrated. Thus, if the DDE ratio is targeted, total loan capital (LRLOANS) will be cointegrated with the sum of total loan capital and the historical market value of equity (LNPLUSEQ). If the DE ratio is targeted, total loan capital will be cointegrated with the historical market value of equity (HMVEQUITY). Finally, if the DTA ratio is targeted, total loan capital will be cointegrated with the total assets employed by the firm (ASSETS).

The tests employed to determine whether European firms target various capital structure measures in an intra-ratio manner is the Engle and Granger (1987) approach to cointegration analysis, applied in a slightly different manner in the construction of the bivariate EC models. Firstly, the order of integration of the four capital structure constituent variables is determined using the Dickey Fuller (1979) unit root test, hereafter known as the DF test. Secondly, those variables which are integrated of the same order as total loan capital are tested using the DF or Augmented Dickey Fuller (ADF) (1981) tests to determine whether they are cointegrated with that variable. Thus, measures which are cointegrated with total loan capital form the constituents of targeted capital structure measures.

Before the unit root tests are undertaken, all of the constituent variables are tested for the presence of a deterministic trend. The null hypothesis is that there is no deterministic trend, and each variable is tested by means of an F-test of the estimated equation 8.3, with a critical value of 10.61 for 25 observations at the one per cent level (Dickey and Fuller (1981), p.1063, table 6). If the F-ratio is greater than the DF critical value then the null hypothesis of no deterministic trend is rejected, and thus a deterministic trend is present.

$$\Delta y_t = a + bT + cy_{t-1} + \varepsilon_t \quad \text{Equation 8.3}$$

Where:
T = a time trend

Once the deterministic trend test is computed for each of the constituent variables, the DF test is computed, as given in equation 8.4. The null hypothesis is that each capital structure constituent is non-stationary. Each variable is sequentially tested and differenced until the order of integration is determined, that is, until the null hypothesis is rejected and the variable is found to be stationary.

$$\Delta y_t = \delta . y_{t-1} + \varepsilon_t \quad \text{Equation 8.4}$$

Critical values for the DF test are computed from Mackinnon (1991) response surface values. The null hypothesis of non-stationarity is rejected if the DF statistic is lower than the Mackinnon critical value for the relevant number of observations. If the DF statistic is higher than the Mackinnon critical value, then, the null hypothesis may not be rejected, and the variable must be integrated of some higher order. In cases where a deterministic trend is present within the variable, the DF unit root test is estimated with a trend in the right hand side of the test equation, as given in equation 8.5.

$$\Delta y_t = \mu + \alpha . T + \delta . y_{t-1} + \varepsilon_t \quad \text{Equation 8.5}$$

The Durbin Watson (DW) test for autocorrelation is computed at each stage of the sequential DF testing. The null hypothesis is that there is no residual autocorrelation, and this hypothesis is rejected if the DW statistic is less than the lower bound DW critical value, accepted if the statistic is greater than the upper bound, and an inconclusive result is produced if the statistic lies between the bounds. To strengthen the result of the DF test, the null hypothesis must not be rejected, that is, insignificant autocorrelation supports a stationarity result.

Only those constituent variables integrated of the same order as the total loan capital variable are tested in the second stage of the procedure to determine whether they are cointegrated with it. Before the DF and ADF tests are undertaken, the residuals from a static long-run regression equation of the total loan capital variable upon the constituent to be examined are tested for the presence of a deterministic trend. Equation 8.6 is regressed for the residuals of each static long-run regression. The null hypothesis of no deterministic trend within the residuals is rejected if the F-ratio arising from the estimated regression of equation 8.6 exceeds the DF critical F value of 10.61 for 25 observations at the one per cent level.

$$\Delta ECM_t = a + bT + cECM_{t-1} + \varepsilon_t \qquad \text{Equation 8.6}$$

Where:

ECM = the error correction mechanism

The second stage of the Engle and Granger cointegration testing procedure is then undertaken. Firstly, the cointegrating vector is estimated by regressing the total loan capital variable upon each of the other constituent variables in turn, as given in equation 8.7.

$$y_t = \mu + \beta_1 x_t + v_t \qquad \text{Equation 8.7}$$

The estimated residuals are then tested for stationarity by means of the DF and ADF tests of equations 8.8 and 8.9.

$$\Delta\hat{v}_t = \delta.\hat{v}_{t-1} + \xi_t \qquad \text{Equation 8.8}$$

$$\Delta\hat{v}_t = \delta.\hat{v}_{t-1} + \sum_{i=1}^{k}\delta_i.\Delta\hat{v}_{t-i} + \xi_t \qquad \text{Equation 8.9}$$

The ADF tests, which allow for autocorrelation, introduce as many lags as each sample requires. The null hypothesis that the residuals (error correction mechanisms) are non-stationary is rejected if the DF or ADF statistic is lower than the Mackinnon critical value for the relevant number of observations. Where ECM's are non-stationary the relationship from which they are estimated is not a cointegrating relationship. In this context, a non-stationary ECM signals that the capital structure measure tested is not a targeted measure. Where a deterministic trend is found to be present within the ECM, the DF and ADF tests of equations 8.10 and 8.11 are estimated, including a trend.

$$\Delta\hat{v}_t = \alpha.T + \delta.\hat{v}_t + \xi_t \qquad \text{Equation 8.10}$$

$$\Delta\hat{v}_t = \alpha.T + \delta.\hat{v}_t + \sum_{i=1}^{k}\delta_i.\Delta\hat{v}_{t-i} + \xi_t \qquad \text{Equation 8.11}$$

Again, the DW test is computed, for each DF/ADF test computed. Acceptance of the null hypothesis of no residual autocorrelation is again the result required to lend support to a rejection of the null hypothesis of non-stationarity. Therefore, the method employed to determine whether European firms target capital structure measures through time is that of unit root testing and then cointegration testing, in addition to the respective deterministic trend and DW tests. Where the total loan capital measure is found to be integrated of the same order as, and is cointegrated with, another capital structure constituent, then it is argued that a capital structure measure with total loan capital as numerator and the cointegrated variable as denominator is indeed a measure targeted by European firms.

8.4.4 Results of the testing for the existence of intra-ratio targeting behaviour

The majority of the statistical test results are presented in appendix R, although the salient results are summarised in tables 8.14 and 8.15 below. Table 1 of appendix R shows that, excepting the total loan capital variable for the UK weighted sample, none of the other capital structure consistent variables contain a significant deterministic trend at the 1 per cent level. The DF unit root tests for this particular variable thus include a trend in the right hand side of the DF test equation for the UK weighted sample, as given in equation 8.5.

Table 8.14
Summary of the results of the unit root tests computed for the capital structure ratio constituents at the 1 per cent level, showing the order of integration

variable	weighted/ non-weighted	UK	Netherlands	Germany	France
LRLOANS	weighted	0	**2**	**2**	**2**
HMVEQUITY	weighted	1	1	1	1
LRLOANS+ HMVEQUITY	weighted	1	1	**2**	**2**
ASSETS	weighted	2	**2**	**2**	N
LRLOANS	non-weighted	**1**	**1**	**1**	**2**
HMVEQUITY	non-weighted	**1**	**1**	**1**	**2**
LRLOANS+ HMVEQUITY	non-weighted	**1**	**1**	**1**	**2**
ASSETS	non-weighted	2	2	2	N

Figures in bold give the order of integration of those variables which may be tested for the existence of a cointegrating relationship with the total loan capital in the second stage of the cointegration testing procedure. These capital structure constituent variables are integrated of the same order as the total loan capital variable.
N = variable which is not capable of becoming integrated.

The results of the DF unit root tests are given in tables 2 to 5 of the appendix, and are summarised in table 8.14. The table shows that many of the capital structure constituent variables are integrated of the same order as the total loan capital variable within each sample and thus may be tested for the existence of a cointegrating relationship with that variable. None of the capital structure variables are integrated of the same order as the total loan capital constituent variable for the UK weighted sample because it is integrated of order zero. An interesting result is that in the majority of samples, the total assets employed (ASSETS) variable is either integrated of a higher order than the total loan capital variable, or is not integrated at all. As a result of this, total assets employed is not tested for the possibility of a cointegrating relationship with total loan capital in the majority of samples. This suggests that the majority of European firms do not target the DTA ratio (debt-to-total-assets ratio), possibly due to the shortcomings of this ratio such that it is not a pure capital structure measure and is not bounded by unity, rendering it less readily interpretable than other capital structure measures. Even at this early stage in the analysis, therefore, hypothesis H47 is questioned.

Table 6 of the appendix reveals that the residuals of the static long-run regressions of total loan capital on each capital structure constituent variable do not contain significant deterministic trends in any of the European samples tested. Thus, a trend need not be included in any of the cointegration test equations. The DF/ADF cointegration test results are given in tables 7 to 13 of the appendix and are summarised in table 8.15.

Table 8.15
Summary of cointegration testing of the total loan capital variable upon each of the capital structure constituent variables at the 10 per cent significance level

variable	weighted/ non-weighted	UK	Netherlands	Germany	France
HMVEQUITY	WEIGHTED	NT	NT	NT	NT
LRLOANS+ HMVEQUITY	WEIGHTED	NT	NT	**cointegrated lag 0,1*,2***	**cointegrated lag 0**
ASSETS	WEIGHTED	NT	NR	NR	NT
HMVEQUITY	NON-WEIGHTED	**cointegrated lags 0,2**	**cointegrated lag 3***	NR	NR
LRLOANS+ HMVEQUITY	NON-WEIGHTED	**cointegrated lags 0,2**	**cointegrated lag 3***	NR	NR
ASSETS	NON-WEIGHTED	NT	NT	NT	NT

* = the Durbin Watson test is inconclusive for this lag length within the DF/ADF test.
NT = the capital structure constituent variable is not tested for the existence of a cointegrating relationship with the total loan capital variable, as either it is integrated of a different order than this variable or is not integrated at all.
NR = the null hypothesis of no cointegration is not rejected.

The table shows that there are relatively few occurrences of cointegrated capital structure relationships. However, some capital structure constituents show more evidence of a cointegrating relationship with the total loan capital measure than others. Of the six incidences of cointegrating capital structure constituents (targeted capital structure measures), four relate to the targeting of the DDE ratio and two relate to the targeting of the DE ratio. Therefore, there is some evidence to support hypotheses H45 and H46, although such evidence is weak as capital structure targeting behaviour is not universal across samples. The DTA ratio does not exhibit cointegrated constituent variables for any of the European data samples, and it is thus inferred that such a measure is not widely employed by finance managers as a capital structure target, refuting hypothesis H47.

Table 8.15 reveals quite clearly that the effect of the scale of the firm appears to be important to the targeting behaviour of the finance manager. There is some evidence of a targeting behaviour dichotomy between larger and smaller firms, whereby larger firms are more likely to engage in extra-ratio targeting (full-optimisation) and smaller firms are more likely to engage in intra-ratio targeting (bounded-optimisation). Therefore hypothesis H48 is supported.

Once it is determined that intra-ratio targeting is behaviour associated mainly with smaller European quoted firms, it is the lower half of table 8.15 which becomes of greater interest, as this shows the cointegration test results for the non-weighted European samples. Additionally, once the less popular DTA ratio measure is eliminated as a targeted measure, it is clearly observed that the DE ratio and the DDE ratio are important capital structure target measures. One reason why cointegrating relationships for these measures are not universal across samples may be merely that statistically significant cointegration test results require a greater number of observations than is available within the shorter time-span samples.

Before the salient results are brought together, the limitations of the analysis undertaken are briefly discussed. Firstly, residual autocorrelation appears to be a problem in a number of the cointegration tests, although the use of the Durbin Watson test in this analysis may be problematic anyway as the cointegration test equation contains a lagged dependent variable. Secondly, it may be argued that the time series data time-spans are too short to produce strong evidence of intra-ratio targeting behaviour. However, although data availability limits the strength of the results, the analysis may be considered an extremely useful illustrative exercise.

On balance, once the effect of the scale of the firm is taken into account, hypotheses H45 and H46 are given greater support, particularly once the effect of short time-spans on the cointegration test results is understood. As anticipated, the less popular DTA ratio measure is not found to be targeted at all for the countries analysed, and thus hypothesis H47 is firmly rejected. The effect of the scale of the firm is clearly observed, supporting hypothesis H48. Therefore, there is some evidence that European quoted firms, particularly smaller firms, target capital structure accounting ratios, thus supporting hypothesis H44, although firms appear to be very specific with respect to the precise measure they target.

8.4.5 Summary

Thus, the concept of intra-ratio targeting behaviour, developed in this section, involves the targeting of the constituents of the capital structure ratio with reference to the ratio of another firm or group of firms. Some evidence is found to support the hypothesis that European quoted firms target capital structure ratios in an intra-ratio targeting manner. Consistent with the theory developed, evidence reveals that smaller quoted firms are more likely to engage in intra-ratio targeting behaviour than larger quoted firms as they do not have in place the sophisticated information systems necessary to facilitate extra-ratio targeting. Additionally, there is evidence that finance managers only target very specific capital structure ratio measures such as the DDE ratio and the DE ratio, and that measures such as the DTA ratio are not targeted, probably because they are not so readily interpretable. Whilst intra-ratio targeting appears to be a fairly naive form of corporate behaviour, it is useful as a form of bounded-optimisation whereby the finance manager may approximate the firm's optimal capital structure ratio, given the firm's business risk and other prevailing market conditions. Therefore, there exists a behavioural dichotomy with respect to corporate capital structure policy which is supported both by the results of the bivariate and multivariate time series models and by the results from the analysis of this section. There is evidence, then, that predominantly larger firms engage in full-optimisation in the long-run (extra-ratio targeting) whereas predominantly smaller firms engage in bounded-optimisation (intra-ratio targeting) in the long-run.

8.5 Summary of results arising from the corporate capital structure time series analyses

It is clearly demonstrated that the capital structure policies undertaken by European firms are complex. Perhaps the most pronounced result arising from the time series capital structure research is the dichotomous nature of capital structure policy behaviour, such that smaller firms and larger firms appear to engage in different capital structure behaviour due to differences in the sophistication of their respective finance functions. There are likely to be differences in the sophistication of the information collection, analysis, and actioning systems within the finance function between larger and smaller firms which determine the extent to which the individual firm is able to engage in optimising capital structure setting behaviour. It is essential to present a synthesis of the results arising from the time series research to explain the nature of the capital structure behavioural dichotomy which emerges.

Smaller European firms operate both operational and strategic capital structure policies. In the short-run, the firm operates an operational capital structure policy which determines the setting of the DDE ratio on a month-to-month or even year-to-year basis. The most important influences upon the operational capital structure policy of the smaller firm are those factors which impact directly upon the explicit relative costs of financial instruments. The finance manager monitors changes in nominal taxation measures such as the nominal tax advantage to debt and the nominal corporate tax rate, and reacts to increases in these variables by increasing the firm's DDE ratio. There also appears to be a reaction to an increase in the effective corporate tax and effective total tax rates, which may alternatively be described as a reactive response to an increase in the relative tax bill, whereby managers raise the DDE ratio as part of a tax-reduction strategy. However, there is more evidence of a reaction to changes in the effective taxation variables in larger firms because the effective taxation measures proxy the effective tax advantage to debt more closely than the naive nominal measures, and it is argued that the larger, more sophisticated firm finance managers appreciate this distinction more than smaller, naive firm finance managers.

Macroeconomic environment factors also impact directly upon the relative costs of financial instruments and thus exert a strong exogenous influence upon the operational capital structure policy of the smaller firm. An increase in the rate of inflation encourages the finance manager to increase the DDE ratio as the inflation rate increase is likely to have a positive influence upon the tax advantage to debt by raising interest rates and reducing the value of non-debt tax allowances which may crowd out debt tax allowances. Additionally, the performance of financial markets significantly affects the operational capital structure decision of the smaller firm as the manager may only significantly increase issues of debt or equity claims if interest rates are relatively high or equity markets are buoyant, respectively. The timing of capital structure decisions may also be influenced by the performance of financial markets in the short-run, due to the investor, rather than the corporate, orientation of such markets. Therefore, those factors which exert the most important influence upon the operational capital structure decision of the smaller firm are factors which impact directly upon the explicit relative costs of financial instruments, whereby macroeconomic environment factors determine the before-tax cost of finance and taxation factors determine the after-tax cost.

Taxation and macroeconomic factors which do not impact directly upon the explicit costs of finance exert little influence upon the operational capital structure policy of the smaller firm as their influence upon gearing is too remote. It is noted that the finance manager monitors closely exogenous influences upon the DDE ratio whereas endogenous influences, determined within the firm, exert only a weak influence. There is some evidence that relatively larger and more profitable firms are more willing to maintain higher gearing, although financial risk is not an important influence, probably because the quoted firms in the European research are not greatly concerned with the possibility of financial distress as they are likely to be characterised by diversified markets, large reserves, and so on. It may be the case that increases in firm size and profitability impinge weakly upon policy because only longer-run increases in both variables will cause an improvement in the finance managers' perception of the firm's debt capacity. Therefore, potential influences of the operational capital structure policy of the firm will not be significant unless they are capable of exerting an exogenous influence upon gearing through their direct impact upon the explicit costs of financial instruments.

A further influence upon the operational capital structure policy of the smaller firm is that of endo-exogenous interaction. This describes the impact of exogenous factors, in conjunction with endogenous factors, upon the corporate capital structure policy. For example, managers may observe an increase in the corporate tax rate, which exerts an influence upon gearing policy at the aggregate level. However, once the current tax-allowances of the firm (which depend in part upon the nature of each individual firm's investment projects) are taken into account, managers' gearing reactions are likely to vary significantly across firms, producing an influence upon gearing policy at the individual firm level. However, the complexity of this interaction may mean that only the finance managers of larger, more sophisticated firms may correctly understand and take account of this effect. This may mean that the endo-exogenous effect is weaker for smaller European firms.

There are also influences upon the operational capital structure policy of the smaller firm which work in the converse direction of causation. The cross-sectional bivariate regression analyses determined that the DDE ratio is perhaps better considered as an exogenous variable with respect to corporate environment factors. Therefore, the finance manager must take into consideration the potential influence of the DDE ratio upon the corporate environment before he or she can make a gearing decision which may be considered optimal for the firm. As the European capital structure research strongly confirms the presence of two-way causal capital structure relationships across the samples, such potential effects are likely to be understood by even the most naive firms and thus both relationships in a two-way causal relationship must form inputs into the operational capital structure policy of the smaller firm.

Overall, then, those exogenous factors which impact upon the explicit costs of finance continually influence the smaller firm finance manager's operational capital structure policy. As such factors are exogenous and are relatively easily understood in terms of the appropriate gearing response, corporate DDE ratios are adjusted fairly rapidly to factor changes. Whilst the exogenous factors dominate the operational policy, the finance manager may also monitor the year-to-year profitability and scale of the firm, though may not react to changes in these variables unless it is perceived that they represent more permanent shifts and are not merely transitory. Endo-exogenous interaction effects may exert an influence upon operational capital structure policy, although this influence is likely to be weak due to the difficulties in correctly gauging an appropriate gearing response. Finally, at each juncture of the operational policy process, the manager will roughly gauge the likely impact of gearing adjustments upon the health of the firm as a whole. Thus, the dominating influence of exogenous factors (which determine the explicit costs of finance) and the more implicit recognition of the converse effect of gearing upon the corporate environment together form the salient processes governing the operational capital structure policy of the firm.

In the longer-run, smaller firm finance managers are demonstrated to operate a type of strategic capital structure policy behaviour referred to as intra-ratio targeting, whereby the manager targets the capital structure ratio of the firm upon the norm for the industry to which the firm belongs, upon the capital structure ratio of some larger firm(s), or on the basis of some other targeting criterion. Such behaviour is a form of bounded-optimisation because the finance manager is optimising within the bounds imposed by the constraints of the firm's information systems and is emulating the capital structure ratio of a firm or group of firms which it perceives itself to be similar to, or has aspirations to be similar to. Thus, the firm is benefiting from copying the capital structure ratio of other firms which approximate its degree of business risk or copying the ratio of a larger, more successful firm, for example. The smaller firm finance manager, then, may be approximating the capital structure ratio which is optimal for his or her firm.

Overall, then, the operational capital structure policy of the smaller firm is similar to that for the larger firm. However, smaller firm finance managers may react more significantly to changes in nominal taxation variables than larger firm managers might. The operational policy is driven mainly by those exogenous factors which determine the explicit costs of financial instruments, although it is also determined by an awareness of the influence of gearing upon the health of the firm. The endo-exogenous interaction effect is not as strong in smaller firms as it is likely to be in larger firms, as to understand its full influence demands more sophisticated information systems to be present within the finance function of the firm. The relationship between the operational and strategic policy behaviour of the smaller firm may be explained in an intuitive manner. It is argued that the finance manager of the smaller firm essentially emulates other firms' capital structure ratios in the long-run, based upon one of the criteria discussed above, thus producing the long-term path of the DDE ratio. However, from year to year there may be fluctuations around this path due to the operational policy gearing adjustments, which arise mainly from changes in factors which determine the explicit costs of finance. Thus, the capital structure ratio of the smaller firm is determined in the long-run by emulating behaviour referred to as intra-ratio targeting, although in the short-run there may be fluctuations around this longer-term path due mainly to movements in those exogenous factors which determine the explicit costs of finance.

Larger European firms operate both operational and strategic capital structure policies, though the nature of the strategic policy of the larger firm, in particular, is radically different from that of the smaller firm. The year-to-year, or operational, capital structure policy of the larger firm is identical to that of the smaller firm, discussed above, except for two important differences. Firstly, larger firms appear more likely to react to changes in measures of the effective tax advantage to debt than smaller firms, realising that the effective taxation measures are more important to capital structure policy decisions than nominal taxation measures. As larger firms have in place the sophisticated information systems which enable the firm to gauge the extent of the effective tax advantage to debt, taking into account factors such as tax exhaustion, their reaction to changes in the taxation environment are likely to be more considered and appropriate. Secondly, larger firms are more sophisticated and can thus understand and more accurately take account of endo-exogenous interaction effects. Thus, changes in the taxation environment, for example, do not only exert an influence in aggregate, but also exert an influence upon each individual firm. A change in the aggregate tax advantage to debt leads to differential effects across firms because such firms will be tax-exhausted to different extents, and thus less tax-exhausted firms may make a more significant gearing adjustment than more tax exhausted firms. This is due to the fact that non-debt tax allowances may crowd out to some extent the tax allowances associated with new debt, thus rendering the tax advantage to new debt contingent upon the structure and operations of the firm which give rise to the amount of non-debt allowances, such as the nature of the firm's investment projects. Thus, the operational capital structure policy of the larger firms will still be dominated by those exogenous factors which determine the explicit costs of finance, although the converse effect of gearing upon the corporate environment and endo-exogenous interaction effects will also influence the determination of that policy.

In the longer-run, larger firm finance managers engage in a form of strategic capital structure behaviour referred to as extra-ratio targeting, whereby the manager targets the long-run path of the capital structure ratio in relation to its key long-run taxation, macroeconomic and corporate determinants. As observed for the operational capital structure policy of the European firm, the dominant determinants of the strategic capital structure policy decision are those exogenous factors which impact upon the explicit costs of finance. Additionally, however, corporate environment factors which exert a weak influence upon the operational corporate capital structure policy may exert a more significant influence upon the strategic capital structure policy. An increase in financial safety appears to lead to a reduction in gearing in the long-run, as this "good news" information signalling effect leads to an increase in investor demand for the firm's equity. An increase in profitability over the long-run causes an increase in gearing, probably because finance managers may wait until the improvement in the fortunes of the firm appear to be sustained before significantly increasing the debt risk stance of the firm. Endo-exogenous interaction effects also impinge significantly upon the strategic capital structure policy of the larger firm in a manner similar to that discussed at the operational level. Therefore, in the longer-run, the finance manager not only examines those exogenous factors which determine the explicit costs of finance, but also considers the ability of the firm generally to cover its debt servicing commitments.

Once the strategic capital structure ratio is determined, the finance manager of the larger firm then considers the likely influence of that ratio upon the corporate environment. Such a consideration of the converse direction of causation is essential as a long-run optimal solution placed within a nexus of two-way causal capital structure relationships must logically optimise with respect to each causal direction. In the longer-run, an adjustment to corporate gearing appears to exert a significant influence upon firm liquidity, profitability, growth, and financial safety. An increase in gearing exerts a detrimental effect upon firm growth and financial safety. The former effect may arise from increased gearing displacing marginal investment projects, or may arise due to the increasing restrictiveness of debt covenants constraining activities which might lead to faster growth. The latter effect may arise from increased gearing reducing the financial safety of the firm, due to the increased servicing commitments associated with debt which must be covered by future income streams. An increase in gearing may also exert a beneficial effect upon firm liquidity and profitability, as gearing may facilitate the expansion of the firm's investment project portfolio, leading to an increase in future income streams. Whilst the detrimental and beneficial effects of gearing upon the corporate environment may at first glance appear inconsistent, it is recognised that the capital structure policy of the firm involves the trading-off of all of these influences, in addition to the myriad of influences upon gearing itself, to arrive at an optimal solution. It is intuitive that, whereas the shorter-term impact of debt may be detrimental to the firm as debt mainly confers costs upon the firm in the short-run (a proposition which is supported by the results of the short-term models of chapter 5), the benefits may only be identified in the longer-run (as demonstrated in the bivariate EC models discussed above). Thus, the "knock-on" effects of gearing are an important determinant of the long-run strategy of capital structure policy of the larger European firm.

The multivariate EC models provide a further perspective on the capital structure policy behaviour of larger European firms, although the perspective may also logically apply to smaller firms even though they were not modelled in this manner due to data constraints. There is some evidence that the DDE ratio exerts an influence upon the corporate environment which is potentially of greater significance than the converse direction, although the results which underpin this proposition arise from the analysis of only one of the samples in the European data set. Clearly, the firm is not driven by the sole objective of optimising the long-run external financing decision, and it is likely that senior managers from other functions of the firm maintain objectives which are of greater importance to the continued success of the firm. Whilst the ultimate owners of the firm, its shareholders, are constantly concerned that the finance manager maximises the value of the firm by minimising the weighted average costs of the capital it employs, a more prominent shareholder concern would be the overall profitability of the firm. Thus, the firm's target profitability ratio may represent a more prominent firm target than its capital structure ratio target, even though the two are intrinsically bound together and related. Another prominent target of the firm is that of risk minimisation, whether business risk, financial risk, or other forms of risk, as all firms seek to maximise returns whilst minimising the risks associated with those returns. However, rather than proposing a likely hierarchy of targets / objectives for the European firm in this research to enable the placing of the capital structure ratio target within that hierarchy, it is merely noted that the capital structure ratio is only one of a range of targets, though is likely to remain an extremely important concern to the overall corporate strategy of the firm.

Overall, then, the operational capital structure policy of the larger firm is very similar to that of the smaller firm, except for the fact that taxation measures and endo-exogenous interaction effects will exert a greater influence. The key distinction between smaller and larger firm capital structure policy behaviour is at the strategic level, as larger firms engage in a form of full-optimisation involving the targeting of the long-run path of the capital structure ratio in relation to its key extra-ratio determinants, whereas smaller firms engage merely in a form of bounded-optimisation. However, in addition to extra-ratio targeting behaviour, there are also long-run endo-exogenous interaction effects, whereby aggregate changes in taxation and macroeconomic environment factors produce individual firm-level effects. Once the strategic capital structure ratio is determined in relation to its key long-run determinants, the finance manager then considers the likely influence of the ratio upon the corporate environment, before arriving at a final capital structure solution which is optimal in the long-run. Therefore, the finance manager of the larger firm determines the optimal long-run capital structure solution which dictates the long-run desired path of the capital structure ratio, around which there will be short-run fluctuations due to operational policy gearing adjustments, which arise mainly from changes in factors which determine the explicit costs of finance.

The synthesis of results described above gives rise to a theoretical model of the operational and strategic capital structure policy behaviour of the European quoted firm which is supported by empirical evidence arising from the application of a wide range of econometric and statistical techniques. The overall corporate capital structure model highlights the importance of a behavioural dichotomy based upon the scale of the firm. However, the most important development of this research is that the complete corporate capital structure model may be employed to address the central hypothesis of European research, which states that there exist firm-level optimal capital structures. However, there are four criteria to be met before the existence of firm-level optimal solutions may be supported with any degree of confidence.

Firstly, for there to exist firm-level optimal capital structure solutions, firm behaviour must evidence <u>at least</u> weak-form optimising behaviour. A weak-form optimal capital structure solution may be argued to occur where the firm finance manager takes into account a wide range of factors before setting the level of the capital structure. In the European research, weak-form optimising behaviour is consistent with the operational capital structure behaviour evidenced by larger and smaller firms alike. Although the key influences upon operational capital structure policy are those factors which determine the explicit costs of finance, in addition a more extensive group of variables is demonstrated to exert a weaker influence. Indeed, the multivariate logistic regression marginal models identified that firms' gearing decisions are influenced by a very wide range of mainly corporate environment variables, even though their influence is weak. Other influences upon the operational capital structure policy include endo-exogenous interaction effects, which describe the combined effect of related factors upon corporate gearing. Additionally, the finance manager is demonstrated to examine the influence of gearing upon the corporate environment in the cross-sectional models of chapter 5, which confirms that finance managers must take into account the two-way causal nature of the corporate gearing decision in relation to the corporate environment. Therefore, it is demonstrated that the operational capital structure policy decision made by the firm is influenced by: the explicit costs of finance, arising from the taxation and macroeconomic environments; a weaker influence from endogenous corporate environment variables, particularly those describing the firm's ability to support debt; complex endo-exogenous interaction effects; and the two-way causal nature of the gearing decision in relation to the corporate environment. As there is evidence of significant gearing adjustments to this diverse and complex range of influences; evidence that the finance manager takes into account the influence of gearing upon the corporate environment; and evidence that such behaviour holds for both larger and smaller firms though to slightly different extents in some cases, the existence of weak-form optimisation behaviour is firmly supported.

Although evidence of weak-form optimisation enables the first criterion to be met, a more robust support for the first optimality criterion would be provided if there were also evidence of strong-form optimising behaviour. A strong-form optimal capital structure solution may be argued to occur where the individual firm finance manager determines the desired long-run path of the DDE ratio in relation to key long-run determinants of that ratio. Smaller firms engage predominantly in intra-ratio targeting in the long-run. Although evidence of intra-ratio targeting behaviour is provided by the presence of cointegrating processes, thus evidencing long-run disequilibrium-correction behaviour in relation to the firm's target ratio, this form of behaviour is still relatively naive as it is a form of bounded-optimisation behaviour. The underlying bounded nature of the optimisation and the fact that the manager does not make full use of information describing the key long-run determinants of the capital structure ratio must mean that intra-ratio targeting may not be described as strong-form optimisation. However, it is a stronger-form of optimising behaviour than the operational capital structure setting behaviour observed for the short-run as it evidences error-correction behaviour and therefore must be described as a form of strategic behaviour which is classified somewhere between weak-form and strong-form optimisation. Larger firms engage in extra-ratio targeting in the long-run, whereby the finance manager does indeed target the long-run path of the capital structure ratio in relation to its key determinants. As such targeting is evidenced by the error-correction behaviour of the finance manager and the target ratio is based upon key taxation, macroeconomic and corporate environment determinants, then this fulfils the requirements for strong-form optimisation. Furthermore, as the finance manager also examines the likely converse influence of the DDE ratio upon the corporate environment before arriving at a final long-run solution which is considered optimal, this surely augments the strong-form optimising nature of the strategic capital structure behaviour of larger firms.

Therefore, there is strong evidence to support the first criterion towards the existence of firm-level optimal capital structure solutions, as there is evidence, at the very least, of weak-form optimising behaviour across all firms. Additionally, smaller firms engage in behaviour approaching strong-form optimisation in the long-run whilst larger firms do indeed engage in full-optimisation or strong-form optimising behaviour in the long-run.

Secondly, for there to exist firm-level optimal capital structure solutions, it must be demonstrated that optimising behaviour is capable of occurring for the individual firm, and not merely for the market as a whole. As operational capital structure policy is determined to a weak extent by corporate environment factors, to a somewhat stronger extent by endo-exogenous interaction effects, and is also determined by taking into consideration the potential converse influence of the DDE ratio upon the corporate environment, firm-level solutions should arise from such a policy. The reason for this is that the corporate environment is interrelated with the capital structure decision by means of both direct and indirect relationships, forcing the solution of the individual firm to reflect the influence not only of aggregate, exogenous factors but also the influence of the corporate environment of the firm. The longer-run or strategic capital structure policy is somewhat more complex to consider in terms of the second criterion. The strategic policy of the larger firm is determined in relation to key corporate environment factors, endo-exogenous interaction effects, and the two-way causal nature of the DDE ratio with respect to corporate environment factors, all of which are capable of producing a firm-level optimal solution. However, the strategic behaviour of the smaller firm may, by definition, produce a capital structure solution which is identical to that of the firm(s) which it seeks to emulate by means of intra-ratio targeting, and thus a solution may result which is common to a number of firms of like nature (such as those firms within the same industry). This does not mean that, overall, smaller firm capital structure solutions are not firm-specific, however, because it is demonstrated that the operational capital structure policy is likely to produce fluctuations around the long-run capital structure path, thus rendering each firm's solution unique. Furthermore, the interaction of the operational and strategic capital structure policies of larger firms merely serves to strengthen the firm-level nature of their capital structure solutions, as either policy is capable of producing a firm-specific solution. There is strong evidence to support the firm-level nature of optimal capital structure solutions, then, as both larger and smaller firm capital structure policies are capable of producing firm-level solutions, therefore lending support to the second optimality criterion.

Thirdly, for there to exist firm-level optimal capital structure solutions, any variation in the extent of capital structure optimisation across firms must be explained in terms of the tangible characteristics of those firms. The characteristic of the firm which determines the extent to which the firm may engage in full optimisation, and which is capable of explaining the behavioural dichotomy that exists between smaller and larger firms, is the complexity of the information gathering, monitoring, analysis, and utilisation systems present within the finance function of the firm. Whilst the research has not tested directly whether significant differences occur in the complexity of information systems between smaller and larger firms, it is argued that all of the processes by which the finance manager is seen to determine the corporate capital structure ratio may be explained in terms of information system differentials. The information systems proposition relies merely upon the logical statement that larger firms have in place more complex information systems, facilitated by large, expert teams, whereas smaller firms' information systems are much less sophisticated. Clearly, it would be difficult to dispute such a statement even though it is not explicitly tested in this research. Therefore, the analysis of capital structure behaviour across European firms strongly supports the probability of a behavioural dichotomy based upon differentials in information system complexity. The complexity of information systems, then, is clearly capable of explaining the observed variation in the extent of optimisation across European firms, thus supporting the third criterion towards firm-level optimal capital structure solutions.

Fourthly, for there to exist firm-level optimal capital structure solutions, all of the environments within which the firm is placed must be demonstrated to contribute towards any optimal solution found to exist, otherwise the solution is optimal only with respect to an artificial subset of the real-world environment. Taxation and macroeconomic environment factors are demonstrated to contribute most significantly towards an optimal solution, both at the operational and strategic policy level, as they determine the explicit costs of external finance. Hypotheses H2 and H3, which state that taxation and macroeconomic factors, respectively, significantly influence the corporate capital structure, are therefore firmly supported. As discussed above, however, the corporate environment exerts an influence which is generally weaker and more indirect, resulting from two-way causal interrelationships with the capital structure ratio and endo-exogenous interaction effects. Thus, although corporate environment factors exert a weaker and perhaps more complex influence than the more exogenous factors examined, the impact of corporate environment factors is still a significant influence upon the corporate capital structure, supporting hypothesis H4. Hypotheses H2 to H4, which are termed the supporting hypotheses in chapter 4, must be addressed before finally addressing the central hypothesis, H1. As there is strong support for each of these supporting hypotheses, which further derives from the empirical testing of numerous subsidiary hypotheses, the resulting optimising capital structure behaviour of the firm does indeed appear to be conducted with reference to the taxation, macroeconomic and corporate environments within which the firm is placed, and thus resulting solutions are optimal in relation to the whole environment. Therefore, hypothesis H1 is supported, and resulting optimal solutions arise from a theoretically-underpinned empirical analysis which is as comprehensive as data limitations allow, thus supporting the fourth criterion.

In summary, the central hypothesis, H1, is strongly supported, and thus there exist firm-level optimal capital structures within European quoted firms. Capital structure solutions are, in the least, weak-form-optimal, although are demonstrated to be strong-form-optimal for larger firms in the long-run. The varied and complex influence of the corporate environment ensures that solutions are firm-specific, and are not merely optimal at the aggregate-level. Variations in the extent of optimising behaviour, exhibited in particular between smaller and larger firms, may be explained by differences in the complexity of information systems across firms. Finally, all of the environments within which the firm is placed (the taxation, macroeconomic and corporate environments) significantly contribute towards the determination of the ultimate capital structure solutions of individual European quoted firms.

CHAPTER 9

CONCLUSION

9.1 Conclusion

The main objective of this research was to test the central hypothesis that there exist firm-level optimal capital structure solutions for European firms. In a general sense, the question of optimality is addressed with reference to the taxation, macroeconomic and corporate environments within which the firm is placed. More specifically, the extent of optimality of observed corporate capital structure solutions is determined by examination of the processes governing the interaction between the corporate capital structure and those environments, which in turn describe the operational and strategic capital structure policies of European firms. An additional objective was to identify and explain the nature of the most important determinants of the capital structure solution. A further objective was to determine whether the hypotheses arising from the mainstream corporate finance literature, which exhibits a strong Anglo-American bias, may be supported for firms from a far wider and more diverse range of countries across Europe.

The existing theoretical and empirical literature reveal that taxation exerts a significant influence upon the corporate capital structure due to the distinct tax advantage associated with corporate debt, the presence of which, Modigliani and Miller (1963) argued, leads to firm-level optimal capital structure solutions. However, as there is little empirical evidence in the literature that various tax advantage to debt measures exhibit a relationship with observed gearing, it was argued that influences such as the type of tax system, the structure of tax rates, corporate tax exhaustion, and other factors, reduce the tax advantage from that proposed by Modigliani and Miller. Furthermore, even if there remains a significant tax advantage to debt, it may not exhibit a clear relationship with corporate gearing because macroeconomic and corporate environment factors may counterbalance the tax advantage in the real world. Of the other environments within which the firm is placed, the literature suggests that the macroeconomic environment exerts a more significant influence than the corporate environment because the macroeconomy essentially defines the parameters within which all operations of the individual firm occur. The significant macroeconomic determinants of corporate gearing identified in the literature are those factors which essentially describe the direct costs of external financial instruments, such as inflation, and stock and bond market performance variables. The corporate environment factors which exhibit a strong theoretical and empirical relationship with corporate gearing are: bankruptcy and earnings risk; the agency costs and benefits of debt and equity instruments; financial instrument transactions costs; firm size and growth; firm profitability and asset tangibility; investment, production, and marketing factors; and the gearing norm for the industry to which the firm belongs. It was postulated that the finance manager monitors changes in the taxation, macroeconomic, and corporate environments within which the firm is placed and makes adjustments to the firm's capital structure based upon a priority order of influences. The priority influences are those which exert a direct impact upon the costs of external financial instruments, whereas the influences of less priority to the finance manager are those which exert an impact which is less readily ascertainable and direct. As the corporate finance manager's priority order of capital structure influences may vary across firms with differing objective functions, as many of the capital structure influences identified in the literature are firm-specific in nature, and as the literature generally supports the proposition of the presence of a distinct tax advantage to debt at the firm-level, then the literature supports the existence of firm-level optimal capital structure solutions.

The central objective of the European research, which was to test the central hypothesis that there exist firm-level optimal capital structure solutions for European firms, forms hypothesis H1. Hypotheses H2 to H4 form the supporting hypotheses, to determine whether the taxation, macroeconomic, and corporate environments significantly influence the corporate capital structure solution of the firm. Numerous subsidiary hypotheses were developed, arising from the existing literature and new developments in the theoretical and empirical research, to enable testing of the supporting hypotheses, and ultimately the central hypothesis.

Analyses of a purely descriptive or statistical nature identified patterns and relationships within the European data sets which, when considered together, produce a perspective on the environment of the corporate capital structure decision as a precursor to formal modelling. Such analyses are conducted at the cross-section and on an inter-temporal basis. Analysis of variance tests revealed that the country, tax system, and industry within which the firm is placed exert a significant impact upon the corporate capital structure ratio, thus supporting the later modelling of firms on a country-specific basis to account for differences between respective macroeconomies and tax system characteristics. Two results at the cross-section have implications for the optimality hypothesis: the Miller (1977) capital structure irrelevance model is questioned by means of a distributional analysis of capital structure ratios for each country; and tax exhaustion is a very significant phenomenon across Europe, as at least 30 per cent of firms are completely tax-exhausted and many others are partially tax-exhausted. Whilst the distributional analysis does not prove the existence of firm-level optimal capital structure solutions, it does question the existence of aggregate optimal solutions. The tax exhaustion phenomenon does, however, have implications for optimality in that the degree of tax exhaustion observed results directly from the level of non-debt tax shields which will vary across firms, producing different effective tax advantage to debt values for each firm and thus firm-level optimal capital structure solutions. Therefore, the cross-sectional descriptive results suggest that country-specific capital structure modelling is the logical basis for development of the European research, and that, even at an early stage in the European research, firm-level optimal capital structure solutions appeared probable.

Inter-temporal descriptive analyses revealed important trends within external finance markets and sought to explain these trends in relation to macroeconomic and taxation events and movements. Debt-financing appears to be experiencing a long-term decline in relation to equity-financing across Europe, caused by the switch from classical towards imputation tax systems, convergence of capital structure ratios due to tax competition within Europe, a dramatic reduction in corporate tax rates, and political efforts to encourage a greater use of equity-financing and wider share ownership amongst investors. Although there was clearly a significant tax advantage to debt over most of the research study period, in the last few years reductions in corporate tax rates have reduced that advantage towards zero in some countries. However, in the last few years, debt financing has experienced a resurgence in demand due to various macroeconomic shocks such as the stock market crash of 1987 and German re-unification in 1989. The corporate DDE ratio exhibits prima-facie evidence of a positive relationship with the corporate tax rate, the tax advantage to debt measure, stock market buoyancy, long-term interest rates, and aggregate investment, although there appears only weak evidence of a positive relationship with inflation and no evidence of a direct relationship with GDP. Therefore, both taxation and macroeconomic environment factors are seen to exhibit significant influences upon corporate gearing in Europe. However, as such prima facie evidence based upon data plots was unlikely to adequately capture the dynamic processes present within bivariate capital structure relationships or the underlying long-run equilibrium relationships which may be present once the short-run fluctuations are removed, it was ascertained that more formal econometric analysis was required. Therefore, the inter-temporal descriptive results identified the need for more formal econometric modelling of the interaction between the corporate capital structure decision and the taxation and macroeconomic environments, as well as revealing that, in more recent years, debt and equity have become less distinguished by their inherent tax effects, implying that macroeconomic and corporate environment factors are likely to become more significant determinants of European corporate gearing with the next decade.

Econometric modelling was undertaken to establish more precisely the nature of relationships between the corporate capital structure ratio and factors related to it. Hypotheses arising from the existing literature may be tested by examining the significance of individual estimated relationships between the corporate DDE ratio and quantifiable factors from the taxation, macroeconomic and corporate environments within which the firm is placed. The main benefit of econometric modelling as opposed to less formal statistical analyses is that relationships which are not readily observable, such as error correction processes, may be determined and quantified, in addition to modelling the more readily observable relationships. A wide range of econometric modelling techniques are employed to analyse the European data sets. To study the processes governing the short-term, or operational, capital structure policy of the European firm: bivariate cross-sectional regressions identify relationships across firms from a static perspective; multivariate logistic regressions identify the influences of the capital structure decision at the margin; and autoregressive distributed lag models identify bivariate dynamic relationships. As all of these methods examine capital structure policy in the short-term, they essentially constitute disequilibrium models. To study the processes governing the longer-term, or strategic, capital structure policy of the European firm: bivariate error correction models identify dynamic and equilibrium relationships; the Johansen procedure analysis identifies multivariate error correction relationships; and intra-ratio targeting cointegration analysis determines whether firms engage in a form of bounded capital structure optimisation. As these latter methods examine capital structure policy in the long-run, identifying separate long-run error correction processes and dynamic processes, they constitute equilibrium models. Whilst the main objective of the econometric modelling is to identify significant determinants of corporate capital structure policy and the precise nature of their influence, the bivariate regression and error correction models additionally enable the converse direction of causation to be examined. Therefore, the econometric techniques, considered together, yield models of the processes governing capital structure determination over average, marginal, short-run, and long-run time-frames, as well as identifying which relationships form disequilibrium models (operational policy models) and which form equilibrium models (strategic policy models). Rather than distinguish separate results arising from each of the modelling techniques, the overall European corporate capital structure model is briefly described below.

The European corporate capital structure model is essentially a synthesis of hypothesis test results, the results of the descriptive analyses, and the policy processes identified in the econometric modelling techniques. The model describes a capital structure policy behaviour dichotomy between larger and smaller European firms due to differences in the sophistication of information systems within their respective finance functions. The overall model is perhaps best described by examining the operational and strategic capital structure policies of smaller firms and larger firms in turn.

Smaller European firms engage in capital structure setting behaviour which supports the operation of distinct operational and strategic capital structure policies. In the long-run, the manager targets the capital structure ratio of the firm upon the norm for the industry to which the firm belongs, upon the capital structure ratio of some larger firm(s), or on the basis of some other targeting criterion in a manner referred to as intra-ratio targeting. This targeting behaviour represents a form of bounded-optimisation as the finance manager is approximating the firm's optimal capital structure ratio by copying the ratio of firms which it is similar to, or aspires to be similar to, within the boundaries imposed by the information constraints of the firm. Such constraints are caused by the limitations of the smaller firm's information collection, analysis and actioning systems, which are far less developed, resourced, and sophisticated than the information systems present within the finance function of the larger firm. There are departures from the long-run path produced by this intra-ratio targeting behaviour due to operational policy gearing adjustments. The operational or short-run capital structure policy of the firm gives rise to adjustments in the capital structure ratio due mainly to the dominating influence of those exogenous factors which determine the explicit costs of finance and to the more implicit recognition of the converse effect of gearing upon the corporate environment. Weaker influences upon the operational capital structure policy result from a reaction to significant changes in the scale of the firm, or from endo-exogenous interaction effects such as the influence of non-debt tax shields upon the value of any tax advantage to debt.

Therefore, the capital structure ratio of the smaller European firm is determined in the long-run by emulating behaviour referred to as intra-ratio targeting, although in the short-run there may be fluctuations around this longer-term path due to the determinants of operational policy and, in particular, movements in those exogenous factors which determine the explicit costs of finance.

Larger European firms operate operational and strategic capital structure policies, although the nature of the strategic policy of such firms, in particular, is radically different from that of smaller firms. At the strategic policy level, larger firms engage in a form of full-optimisation behaviour such that the finance manager targets the long-run path of the capital structure ratio in relation to its key extra-ratio determinants. The dominant determinants are those exogenous factors which impact upon the explicit costs of finance, although corporate environment factors such as financial risk and profitability also exert some influence. Additionally, endo-exogenous interaction effects impact upon the long-run optimal capital structure ratio, whereby changes in taxation and macroeconomic environment variables produce individual firm-level effects. One further influence upon the strategic capital structure policy of the firm is the finance manager's consideration of the likely influence of the capital structure ratio upon the corporate environment, particularly the liquidity, profitability, growth, and financial safety of the firm. Therefore, the strategic capital structure policy of the larger firm, which determines the optimal long-run path of the capital structure ratio, is far more complex than the bounded-optimisation policy of the smaller firm. Fluctuations around the long-run desired path of the capital structure ratio arise due to operational policy gearing adjustments. Such adjustments are identical to those undertaken by smaller firms, except: effective taxation measures should exert a greater influence, as such measures are more clearly more important to the capital structure decisions of larger, more sophisticated firms than nominal taxation measures; and endo-exogenous interaction effects will be stronger as larger firms understand and make adjustment for such complex effects in a more optimal manner than smaller firms. Therefore, the finance manager of the larger firm determines the optimal long-run capital structure solution which dictates the long-run desired path of the capital structure ratio, around which there will be short-run fluctuations due to operational policy gearing adjustments.

The most significant determinants of the capital structure policy of the European firm are found to be those factors which impact directly upon the <u>explicit costs of finance</u>. Financial market performance factors determine the before-tax cost of debt and equity finance, as well as affecting the timing of issues. As finance markets are demonstrated to be demand-driven in nature, the finance manager may only significantly increase debt or equity financing if interest rates are relatively high or equity markets are buoyant, respectively. Taxation and inflation factors then determine the after-tax relative costs of financial instruments. An increase in the tax advantage to debt (or corporate tax rate) reduces the weighted average cost of capital to the firm, rendering debt a more attractive financial instrument than before. An increase in the rate of inflation impacts upon the after-tax cost of debt because it causes an increase in interest rates, thus directly increasing the tax advantage to debt, whilst at the some time reducing the value of non-debt tax allowances, enabling greater debt tax allowances to be utilised. Thus, increases in the tax advantage to debt and the rate of inflation both encourage greater use of corporate debt. It is an unsurprising result that, even though capital structure research in the last few decades has become characterised by models of ever-increasing complexity, often concentrating upon examination of the more indirect and less tangible determinants of corporate gearing, the European research suggests that the key determinants of gearing still remain those factors which impact upon the more explicit, tangible after-tax weighted average costs of capital. This result is consistent with the mainstream capital structure literature reviewed in this research, especially the Modigliani and Miller (1963) model, which also identified the explicit after-tax costs of finance as key determinants of corporate gearing.

The corporate capital structure ratio itself exerts an important influence upon the corporate environment of the firm in a manner which extends far beyond its impact upon the financial risk of the firm, discussed by authors such as DeAngelo and Masulis (1980). It is clear that the influence of corporate gearing upon the corporate environment forms a key element in the capital structure optimisation process because the final capital structure solution is placed within a nexus of two-way causal capital structure relationships and thus must optimise with respect to each causal direction. The corporate capital structure policy is only one of the key policies implemented by the firm, and moreover, the DDE ratio is only one of a group of corporate environment targets which the finance manager is likely to set, monitor, and strive to achieve. It is intuitive that the capital structure target ratio may be of subordinate importance when considered in relation to targets for the profitability and overall risk of the firm, as the latter targets are of greater importance to the continued success of the European firm.

The central hypothesis, H1, was developed by examining four criteria essential to the existence of firm-level optimal capital structure solutions. The first criterion, which states that there should be evidence of at least weak-form optimising behaviour, is strongly supported. Operational capital structure policy processes, which constitute weak-form optimising behaviour, are determined for all firms in the European research. Furthermore, smaller firms are seen to engage in intra-ratio targeting behaviour in the long-run, which is a form of bounded-optimisation approaching strong-form optimisation, whilst larger firms engage in full-optimisation or strong-form optimisation in the long-run, as evidenced by their extra-ratio targeting and other long-run behaviour of an optimising nature. The second criterion, which states that optimising behaviour must be capable of occurring for the individual firm, and not merely for the market as a whole, is also supported, as firm-level optimal capital structure solutions arise due to the influence of endo-exogenous interaction effects and the two-way causal nature of the DDE ratio with respect to corporate environment factors. Such influences produce solutions which are firm-specific in nature as a result essentially of the uniqueness of each individual firm's corporate structure. The third criterion, which states that any variation in the extent of capital structure optimisation across firms must be explained in terms of the tangible characteristics of those firms, is supported. The characteristic of the firm which determines the extent to which the firm may engage in full optimisation, and which is capable of explaining the behavioural dichotomy that exists between smaller and larger firms, is the complexity of information gathering, monitoring, analysis and utilisation systems present within the finance function of the firm. The fourth criterion, which states that all of the environments within which the firm is placed must be demonstrated to contribute towards any optimal solution found to exist, is supported. The explicit costs of finance, discussed above, which consist of taxation and macroeconomic environment factors, are seen to be the most significant determinants of both the operational and strategic capital structure policies of European firms. Additionally, although the influence of the corporate environment is often weaker and less direct, its impact is still pivotal to any capital structure solution due to its two-way causal interrelationship with the capital structure ratio and endo-exogenous interaction effects. As taxation, macroeconomic and corporate environment factors are all significant determinants of corporate gearing, the respective supporting hypotheses, H2 to H4, are given strong support, in turn supporting the fourth optimality criterion. Overall, then, the theoretical and empirical analyses of the European research provide very strong support for hypothesis H1, and thus there exist firm-level optimal capital structures within European firms.

Before summarising the main contributions of the European research to the corporate capital structure research area, it is essential to briefly identify and discuss its limitations. The limitations of the European research are associated predominantly with data availability constraints, as discussed throughout the empirics of this report. Firstly, the coverage of the European data varies in its scope and quality across the data sets analysed. However, it is argued that as the existing theoretical and empirical capital structure literature exhibits a narrow Anglo-American bias, any research undertaken for firms from a much wider range of countries must be considered a significant development, even if the results of such research require careful qualification. Secondly, smaller cross-sectional or shorter inter-temporal data sets may give rise to econometric models which are insignificant merely as a result of the quality of the data sets analysed. The empirical research, however, takes this shortcoming into account by examining the coefficients and structures of models which are both significant and insignificant at the interpretation stage, although whilst still giving greater weight to the significant models. Thirdly, the time series data set is characterised by time-span paucity limitations, although it is argued that the resulting models remain robust as each time series observation for each variable is computed by aggregating data from a very large cross-sectional sample. Finally, it is recognised that only a subset of the initial European countries chosen are analysed in the time-series models constructed and estimated, which may be argued to reduce the extent to which the time series results may be generalised. However, the countries studied in the time series analyses are the only countries for which sufficient time-span data sets were available, and furthermore, the subset of countries analysed contain the majority of quoted firms within Europe. Overall, then, although there are a number of limitations identified in the European research which are the direct result of data availability constraints, empirical results are carefully qualified throughout the research such that the limitations do not significantly weaken them. Moreover, as individual hypotheses are tested by means of a number of different statistical and econometric techniques, as such techniques produce results of remarkable consistency, and as the resulting overall synthesis model is both coherent and logical, the empirical research is arguably robust.

The main contributions of the European research to the corporate capital structure area may be summarised into five areas. Firstly, the complete European corporate capital structure model represents a coherent synthesis of interaction between the capital structure decision of the firm and each of the environments within which the firm is positioned. Whilst many authors within the mainstream finance literature, particularly in recent years, have sought to concentrate upon the influence of very specific individual capital structure determinants, the European research brings together the influence of taxation, macroeconomic and corporate factors into a comprehensive model of corporate capital structure determination. Although the model component parts are underpinned by mainstream finance theory, the contribution of the European research is to test individual capital structure determination hypotheses which arise, model the processes by which such determinants influence gearing, and then bring together individual processes to examine the capital structure policy decisions of the firm.

Secondly, the model contributes a European perspective to the ongoing capital structure relevancy debate. Clearly, the model supports the proposition of firm-level optimal capital structure solutions, and thus supports the conclusion that the individual firm's capital structure decision is indeed relevant. The European research therefore supports the propositions of Modigliani and Miller (1963) and questions the relevance of the Miller (1977) model to European capital structure determination. However, rather than being positioned firmly at the MM (1963) end of the bi-polar capital structure debate, the European model suggests that although there may be a distinct tax advantage to debt, it may be much smaller than that proposed by Modigliani and Miller due to the effect of European tax systems and structures of tax rates, widespread and significant corporate tax exhaustion, and other factors which may counterbalance the tax advantage to debt. In this respect, the model may be positioned in the same school of thought as authors such as DeAngelo and Masulis (1980), who examine the effect of factors which may counterbalance any tax advantage to debt.

Thirdly, there are four important new results which arise from the European research. The first of these is that the model extends the Anglo-American biased capital structure research area to a European perspective, thus legitimising many broad generalisations drawn from US or UK experience which have been applied to Europe whilst questioning other generalisations. The second result is that the research extends the examination of capital structure determination to encompass average, marginal, dynamic, and long-run time-frames, and identifies by means of modern econometric techniques which processes describe equilibrium relationships and which describe disequilibrium relationships. In so doing, capital structure determination becomes the sum consequence of distinct operational and strategic policies undertaken by the finance manager rather than merely assuming that such determination results merely from a year-to-year, or operational, policy alone. The third result is that the research identifies a clear capital structure behavioural dichotomy, determined on the basis of a number of different analytical techniques, which is based upon the scale of the firm. The scale effect is logically explained by differentials in the sophistication of finance function information systems between larger and smaller firms. The fourth result is that the corporate capital structure ratio target of the firm is merely one of a series of targets present within the corporate strategy of the firm, a result which is demonstrably supported by the Johansen procedure multivariate error correction modelling analysis. Whilst this result is perhaps not surprising or ground-breaking, the manner in which it was identified in the empirics appears to be.

Fourthly, the European research methodology represents the application of modern econometric techniques which have not previously been applied to the area of capital structure determination, at least not in the structured manner presented in this report. The application of cointegration analysis, in particular, enables the identification of equilibrium and disequilibrium relationships, a development which impacts significantly upon the modern capital structure debate.

Finally, the European research reveals that the tax advantage to corporate debt has been significantly eroded in many European countries in the last few decades due mainly to the movement towards imputation tax systems and the dramatic reduction in corporate tax rates. Logically, macroeconomic and corporate environment factors are likely to become more important determinants of corporate gearing as the influence of taxation diminishes. Additionally, with the increasing sophistication of financial markets, the more indirect determinants of corporate gearing such as agency costs and information signalling effects are also likely to become relatively more important. However, as weak and strong-form optimisation both involve complex trade-offs of influences from the entire set of environments within which the individual firm if placed, capital structure determination is likely to remain the result of corporate optimisation behaviour, even if the influence of taxation effects is greatly diminished or even eliminated.

In summary, then, European firm finance managers engage in operational and strategic policy behaviour which produces firm-specific optimal capital structure solutions.

9.2 Recommendations for further research

Although the research undertaken is a comprehensive study of European corporate capital structure determination, a number of areas may be identified for further research, to build upon the results and theoretical framework described in this report. The potential areas for further research consist of new techniques that may be employed to extend the European corporate capital structure research or existing techniques which may be applied to new data sets.

A useful extension of the European corporate capital structure research might be undertaken by means of survey-based or case-study-based analyses. A survey-based analysis might be performed to ascertain how the theoretical model developed in the research of this report compares with the actual corporate capital structure policies of European firms. However, it is noted that most finance managers would argue that they have complex capital structure strategies in place, even if this were not the case, because to admit otherwise would project a poor image of their firms and their own activity in particular. As a result of this, such a survey would thus have to be extremely carefully worded and interpreted. An important issue to be explored in such a survey might be to determine whether there are indeed significant differences in the sophistication of information systems of smaller and larger firms, as this concept is pivotal to the European research model.

Another potential extension of the research would be to conduct case studies of capital structure policy behaviour for a small sample of quoted firms in each European country. Finance managers could then be questioned directly about their capital structure policies, and the key determinants and processes which influence those policies. Again, finance managers might be unwilling to disclose details of their true capital structure policies as they may not wish to be perceived naive in their approaches, or they may be unwilling to disclose key financial information as such information is necessarily of a very sensitive nature. Therefore, although other techniques may be employed to extend the European corporate capital structure research, even preliminary consideration of the feasibility of such extensions highlights potential difficulties which are related mainly to the willingness of finance managers to divulge sensitive financial policy information.

Another technique which might be applied to European capital structure data is a the simultaneous equation modelling approach, to investigate further the corporate environment within which the capital structure is determined. Such an approach may enable complex causal relationships, which include the processes which determine the capital structure ratio, to be examined from a number of different perspectives, allowing a more detailed consideration of the relationship between the highly inter-related accounting ratios which define the corporate environment.

The European corporate capital structure research has demonstrated the application of numerous econometric techniques, ranging from long-established conventional methods through to very modern techniques which are still in their infancy. These techniques have enabled average, marginal, dynamic and long-run perspectives to be established with respect to European corporate capital structure behaviour, and have additionally enabled consideration of the large/small firm policy dichotomy. It is thus argued that the econometric techniques employed constitute a framework for analysis which may be applied to the study of corporate capital structure policies in any country. Two potential extensions may be identified here. Firstly, the framework might be employed to study the capital structure behaviour of firms in the non-European major industrialised countries of the world. Secondly, the framework might be employed to study capital structure behaviour in the newly-emerging finance markets of the world. It would indeed be a worthwhile exercise to determine whether the capital structure behaviour identified within European quoted firms also holds for firms in non-European countries, whether industrialised or newly-industrialising.

Therefore, the corporate capital structure research may be extended by undertaking survey or case study approaches, to enable the capital structure practices of the theoretical model of this research to be compared with the perceptions of finance managers as to capital structure practices in the real world. Simultaneous equation modelling might additionally be applied to European corporate capital structure data sets to enable a greater understanding of the complex corporate environment inter-relationships within which the corporate capital structure decision is positioned.

If, alternatively, the research is extended by employing a similar econometric framework to study the corporate capital structure behaviour of other industrialised and newly-industrialising countries, then it may be determined whether the theoretical capital structure behaviour proposed is a world-wide or merely a European-wide phenomenon.

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APPENDICES

APPENDIX A:
DEFINITION OF THE VARIABLES USED IN THE MARGINAL CAPITAL STRUCTURE ANALYSIS

The variables to be used in the analyses of chapters 4 and 5 are defined below. All of the variables are ratios, constructed either within the Datastream financial database or within the SPSS statistical package. Where possible, further definitions are given of those component accounts items which form a particular ratio, although limitations of space mean that an exhaustive definition of each component item is not possible. Each variable is defined both in words, and as an expression, where appropriate. The variable label is that which is actually employed in the computer analysis, and is thus a shortened version of the variable name. The Datastream codes for the separate accounts items which make up the variables are given to aid any follow-on work deriving from this research.

The debt-to-debt-plus-equity-ratio

This variable will be described only briefly as it has been discussed in some detail in chapter 3. This ratio is the main measure of the stock of funds raised by the firm to date, in order to finance its investments. The ratio is thus defined as:

$$\text{debt-to-debt-plus-equity-ratio} = \frac{\text{total loan capital}}{\text{total loan capital + the market issue value of equity}}$$

Where:

debt-to-debt-plus-equity ratio variable label = DDERATIO
total loan capital Datastream code = 321
market issue value of equity code = MV

The depreciation ratio

The depreciation ratio is defined as provisions for amounts written off, and depreciation of fixed assets and assets leased-in as a proportion of total net fixed assets. The latter variable is comprised of the net total of land and buildings, plant and machinery, construction in progress and any other fixed assets. The ratio is thus defined as:

$$\text{depreciation ratio} = \frac{\text{depreciation}}{\text{total net fixed assets}}$$

Where:

depreciation ratio variable label = DEPRATIO
depreciation Datastream code = 136
total net fixed assets Datastream code = 339

Dividend cover

The dividend cover ratio is defined as adjusted net earnings per share divided by dividends per share. The net earnings per share measure is the adjusted earned-for-ordinary profit divided by the year end number of shares. The dividends per share measure relates to the net dividend per share, adjusted for subsequent scrip and rights issues. The ratio is thus defined as:

$$\text{dividend cover} = \frac{\text{adjusted net earnings per share}}{\text{dividends per share}}$$

Where:

dividend cover variable label = DIVCOVER
adjusted net earnings per share Datastream code = 211
dividends per share Datastream code = 190

The depreciation-adjusted tax ratio

The depreciation-adjusted tax ratio is defined as the amount of corporation tax charged on the profit for the current period divided by adjusted pre-tax profit (including associates) plus depreciation. The pre-tax profit, (including associates) measure is adjusted for exceptional/extraordinary items, non-operating provisions and exchange profits/losses. The ratio is thus defined as:

$$\text{depreciation-adjusted tax ratio} = \frac{\text{corporation tax}}{\text{adjusted pre-tax profit + depreciation}}$$

Where:

depreciation-adjusted tax ratio variable label = DTAXRAT
corporation tax Datastream code = 160
adjusted pre-tax profit (including associates) Datastream code = 157
depreciation Datastream code = 136

The fixed-assets ratio

The fixed asset ratio is defined as total net fixed assets as a proportion of total assets employed. The former has already been defined but the latter measure, total assets employed, shows the sum of all assets less all current liabilities.
The ratio is thus defined as:

$$\text{fixed asset ratio} = \frac{\text{total net fixed assets}}{\text{total assets employed}}$$

Where:

fixed asset ratio variable label = FARATIO
total net fixed assets Datastream code = 339
total assets employed Datastream code = 391

Interest cover

Interest cover is defined as total non-operating income plus adjusted operating profit, all divided by total interest charges. Total non-operating income includes dividend income, interest received, rents, grants, and any other non-operating income. Adjusted operating profit is the net profit derived from normal activities of the company, after depreciation and operating provisions. Total interest charges includes interest on bank, convertible and other loans, bonds and debentures, leasing finance and hire purchase minus interest capitalised. The ratio is thus defined as:

$$\text{interest cover} = \frac{\text{total non-operating income} + \text{adjusted operating profit}}{\text{total interest charges}}$$

Where:

interest cover variable label = INTCOVER
total non-operating income Datastream code = 144
adjusted operating profit Datastream code = 137
total interest charges Datastream code = 153

The liquid assets ratio

The liquid assets ratio is defined as total cash and equivalent items divided by the sum of total creditors and equivalent, provisions due in less than one year, and borrowings repayable within one year. Total cash and equivalent includes cash, bank balances, short-term loans and deposits and investments shown under current assets. Total creditors and equivalent includes the amount payable after one year relating to the normal trading activities of the firm. Provisions due in less than one year includes the current portion of longer-term provisions. Borrowings repayable within one year includes bank overdrafts, loans and other short-term borrowings. The ratio is thus defined as:

$$\text{liquid assets ratio} = \frac{\text{total cash and equivalent}}{\text{total creditors and equivalent} + \text{provisions due in less than one year} + \text{borrowings repayable within one year}}$$

Where:

liquid assets ratio variable label = LARATIO
total cash and equivalent Datastream code = 375
total creditors and equivalent Datastream code = 385
provisions due in less than one year Datastream code = 380
borrowings repayable within one year Datastream code = 309

The net profit margin
Net profit margin is defined as after-tax profit divided by total sales. Adjusted after-tax profit gives the after-tax profit, adjusted for items which do not relate to the normal trading activities of the company, net of adjusted tax. Total sales is the amount of sales of goods and services to third parties, relating to the normal activities of the company.
The ratio is thus defined as:

$$\text{net profit margin} = \frac{\text{adjusted after-tax profit}}{\text{total sales}} \times 100$$

Where:

net profit margin variable label = NPMARGIN
adjusted after-tax profit Datastream code = 175
total sales Datastream code = 104

The payout ratio
Payout ratio is defined as dividends per share divided by adjusted net earnings per share. It is effectively the inverse of dividend cover. The ratio is thus defined as:

$$\text{payout ratio} = \frac{\text{dividends per share}}{\text{adjusted net earnings per share}}$$

Where:

payout ratio variable label = PAYRATIO
dividends per share Datastream code = 190
adjusted net earnings per share Datastream code = 211

The quick assets ratio
Quick asset ratio is defined as total current assets less total stock and work in progress, all divided by total current liabilities. Total current assets includes stock, work in progress, debtors, cash and equivalent, and any other current assets and accounts receivable after one year. Total stock and work in progress includes all stocks, raw materials, plus work in progress, less advances on work in progress. Total current liabilities includes current provisions, creditors, borrowings repayable within one year and any other current liabilities.
The ratio is thus defined as:

$$\text{quick assets ratio} = \frac{\text{total current assets - total stock and work in progress}}{\text{total current liabilities}}$$

Where:

quick assets ratio variable label = QARATIO
total current assets Datastream code = 376
total stock and work in progress Datastream code = 364
total current liabilities Datastream code = 389

The retentions ratio

The retentions ratio is defined as published retentions divided by adjusted after-tax profit. Published retentions consist of after-tax profit, after deducting dividends and adding post-tax extraordinary items. Adjusted after-tax profit consists of after-tax profit, adjusted for items which do not relate to the normal trading activities of the company, net of adjusted tax. The ratio is thus defined as:

$$\text{retentions ratio} = \frac{\text{published retentions}}{\text{adjusted after-tax profit}}$$

Where:

retentions ratio variable label = RETRATIO
published retentions Datastream code = 196
adjusted after-tax profit Datastream code = 175

The return on capital employed

Return on capital employed is defined as profit before interest and taxation divided by capital employed multiplied by 100. The ratio is thus defined as:

$$\text{return on capital employed} = \frac{\text{profit before interest and taxation}}{\text{capital employed}} \times 100$$

Where:

retentions ratio (Datastream code 707) variable label = ROCE

The short-run-to-long-run-debt ratio

The short-run to long-run debt ratio is defined as borrowings repayable within one year divided by total loan capital. The borrowings measure is defined earlier in this section. Total capital relates to all loans repayable in more than one year.
The ratio is thus defined as:

$$\text{short-run-to-long-run-debt ratio} = \frac{\text{borrowings repayable within one year}}{\text{total loan capital}}$$

Where:

short-run-to-long-run-debt ratio variable label =SRLRDEBT
borrowings repayable within one year Datastream code = 309
total loan capital Datastream code =321

The stock ratio

Stock ratio (days) is defined as total stock and work in progress divided by total sales, all multiplied by 365 days. The ratio is thus defined as:

$$\text{stock ratio} = \frac{\text{total stock and work in progress}}{\text{total sales}} \times 365 \text{ days}$$

Where:

stock ratio variable label = STKRATIO
total stock and work in progress Datastream code = 364
total sales Datastream code = 104

The tax-to-pre-tax-profit ratio

The tax to pre-tax profit ratio is defined as the adjusted total tax charge divided by adjusted pre-tax profit (excluding associates). The adjusted total tax charge is the total amount of tax charged against the profits for the year. The adjusted pre-tax profit (excluding associates) includes the pre-tax profit, adjusted for exceptional/extraordinary items, non-operating provisions and exchange profits/losses. The ratio is thus defined as:

$$\text{tax to pre-tax profit ratio} = \frac{\text{adjusted total tax charge}}{\text{adjusted pre-tax profit}}$$

Where:

tax to pre-tax profit ratio variable label = TAXONPTP
adjusted total tax charge Datastream code = 172
adjusted pre-tax profit Datastream code = 155

The tax ratio

The tax ratio is defined as the adjusted total tax charge divided by the sum of adjusted pre-tax profit (excluding associates) and associates pre-tax profits. The total tax charge and pre-tax profit (excluding associates) have already been defined in this section. The associates pre-tax profits gives the portion of pre-tax profits/losses of associates and other companies under the equity method. The ratio is thus defined as:

$$\text{tax ratio} = \frac{\text{adjusted total tax charge}}{\text{adjusted pre-tax profit (excluding associates)} + \text{associates pre-tax profits}}$$

Where:

tax ratio (Datastream code 761) variable label = TAXRATIO

The working capital ratio

The working capital ratio is defined as total current assets divided by total current liabilities. Total current assets includes stock, work in progress, debtors, cash and equivalent and any other current assets. Total current liabilities includes current provisions, creditors, borrowings repayable within one year and any other current liabilities. The ratio is thus defined as:

$$\text{working capital ratio} = \frac{\text{total current assets}}{\text{total current liabilities}}$$

Where:

working capital ratio variable label = WCRATIO
total current assets Datastream code = 376
total current liabilities Datastream code = 389

The net current assets ratio

The net current assets ratio is defined as total current assets less total current liabilities all divided by total assets employed. The ratio is thus defined as:

$$\text{net current assets ratio} = \frac{\text{total current assets - total current liabilities}}{\text{total assets employed}}$$

Where:

net current assets ratio variable label = WORKCAP
total current assets Datastream code = 376
total current liabilities Datastream code = 389
total assets employed Datastream code = 391

APPENDIX B:
THE WALD TESTS FOR THE EUROPEAN MULTIVARIATE LOGISTIC REGRESSION MODELS

Table 1
Wald tests for the German multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	2.2673	3.0374	0.5572	1	0.4554
DEPRATIO	5.1406	6.0140	0.7306	1	0.3927
FARATIO	7.9344	4.5093	3.0960	1	0.0785
INTCOVER	0.1166	0.1059	1.2130	1	0.2707
LARATIO	-1.6010	1.0339	2.3980	1	0.1215
PAYRATIO	5.9406	3.1747	3.5014	1	0.0613
RETRATIO	2.2368	2.1467	1.0857	1	0.2974
ROCE	-0.724	0.0697	1.0781	1	0.2991
SRLRDEBT	0.6912	0.4736	2.1303	1	0.1444
TAXRATIO	-0.0643	0.0527	1.4885	1	0.2225
WORKCAP	6.1240	3.5079	3.0476	1	0.0809
Constant	-6.5088	4.4349	2.1540	1	0.1422

Table 2
Wald tests for the Belgian multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	47.3864	66.9509	0.5009	1	0.4791
DEPRATIO	128.0793	169.4711	0.5712	1	0.4498
FARATIO	-53.1262	56.1620	0.8948	1	0.3442
Constant	4.5120	38.6053	0.0137	1	0.9070

Table 3
Wald tests for the Danish multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	46.1710	45.0296	1.0513	1	0.3052
RETRATIO	-1.5504	1.8353	0.7137	1	0.3982
TAXONPTP	8.5713	6.6230	1.6749	1	0.1956
Constant	-9.2518	8.2089	1.2702	1	0.2597

Table 3
Wald tests for the Spanish multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
PAYRATIO	9.0410	18.6912	0.2340	1	0.6286
Constant	-6.0846	13.8649	0.1926	1	0.6608

Table 4
Wald tests for the French multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DIVCOVER	-0.0326	0.1245	0.0684	1	**0.7937**
DTAXRAT	1.0860	2.8278	0.1475	1	**0.7009**
INTCOVER	-0.0855	0.1787	0.2292	1	**0.6321**
ROCE	-0.0394	0.0516	0.5821	1	**0.4455**
SRLRDEBT	0.5843	0.3355	3.0336	1	**0.0816**
TAXONPTP	8.2934	5.0942	2.6504	1	**0.1035**
TAXRATIO	-0.1808	0.1028	3.0926	1	**0.0786**
WCRATIO	3.4593	1.9746	3.0692	1	**0.0798**
WORKCAP	-0.0599	1.6938	0.0013	1	**0.9718**
Constant	-2.5635	2.1908	1.3692	1	**0.2419**

Table 5
Wald tests for the Irish multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DEPRATIO	-73.4627	136.3096	0.2905	1	**0.5899**
WORKCAP	14.4330	27.3784	0.2779	1	**0.5981**
Constant	3.1805	4.7307	0.4520	1	**0.5014**

Table 6
Wald tests for the Italian multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	3.1951	6.0107	0.2826	1	**0.5950**
FARATIO	3.8637	5.6718	0.4640	1	**0.4957**
INTCOVER	-0.1830	0.2191	0.6973	1	**0.4037**
LARATIO	-6.6559	4.3982	2.2901	1	**0.1302**
RETRATIO	5.4240	3.4130	2.5256	1	**0.1120**
ROCE	-0.7218	0.5478	1.7362	1	**0.1876**
WORKCAP	30.4430	21.4935	2.0061	1	**0.1567**
Constant	7.1441	7.2911	0.9601	1	**0.3272**

Table 7
Wald tests for the Dutch multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
LARATIO	-5.6261	3.7827	2.2121	1	**0.1369**
PAYRATIO	-14.3521	9.2159	2.4253	1	**0.1194**
QARATIO	2.3006	3.8362	0.3596	1	**0.5487**
RETRATIO	6.5788	4.4165	2.2189	1	**0.1363**
SRLRDEBT	-0.1957	0.2719	0.5183	1	**0.4716**
TAXRATIO	7.3378	7.6065	0.9306	1	**0.3347**
WORKCAP	-4.4116	3.7079	1.4156	1	**0.2341**
Constant	0.2677	4.2235	0.0040	1	**0.9495**

Table 8
Wald tests for the Dutch multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
LARATIO	-5.6261	3.7827	2.2121	1	**0.1369**
PAYRATIO	-14.3521	9.2159	2.4253	1	**0.1194**
QARATIO	2.3006	3.8362	0.3596	1	**0.5487**
RETRATIO	6.5788	4.4165	2.2189	1	**0.1363**
SRLRDEBT	-0.1957	0.2719	0.5183	1	**0.4716**
TAXRATIO	7.3378	7.6065	0.9306	1	**0.3347**
WORKCAP	-4.4116	3.7079	1.4156	1	**0.2341**
Constant	0.2677	4.2235	0.0040	1	**0.9495**

Table 9
Wald tests for the Swiss multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	-15.1993	9.9822	2.3184	1	**0.1278**
DIVCOVER	1.3503	1.2953	1.0867	1	**0.2972**
FARATIO	6.4877	6.0598	1.1462	1	**0.2843**
INTCOVER	-0.3998	0.4222	0.8967	1	**0.3437**
NPMARGIN	-0.6846	0.5938	1.3291	1	**0.2490**
Constant	4.8346	3.9764	1.4782	1	**0.2240**

Table 10
Wald tests for the UK multivariate logistic regression model

variable	variable coefficient	standard error	Wald statistic	degrees of freedom	significance level
DDERATIO	-3.3989	1.8026	3.5552	1	**0.0594**
DEPRATIO	-6.3344	4.4027	2.0701	1	**0.1502**
DIVCOVER	-0.3115	0.2955	1.1118	1	**0.2917**
DTAXRAT	-4.2166	2.9073	2.1035	1	**0.1470**
FARATIO	1.9885	1.0771	3.4085	1	**0.0649**
INTCOVER	-0.0146	0.0132	1.2163	1	**0.2701**
LARATIO	0.7449	0.7662	0.9452	1	**0.3309**
PAYRATIO	-1.7817	1.6309	1.1935	1	**0.2746**
QARATIO	-2.0027	1.6817	1.4182	1	**0.2337**
ROCE	-0.0125	0.0265	0.2229	1	**0.6369**
SRLRDEBT	-0.0028	0.0298	0.0089	1	**0.9249**
STKRATIO	-0.0223	0.0119	3.5157	1	**0.0608**
WCRATIO	2.4235	1.3150	3.3966	1	**0.0653**
Constant	1.9810	2.1714	0.8323	1	**0.3616**

APPENDIX C:
DEFINITION OF THE VARIABLES MODELLED IN THE TIME SERIES ANALYSES

The variables listed below represent only the "base" variables from which all other variables used in the time-series analyses are computed. Most of the accounting ratio variables are defined in appendix A and thus their definitions are not repeated here. In the analyses, then, variables containing the word "change" are merely percentage changes in the variables to which they relate. Variables containing the letters "chch" are merely percentage changes in the percentage change variables to which they relate.

The variables used in the UK samples

ASSETS (Datastream code 391) is defined as total assets employed.
CTAXRATIO (Datastream code 160 divided by Datastream code 157) and represents the corporation tax paid by the firm in the period as a proportion of adjusted pre-tax profit.
CTRATE (Datastream code 202) is defined as the average tax rate applicable to the period.
DDERATIO See appendix A.
DIVCOVER See appendix A.
GDP (Datastream code UKGDPAVEG) is defined as the average estimate of GDP.
INCTAX is defined as the basic rate of income tax applying to the period.
INFLATE (Datastream code UKRP....F) is defined as the retail price index, all items.
INTCOVER See appendix A.
INVEST (Datastream code UKGDFCFOA) is defined as gross domestic fixed capital formation.
LRINT (Datastream code UK20YEAR) is defined as the gross redemption yield on 20 year gilts.
MRINT (Datastream code LDNCD2Y) is defined as the Sterling certificate of deposit two year rate.
QRATIO is defined as the ratio of the market value of the firm to the replacement cost of its assets. It is defined below in terms of the Datastream items which form it.

$$QRATIO = \frac{HMV + 389 + 321}{391 + 389 + [(328 - 336).\frac{INFLATE_t}{INFLATE_{t-4}}]}$$

Where:
HMV = the historical market value of equity 389 = total current liabilities
321 = total loan capital 391 = total assets employed by the firm
328 = gross plant and machinery 336 = plant and machinery depreciation
INFLATE = the inflation index as defined above

ROCE See appendix A.

SMIND (Datastream code UKFTALL.) is defined as the Financial Times All Share Index at period end.

SRINT (Datastream code UKTRSBL%) is defined as the three month Treasury bill rate at period end.

TAXADV is defined as

$$\frac{DSCT - INCTAX}{1 - INCTAX}$$

and is referred to as the tax advantage to debt.

TAXRATIO See appendix A.

WCRATIO See appendix A.

The variables used in the Netherlands samples

ASSETS (Datastream code 391) is defined as total assets employed.
CTRATE (Datastream code 202) is defined as the average tax rate applicable to the period.
DDERATIO See appendix A.
DIVCOVER See appendix A.
GDP (Datastream code NLGDPDCN) is defined as the gross domestic product in constant prices.
INFLATE (Datastream code NLCP....F) is defined as the consumer price index.
INTCOVER See appendix A.
INVEST (Datastream code NLINDINVA) is defined as industry gross fixed capital investment.
LRINT (Datastream code NLLONG..) is defined as the interest rate on long term government loans (Staatsleningen).
MRINT (Datastream code NL3TO5L.) is defined as the interest rate on government loans of three to five years.
QRATIO is defined as the ratio of the market value of the firm to the replacement cost of its assets (and is computed using the expression given in the UK definitions).
ROCE See appendix A.
SMIND (Datastream code NLCBSGEN) is defined as the CBS all share general stock price index.
SRINT (Datastream code NLTRSBL%) is defined as the yield on Treasury paper with remaining maturity of three months.
TAXRATIO See appendix A.
WCRATIO See appendix A.

Variables used in the German samples

ASSETS (Datastream code 391) is defined as total assets employed.
DDERATIO See appendix A.
DIVCOVER See appendix A.
GNP (Datastream code BDGNP...B) is defined as the gross national product.
INFLATE (Datastream code BDCP....F) is defined as the cost of living price index.
INTCOVER See appendix A.
INVEST (Datastream code BDINVMACD) is defined as investment in machinery and equipment in constant, seasonally adjusted prices.
LRINT (Datastream code BDOCLNG%) is defined as the period average yield on long term government bonds.
MRINT (Datastream code BDMEDYLD) is defined as the yield on secondary market public bonds three to seven years.
QRATIO is defined as the ratio of the market value of the firm to the replacement cost of its assets. It is defined below in terms of the Datastream items which form it.

$$QRATIO = \frac{HMV + 389 + 321}{391 + 389 + [699.\frac{INFLATE_t}{INFLATE_{t-4}}]}$$

Where:
HMV = the historical market value of equity
389 = total current liabilities
321 = total loan capital
391 = total assets employed by the firm
699 = net plant and machinery
INFLATE = the inflation index as defined above

ROCE See appendix A.
SMIND (Datastream code BDSHRPRC) is defined as the Commerzbank Share Price Index at period end.
SRINT (Datastream code BDTRSBL%) is the three month Treasury bill rate at period end.
TAXRATIO See appendix A.
WCRATIO See appendix A.

French samples

ASSETS (Datastream code 391) is defined as total assets employed.
CTAXRATIO (Datastream code 160 divided by Datastream code 157) and represents the corporation tax paid by the firm in the period as a proportion of adjusted pre-tax profit.
CTRATE (Datastream code 202) is defined as the average tax rate applicable to the period.
DDERATIO See appendix A.
DIVCOVER See appendix A.
GDP (Datastream code FRGDP...D) is defined as the gross domestic product (product interior brut, marchand).
IMPUTE is defined as the imputation rate applicable to the period.
INFLATE (Datastream code FRCP....F) is defined as the consumer price index.
INTCOVER See appendix A.
INVEST (Datastream code FROCGDFXD) is defined as gross domestic fixed investment.
LRINT (Datastream code FRLNGYLD) is defined as the yield on central government bonds of over seven years life on the secondary market.
MRINT (Datastream code FRSHORT3) is defined as the yield on public sector bonds of three to five years.
QRATIO is defined as the ratio of the market value of the firm to the replacement cost of its assets (and is computed using the expression given in the UK definitions).
ROCE See appendix A.
SMIND (Datastream code FROCSPRC) is defined as industrial share prices (INSEE).
SRINT (Datastream code FRTRSBL%) is defined as the auction average three month Treasury bill discount rate.
TAXADV is defined as

$$\frac{\text{CTRATE - IMPUTE}}{\text{1 - IMPUTE}}$$

and represents the tax advantage to debt (alternative model).
TAXRATIO is defined as

$$\frac{\text{TOTAL TAX CHARGE - ADJUSTED}}{\text{PRE-TAX PROFITS (EXCLUDING ASSOCIATES, ADJUSTED)}}$$

WCRATIO See appendix A.

APPENDIX D:
MACKINNON TABLES USED IN THE UNIT ROOT TESTING

Table 1
Mackinnon distribution critical value table at the 1 per cent level (N=1, no constant)

$$\hat{\beta}_{\infty} = -2.5658, \hat{\beta}_1 = -1.960, \hat{\beta}_2 = -10.04$$

T	-2.5658	$-1.960 / T$	$-10.04 / T^2$	**Mackinnon distribution**
5	"	-0.3920	-0.4016	**-3.3594**
6	"	-0.3267	-0.2789	**-3.1714**
7	"	-0.2800	-0.2049	**-3.0507**
8	"	-0.2450	-0.1569	**-2.9677**
9	"	-0.2178	-0.1240	**-2.9076**
10	"	-0.1960	-0.1004	**-2.8622**
11	"	-0.1782	-0.0830	**-2.8270**
12	"	-0.1633	-0.0697	**-2.7988**
13	"	-0.1508	-0.0594	**-2.7760**
14	"	-0.1400	-0.0512	**-2.7570**
15	"	-0.1307	-0.0446	**-2.7411**
16	"	-0.1225	-0.0392	**-2.7275**
17	"	-0.1153	-0.0347	**-2.7158**
18	"	-0.1089	-0.0310	**-2.7057**
19	"	-0.1032	-0.0278	**-2.6968**
20	"	-0.0980	-0.0251	**-2.6869**
21	"	-0.0933	-0.0228	**-2.6819**
22	"	-0.0891	-0.0207	**-2.6756**
23	"	-0.0852	-0.0190	**-2.6700**
24	"	-0.0817	-0.0174	**-2.6649**
25	"	-0.0784	-0.0161	**-2.6603**

Table 2
Mackinnon distribution critical value table at the 1 per cent level
(N=1, with trend)

$$\hat{\beta}_{\infty} = -3.9638, \hat{\beta}_1 = -8.353, \hat{\beta}_2 = -47.44$$

T	-3.9638	$-8.353/T$	$-47.44/T^2$	**Mackinnon distribution**
5	"	-1.6706	-1.8976	**-7.5320**
6	"	-1.3922	-1.3178	**-6.6738**
7	"	-1.1933	-0.9682	**-6.1253**
8	"	-1.0441	-0.7413	**-5.7492**
9	"	-0.9281	-0.5857	**-5.4776**
10	"	-0.8353	-0.4744	**-5.2735**
11	"	-0.7594	-0.3921	**-5.1153**
12	"	-0.6961	-0.3294	**-4.9893**
13	"	-0.6425	-0.2807	**-4.8870**
14	"	-0.5966	-0.2420	**-4.8024**
15	"	-0.5569	-0.2108	**-4.7315**
16	"	-0.5221	-0.1853	**-4.6712**
17	"	-0.4914	-0.1642	**-4.6194**
18	"	-0.4641	-0.1464	**-4.5743**
19	"	-0.4396	-0.1314	**-4.5348**
20	"	-0.4177	-0.1186	**-4.5001**
21	"	-0.3978	-0.1076	**-4.4692**
22	"	-0.3797	-0.0980	**-4.4415**
23	"	-0.3632	-0.0897	**-4.4167**
24	"	-0.3480	-0.0824	**-4.3942**
25	"	-0.3341	-0.0759	**-4.3738**

APPENDIX E:
F-TESTS FOR THE PRESENCE OF A DETERMINISTIC TREND WITHIN THE EUROPEAN TIME SERIES VARIABLES

Table 1
The F-test for the presence of a deterministic trend within the UK weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,22	2.0343	accept
ASSETSchange	2,21	7.7688	accept
CTAXRATIO	2,22	5.3955	accept
CTRATE	2,22	2.3275	accept
DDERATIO	2,22	4.2437	accept
DIVCOVER	2,19	4.497	accept
GDP	2,21	1.2197	accept
GDPchange	2,20	5.3224	accept
INCTAX	2,22	4.7704	accept
INFLATE	2,21	11.194	reject
INFLATEchange	2,20	3.4339	accept
INTCOVER	2,22	5.8376	accept
INVEST	2,21	2.1151	accept
INVESTchange	2,20	4.4418	accept
LRINT	2,21	3.2936	accept
MRINT	2,15	3.9764	accept
QRATIO	2,22	3.8354	accept
ROCE	2,22	2.6789	accept
SMIND	2,20	3.3915	accept
SRINT	2,21	4.9822	accept
TAXADV	2,22	2.3319	accept
TAXRATIO	2,22	3.0618	accept
WCRATIO	2,22	1.2709	accept

Table 2
The F-test for the presence of a deterministic trend within the UK non-weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,22	2.0343	accept
ASSETSchange	2,21	7.7688	accept
CTAXRATIO	2,22	3.4852	accept
CTRATE	2,22	2.1659	accept
CTRATEchange	2,21	3.2181	accept
DDERATIO	2,22	4.1099	accept
DIVCOVER	2,19	6.2161	accept
GDP	2,21	1.2197	accept
GDPchange	2,20	5.3224	accept
INCTAX	2,22	4.7704	accept
INFLATE	2,21	11.194	reject
INFLATEchange	2,20	3.4339	accept
INTCOVER	2,22	7.2072	accept
INVEST	2,21	2.1151	accept
INVESTchange	2,20	4.4418	accept
LRINT	2,21	3.2936	accept
MRINT	2,15	3.9764	accept
QRATIO	2,22	3.1044	accept
ROCE	2,22	2.9889	accept
SMIND	2,20	3.3915	accept
SRINT	2,21	4.9822	accept
TAXADV	2,22	2.3359	accept
TAXRATIO	2,22	1.9128	accept
WCRATIO	2,22	6.3402	accept

Table 3
The F-test for the presence of a deterministic trend within the Netherlands weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,11	1.375	accept
ASSETSchange	2,10	5.6067	accept
CTRATE	2,11	3.8146	accept
DDERATIO	2,11	2.6074	accept
DIVCOVER	2,11	12.784	reject
GDP	2,10	3.4678	accept
GDPchange	2,9	3.3791	accept
GDPchch	3,11	12.922	reject
INFLATE	2,11	2.5829	accept
INFLATEchange	2,10	0.64828	accept
INTCOVER	2,11	5.5331	accept
INVEST	2,9	2.399	accept
INVESTchange	2,8	0.2386	accept
INVESTchch	2,7	5.1258	accept
LRINT	2,11	1.3285	accept
LRINTchange	2,10	2.1248	accept
MRINT	2,11	1.2282	accept
MRINTchange	2,10	2.1663	accept
QRATIO	2,11	5.5437	accept
ROCE	2,11	7.5795	accept
SMIND	2,11	3.8263	accept
SRINT	2,9	1.069	accept
TAXRATIO	2,11	4.1885	accept
WCRATIO	2,11	3.6166	accept
WCRATIOchange	2,10	11.309	reject
WCRATIOchch	2,9	4.4605	accept

Table 4
The F-test for the presence of a deterministic trend within the Netherlands non-weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,11	1.375	accept
ASSETSchange	2,10	5.6067	accept
CTRATE	2,11	3.5724	accept
DDERATIO	2,11	1.7489	accept
DIVCOVER	2,11	9.7063	accept
GDP	2,10	3.4678	accept
GDPchange	2,9	3.3791	accept
GDPchch	3,11	12.922	reject
INFLATE	2,11	2.5829	accept
INFLATEchange	2,10	0.64828	accept
INTCOVER	2,11	0.91635	accept
INTCOVERchange	2,10	5.0269	accept
INVEST	2,9	2.399	accept
INVESTchange	2,8	1.7235	accept
INVESTchch	2,7	5.1258	accept
LRINT	2,11	1.3285	accept
LRINTchange	2,10	2.1248	accept
MRINT	2,11	1.2282	accept
MRINTchange	2,10	1.5564	accept
QRATIO	2,11	4.1892	accept
ROCE	2,11	3.8404	accept
SMIND	2,11	3.8263	accept
SRINT	2,9	1.069	accept
TAXRATIO	2,11	7.0484	accept
WCRATIO	2,11	2.5667	accept

Table 5
The F-test for the presence of a deterministic trend within the German weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,8	2.1826	accept
ASSETSchange	2,7	4.1457	accept
DDERATIO	2,8	6.491	accept
DIVCOVER	2,8	2.8485	accept
GNP	2,8	7.2415	accept
GNPchange	2,7	2.3153	accept
GNPchch	2,6	4.7176	accept
INFLATE	2,8	0.53825	accept
INFLATEchange	2,7	6.215	accept
INFLATEchch	2,6	4.8328	accept
INTCOVER	2,8	3.6769	accept
INTCOVERchange	2,7	35.061	reject
INVEST	2,8	4.4913	accept
INVESTchange	2,7	4.8491	accept
LRINT	2,8	3.4121	accept
MRINT	2,8	3.0024	accept
MRINTchange	2,7	1.6458	accept
QRATIO	2,8	2.6656	accept
ROCE	2,8	3.8799	accept
ROCEchange	2,7	7.8923	accept
SMIND	2,8	2.6359	accept
SRINT	2,8	7.1631	accept
TAXRATIO	2,8	5.1673	accept
TAXRATIOchange	2,7	15.776	reject
WCRATIO	2,8	1.9576	accept
WCRATIOchange	2,7	4.6537	accept

Table 6
The F-test for the presence of a deterministic trend within the German non-weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,8	2.1826	accept
DDERATIO	2,8	2.9742	accept
DIVCOVER	2,8	5.794	accept
GNP	2,8	7.2415	accept
GNPchange	2,7	2.3153	accept
INFLATE	2,8	0.53825	accept
INFLATEchange	2,7	6.215	accept
INTCOVER	2,8	1.3159	accept
INVEST	2,8	4.4913	accept
INVESTchange	2,7	4.8491	accept
LRINT	2,8	3.4121	accept
MRINT	2,8	3.0024	accept
QRATIO	2,8	2.2376	accept
ROCE	2,8	1.7586	accept
SMIND	2,8	2.6359	accept
SRINT	2,8	7.1631	accept
TAXRATIO	2,8	2.1703	accept
WCRATIO	2,8	2.2899	accept

Table 7
The F-test for the presence of a deterministic trend within the French weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,6	7.3275	accept
ASSETSchange	2,5	2.2754	accept
ASSETSchch	2,4	5.8154	accept
CTAXRATIO	2,6	2.7162	accept
CTRATE	2,6	3.2669	accept
CTRATEchange	2,5	4.1404	accept
DDERATIO	2,6	2.4817	accept
DIVCOVER	2,6	7.2729	accept
GDP	2,6	1.193	accept
GDPchange	2,5	1.5094	accept
GDPchch	2,4	2.8192	accept
INFLATE	2,6	18.112	reject
INFLATEchange	2,5	4.2234	accept
INFLATEchch	2,4	4.0521	accept
INTCOVER	2,6	12.003	reject
INTCOVERchange	2,5	6.7197	accept
INVEST	2,6	0.73487	accept
INVESTchange	2,5	5.0329	accept
INVESTchch	2,4	6.3174	accept
LRINT	2,6	2.7219	accept
LRINTchange	2,5	5.2026	accept
MRINT	2,6	2.4799	accept
MRINTchange	2,5	4.9015	accept
QRATIO	2,6	2.766	accept
ROCE	2,6	3.2169	accept
ROCEchange	2,5	3.089	accept
SMIND	2,6	2.2303	accept
SMINDchange	2,5	8.4561	accept
SRINT	2,6	3.2687	accept
SRINTchange	2,5	3.7269	accept
TAXADV	2,6	3.2669	accept
TAXADVchange	2,5	4.0027	accept
TAXRATIO	2,6	4.5604	accept
WCRATIO	2,6	2.5548	accept
WCRATIOchange	2,5	3.142	accept

Table 8
The F-test for the presence of a deterministic trend within the French non-weighted sample data variables

variable	degrees of freedom	F-statistic	accept/reject
ASSETS	2,6	7.3275	accept
ASSETSchange	2,4	5.8154	accept
CTAXRATIO	2,6	4.8464	accept
CTRATE	2,6	8.7244	accept
DDERATIO	2,6	2.5152	accept
DIVCOVER	2,6	1.249	accept
GDP	2,6	1.1961	accept
GDPchange	2,5	1.5059	accept
GDPchch	2,4	2.8192	accept
INFLATE	2,6	18.112	reject
INFLATEchange	2,5	4.2234	accept
INFLATEchch	2,4	4.0521	accept
INTCOVER	2,6	4.1171	accept
INVEST	2,6	0.73487	accept
INVESTchange	2,5	5.0329	accept
INVESTchch	2,4	6.3174	accept
LRINT	2,6	2.7219	accept
MRINT	2,6	2.4799	accept
QRATIO	2,6	5.8199	accept
ROCE	2,6	2.0435	accept
SMIND	2,6	2.2303	accept
SRINT	2,6	3.2687	accept
TAXADV	2,6	8.7244	accept
TAXRATIO	2,6	6.7634	accept
WCRATIO	2,6	1.4988	accept
WCRATIOchange	2,5	1.7107	accept

APPENDIX F:
UNIT ROOT TESTING UPON THE EUROPEAN TIME SERIES VARIABLES

Table 1
Unit root tests for the UK weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.19	1.288	1.454	1,25	R	0.8185	-2.6603	A
ΔASSETS	1.67	1.273	1.446	1,24	A	-2.382	-2.6649	A
ΔΔASSETS	1.65	1.257	1.437	1,23	A	-6.045	-2.6700	R
ASSETSchange	2.27/1.73	1.273	1.446	1,24	A	-2.471	-2.6649	A
ΔASSETSchange	2.17/1.83	1.257	1.437	1,23	A	-7.998	-2.6700	R
CTAXRATIO	2.72	1.288	1.454	1,25	I	-0.8682	-2.6603	A
ΔCTAXRATIO	2.13/1.87	1.273	1.446	1,24	A	-7.106	-2.6649	R
CTRATE	1.30	1.288	1.454	1,25	I	-0.9839	-2.6603	A
ΔCTRATE	1.51	1.273	1.446	1,24	A	-2.869	-2.6649	R
DDERATIO	2.23/1.77	1.288	1.454	1,25	A	-0.7065	-2.6603	A
ΔDDERATIO	2.01/1.99	1.273	1.446	1,24	A	-5.569	-2.6649	R
DIVCOVER	1.40	1.239	1.429	1,22	I	-0.7347	-2.6756	A
ΔDIVCOVER	2.00	1.221	1.420	1,21	A	-4.194	-2.6819	R
GDP	1.19	1.273	1.446	1,24	R	3.631	-2.6649	A
ΔGDP	2.00	1.257	1.437	1,23	A	-2.308	-2.6700	A
ΔΔGDP	2.09/1.91	1.239	1.429	1,22	A	-5.531	-2.6756	R
GDPchange	2.04/1.96	1.257	1.437	1,23	A	-2.5	-2.6700	A
ΔGDPchange	2.15/1.85	1.239	1.429	1,22	A	-5.818	-2.6756	R
INCTAX	2.41	1.288	1.454	1,25	A	-1.801	-2.6603	A
ΔINCTAX	1.99	1.273	1.446	1,24	A	-5.241	-2.6649	R
INFLATEchange	1.91	1.257	1.437	1,23	A	-0.9444	-2.6700	A
ΔINFLATEchange	1.98	1.239	1.429	1,22	A	-4.533	-2.6756	R
INTCOVER	1.94	1.288	1.454	1,25	A	-2.036	-2.6603	A
ΔINTCOVER	2.08/1.92	1.273	1.446	1,24	A	-5.458	-2.6649	R
INVEST	0.706	1.273	1.446	1,24	R	2.647	-2.6649	A
ΔINVEST	1.40	1.257	1.437	1,23	I	-1.751	-2.6700	A
ΔΔINVEST	1.65	1.239	1.429	1,22	A	-3.542	-2.6756	R
INVESTchange	1.82	1.257	1.437	1,23	A	-1.274	-2.6700	A
ΔINVESTchange	1.99	1.239	1.429	1,22	A	-4.625	-2.6756	R
LRINT	1.44	1.273	1.446	1,24	I	-0.09284	-2.6649	A
ΔLRINT	1.86	1.257	1.437	1,23	A	-3.726	-2.6700	R
MRINT	1.87	1.158	1.391	1,18	A	-0.7221	-2.7057	A
ΔMRINT	1.811	1.133	1.381	1,17	A	-3.747	-2.7158	R
QRATIO	1.39	1.288	1.454	1,25	I	0.02011	-2.6603	A
ΔQRATIO	1.61	1.273	1.446	1,24	A	-3.338	-2.6649	R
ROCE	2.25/1.75	1.288	1.454	1,25	A	-0.3583	-2.6603	A
ΔROCE	1.94	1.273	1.446	1,24	A	-5.648	-2.6649	R
SMIND	2.75	1.257	1.437	1,23	R	3.103	-2.6700	A
ΔSMIND	1.91	1.239	1.429	1,22	A	-3.982	-2.6756	R
SRINT	2.36/1.64	1.273	1.446	1,24	A	-0.748	-2.6649	A
ΔSRINT	2.06/1.94	1.257	1.437	1,23	A	-5.883	-2.6700	R
TAXADV	1.66	1.288	1.454	1,25	A	-0.9096	-2.6603	A
ΔTAXADV	1.77	1.273	1.446	1,24	A	-4.093	-2.6649	R
TAXRATIO	2.27/1.73	1.288	1.454	1,25	A	-0.7267	-2.6603	A
ΔTAXRATIO	2.03/1.97	1.273	1.446	1,24	A	-5.502	-2.6649	R
WCRATIO	1.73	1.288	1.454	1,25	A	-1.131	-2.6603	A
ΔWCRATIO	1.82	1.273	1.446	1,24	A	-4.012	-2.6649	R

Table 2
Unit root tests for the UK weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
INFLATE	0.984	1.101	1.656	3,24	R	-2.852	-4.3942	A
ΔINFLATE	1.55	1.078	1.660	3,23	I	-2.248	-4.4167	A
ΔΔINFLATE	1.92	1.053	1.664	3,22	A	-3.093	-4.4415	A
ΔΔΔINFLATE	2.15/1.85	1.026	1.669	3,21	A	-5.941	-4.4692	R

Table 3
Unit root tests for the UK non-weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.19	1.288	1.454	1,25	I	0.8185	-2.6603	A
ΔASSETS	1.67	1273	1.446	1,24	A	-2.382	-2.6649	A
ΔΔASSETS	1.65	1.257	1.437	1,23	A	-6.045	-2.6700	R
ASSETSchange	2.27/1.73	1.273	1.446	1,24	A	-2.471	-2.6649	A
ΔASSETSchange	2.17/1.83	1.257	1.437	1,23	A	-7.998	-2.6700	R
CTAXRATIO	2.15	1.288	1.454	1,25	A	-1.21	-2.6603	A
ΔCTAXRATIO	1.72	1.273	1.446	1,24	A	-5.132	-2.6649	R
CTRATE	0.822	1.288	1.454	1,25	R	-0.8028	-2.6603	A
ΔCTRATE	1.35	1.273	1.446	1,24	R	-2.482	-2.6649	A
ΔΔCTRATE	1.89	1.257	1.437	1,23	A	-4.279	-2.6700	R
CTRATEchange	1.32	1.273	1.446	1,24	I	-2.493	-2.6649	A
ΔCTRATEchange	1.85	1.257	1.437	1,23	A	-4.173	-2.6700	R
DDERATIO	1.90	1.288	1.454	1,25	A	-0.5912	-2.6603	A
ΔDDERATIO	1.98	1.273	1.446	1,24	A	-4.704	-2.6649	R
DIVCOVER	1.99	1.239	1.429	1,22	A	-0.2784	-2.6756	A
ΔDIVCOVER	1.93	1.221	1.420	1,21	A	-4.732	-2.6819	R
GDP	1.19	1.273	1.446	1,24	R	3.631	-2.6649	A
ΔGDP	2.00	1.257	1.437	1,23	A	-2.308	-2.6700	A
ΔΔGDP	2.09/1.91	1.239	1.429	1,22	A	-5.531	-2.6756	R
GDPchange	2.04/1.96	1.257	1.437	1,23	A	-2.5	-2.6700	A
ΔGDPchange	2.15/1.85	1.239	1.429	1,22	A	-5.8181	-2.6756	R
INCTAX	2.41/1.59	1.288	1.454	1,25	A	-1.801	-2.6603	A
ΔINCTAX	1.99	1.273	1.446	1,24	A	-5.241	-2.6649	R
INFLATEchange	1.91	1.257	1.437	1,23	A	-0.9444	-2.6700	A
ΔINFLATEchange	1.98	1.239	1.429	1,22	A	-4.533	-2.6756	R
INTCOVER	2.37	1.288	1.454	1,25	A	-1.561	-2.6603	A
ΔINTCOVER	2.27/1.73	1.273	1.446	1,24	A	-6.694	-2.6649	R
INVEST	0.706	1.273	1.446	1,24	R	2.647	-2.6649	A
ΔINVEST	1.40	1.257	1.437	1,23	I	-1.751	-2.6700	A
ΔΔINVEST	1.65	1.239	1.429	1,22	A	-3.542	-2.6756	R
INVESTchange	1.82	1.257	1.437	1,23	A	-1.274	-2.6700	A
ΔINVESTchange	1.99	1.239	1.429	1,22	A	-4.625	-2.6756	R
LRINT	1.44	1.273	1.446	1,24	I	-0.09284	-2.6649	A
ΔLRINT	1.86	1.257	1.437	1,23	A	-3.726	-2.6700	R
MRINT	1.87	1.158	1.391	1,18	A	-0.7221	-2.7057	A
ΔMRINT	1.811	1.133	1.381	1,17	A	-3.747	-2.7158	R
QRATIO	2.60/1.40	1.288	1.454	1,25	I	-0.4717	-2.6603	A
ΔQRATIO	1.95	1.273	1.446	1,24	A	-6.714	-2.6649	R
ROCE	1.79	1.288	1.454	1,25	A	0.1014	-2.6603	A
ΔROCE	1.87	1.273	1.446	1,24	A	-4.292	-2.6649	R
SMIND	2.75/1.25	1.257	1.437	1,23	R	3.103	-2.6700	A
ΔSMIND	1.91	1.239	1.429	1,22	A	-3.982	-2.6756	R
SRINT	2.36/1.64	1.273	1.446	1,24	A	-0.748	-2.6649	A
ΔSRINT	2.06/1.94	1.257	1.437	1,23	A	-5.883	-2.6700	R
TAXADV	1.27	1.288	1.454	1,25	R	-0.4662	-2.6603	A
ΔTAXADV	1.78	1.273	1.446	1,24	A	-3.366	-2.6649	R
TAXRATIO	2.13	1.288	1.454	1,25	A	-0.6109	-2.6603	A
ΔTAXRATIO	1.90	1.273	1.446	1,24	A	-5.175	-2.6649	R
WCRATIO	2.96/1.04	1.288	1.454	1,25	R	-0.4531	-2.6603	A
ΔWCRATIO	1.87	1.273	1.446	1,24	A	-8.163	-2.6649	R

Table 4
Unit root tests for the UK non-weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
INFLATE	0.984	1.101	1.656	3,24	R	-2.852	-4.3942	A
ΔINFLATE	1.55	1.078	1.660	3,23	I	-2.248	-4.4167	A
ΔΔINFLATE	1.92	1.053	1.664	3,22	A	-3.903	-4.4415	A
ΔΔΔINFLATE	2.15/1.85	1.026	1.669	3,21	A	-5.941	-4.4692	R

Table 5
Unit root tests for the Netherlands weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.83	1.045	1.350	1,14	A	1.63	-2.7570	A
ΔASSETS	1.74	1.010	1.340	1,13	A	-2.638	-2.7760	I
ΔΔASSETS	2.07/1.93	0.971	1.331	1,12	A	-4.188	-2.7988	R
ASSETSchange	1.62	1.010	1.340	1,13	A	-2.748	-2.7760	A
ΔASSETSchange	2.02/1.98	0.971	1.331	1,12	A	-4.726	-2.7988	R
CTRATE	2.28/1.72	1.045	1.350	1,14	A	-1.718	-2.7570	A
ΔCTRATE	2.01/1.99	1.010	1.340	1,13	A	-3.292	-2.7760	R
DDERATIO	2.52/1.48	1.045	1.350	1,14	A	-0.6462	-2.7570	A
ΔDDERATIO	2.11/1.89	1.010	1.340	1,13	A	-4.562	-2.7760	R
GDP	0.821	1.010	1.340	1,13	R	4.35	-2.7760	A
ΔGDP	1.19	0.971	1.331	1,12	I	-0.9631	-2.7988	A
ΔΔGDP	1.55	0.927	1.324	1,11	A	-2.224	-2.8270	A
ΔΔΔGDP	1.83	0.879	1.320	1,10	A	-2.628	-2.8622	A
ΔΔΔΔGDP	2.10/1.90	0.824	1.320	1,9	A	-3.847	-2.9076	R
GDPchange	1.18	0.971	1.331	1,12	I	-1.11	-2.7988	A
ΔGDPchange	1.59	0.927	1.324	1,11	A	-2.273	-2.8270	A
ΔΔGDPchange	1.86	0.879	1.320	1,10	A	-2.708	-2.8622	A
ΔΔΔGDPchange	2.11/1.89	0.824	1.320	1,9	A	-3.871	-2.9076	R
INFLATE	0.423	1.045	1.350	1,14	R	4.741	-2.7570	A
ΔINFLATE	1.28	1.010	1.340	1,13	I	-0.5234	-2.7760	A
ΔΔINFLATE	1.93	0.971	1.331	1,12	A	-2.974	-2.7988	R
INFLATEchange	1.26	1.010	1.340	1,13	I	-0.78	-2.7760	A
ΔINFLATEchange	1.83	0.971	1.331	1,12	A	-2.973	-2.7988	R
INTCOVER	1.49	1.045	1.350	1,14	A	-0.8564	-2.7570	A
ΔINTCOVER	1.18	1.010	1.340	1,13	I	-3.897	-2.7760	R
INVEST	1.21	0.971	1.331	1,12	I	3.857	-2.7988	A
ΔINVEST	1.63	0.927	1.324	1,11	A	-0.9125	-2.8270	A
ΔΔINVEST	1.85	0.879	1.320	1,10	A	-2.746	-2.8622	I
ΔΔΔINVEST	2.10/1.90	0.824	1.320	1,9	A	-3.629	-2.9076	R
INVESTchange	1.47	0.927	1.324	1,11	A	-1.225	-2.8270	A
ΔINVESTchange	1.76	0.879	1.320	1,10	A	-2.52	-2.8622	A
ΔΔINVESTchange	1.98	0.824	1.320	1,9	A	-3.21	-2.9076	R
INVESTchch	2.00	0.879	1.320	1,10	A	-3.196	-2.8622	R
LRINT	1.12	1.045	1.350	1,14	I	-0.1257	-2.7570	A
ΔLRINT	1.75	1.010	1.340	1,13	A	-2.344	-2.7760	A
ΔΔLRINT	2.03/1.97	0.971	1.331	1,12	A	-3.489	-2.7988	R
LRINTchange	1.73	1.010	1.340	1,13	A	-2.28	-2.7760	A
ΔLRINTchange	2.00	0.971	1.331	1,12	A	-3.389	-2.7988	R
MRINT	1.15	1.045	1.350	1,14	I	-0.1138	-2.7570	A
ΔMRINT	1.75	1.010	1.340	1,13	A	-2.355	-2.7760	A
ΔΔMRINT	2.04/1.96	0.971	1.331	1,12	A	-3.534	-2.7988	R
MRINTchange	1.75	1.010	1.340	1,13	A	-2.298	-2.7760	A
ΔMRINTchange	2.02/1.98	0.971	1.331	1,12	A	-3.493	-2.7988	R
QRATIO	2.76/1.24	1.045	1.350	1,14	I	-0.494	-2.7570	A
ΔQRATIO	2.00	1.010	1.340	1,13	A	-5.288	-2.7760	R
ROCE	2.04/1.96	1.045	1.350	1,14	A	-1.197	-2.7570	A
ΔROCE	1.57	1.010	1.340	1,13	A	-4.078	-2.7760	R
SMIND	2.35/1.65	1.045	1.350	1,14	A	1.143	-2.7570	A
ΔSMIND	2.00	1.010	1.340	1,13	A	-3.496	-2.7760	R
SRINT	2.21/1.79	0.971	1.331	1,12	A	-0.4438	-2.7988	A
ΔSRINT	1.34	0.927	1.324	1,11	A	-4.193	-2.8270	R
TAXRATIO	2.57/1.43	1.045	1.350	1,14	A	-0.7705	-2.7570	A
ΔTAXRATIO	2.26/1.74	1.010	1.340	1,13	A	-5.225	-2.7760	R
WCRATIO	1.57	1.045	1.350	1,14	A	-2.241	-2.7570	A
ΔWCRATIO	2.14	1.010	1.340	1,13	A	-2.25	-2.7760	A
ΔΔWCRATIO	2.46/1.54	0.971	1.331	1,12	A	-5.659	-2.7988	R

Table 6
Unit root tests for the Netherlands weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
DIVCOVER	1.40	0.767	1.779	3,14	I	-4.833	-4.8024	R
GDPchch	1.87	0.595	1.928	3,11	I	-5.061	-5.1153	A
ΔGDPchch	2.25/1.75	0.525	2.016	3,10	I	-7.828	-5.2735	R
WCRATIOchange	2.37/1.63	0.715	1.816	3,13	I	-4.732	-4.887	A
ΔWCRATIOchange	2.37/1.63	0.658	1.864	3,12	I	-4.527	-4.9893	A
ΔΔWCRATIOchange	2.23/1.77	0.595	1.928	3,11	I	-4.655	-5.1153	A
ΔΔΔWCRATIOchange	2.50/1.50	0.525	2.016	3,10	I	-5.482	-5.2735	R

Table 7
Unit root tests for the Netherlands non-weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.83	1.045	1.350	1,14	A	1.63	-2.7570	A
ΔASSETS	1.74	1.010	1.340	1,13	A	-2.638	-2.7760	A
ΔΔASSETS	2.07/1.93	0.971	1.331	1,12	A	-4.188	-2.7988	R
ASSETSchange	1.62	1.010	1.340	1,13	A	-2.748	-2.7760	A
ΔASSETSchange	2.02/1.98	0.971	1.331	1,12	A	-4.726	-2.7988	R
CTRATE	2.15/1.85	1.045	1.350	1,14	A	-1.861	-2.7570	A
ΔCTRATE	2.03/1.97	1.010	1.340	1,13	A	-3.039	-2.7760	R
DDERATIO	2.00	1.045	1.350	1,14	A	-1.062	-2.7570	A
ΔDDERATIO	1.73	1.010	1.340	1,13	A	-3.368	-2.7760	R
DIVCOVER	2.39/1.61	1.045	1.350	1,14	A	-1.265	-2.7570	A
ΔDIVCOVER	1.94	1.010	1.340	1,13	A	-7.129	-2.7760	R
GDP	0.821	1.010	1.340	1,13	R	4.35	-2.7760	A
ΔGDP	1.19	0.971	1.331	1,12	I	-0.9631	-2.7988	A
ΔΔGDP	1.55	0.927	1.324	1,11	A	-2.224	-2.8270	A
ΔΔΔGDP	1.83	0.879	1.320	1,10	A	-2.628	-2.8622	A
ΔΔΔΔGDP	2.10/1.90	0.824	1.320	1,9	A	-3.847	-2.9076	R
GDPchange	1.18	0.971	1.331	1,12	I	-1.11	-2.7988	A
ΔGDPchange	1.59	0.927	1.324	1,11	A	-2.273	-2.8270	A
ΔΔGDPchange	1.86	0.879	1.320	1,10	A	-2.708	-2.8622	A
ΔΔΔGDPchange	2.11/1.89	0.824	1.320	1,9	A	-3.871	-2.9076	R
INFLATE	0.423	1.045	1.350	1,14	R	4.741	-2.7570	A
ΔINFLATE	1.28	1.010	1.340	1,13	I	-0.5234	-2.7760	A
ΔΔINFLATE	1.93	0.971	1.331	1,12	A	-2.974	-2.7988	R
INFLATEchange	1.26	1.010	1.340	1,13	I	-0.78	-2.7760	A
ΔINFLATEchange	1.83	0.971	1.331	1,12	A	-2.973	-2.7988	R
INTCOVER	1.52	1.045	1.350	1,14	A	0.005194	-2.7570	A
ΔINTCOVER	2.02/1.98	1.010	1.340	1,13	A	-2.772	-2.7760	A
ΔΔINTCOVER	2.09/1.91	0.971	1.331	1,12	A	-5.443	-2.7988	R
INTCOVERchange	2.08/1.92	1.010	1.340	1,13	A	-3.064	-2.7760	R
INVEST	1.21	0.971	1.331	1,12	I	3.857	-2.7988	A
ΔINVEST	1.63	0.927	1.324	1,11	A	-0.9125	-2.8270	A
ΔΔINVEST	1.85	0.879	1.320	1,10	A	-2.746	-2.8622	I
ΔΔΔINVEST	2.10/1.90	0.824	1.320	1,9	A	-3.629	-2.9076	R
INVESTchange	1.47	0.927	1.324	1,11	A	-1.225	-2.8270	A
ΔINVESTchange	1.76	0.879	1.320	1,10	A	-2.52	-2.8622	A
ΔΔINVESTchange	1.98	0.824	1.320	1,9	A	-3.211	-2.9076	R
INVESTchch	2.00	0.879	1.320	1,10	A	-3.196	-2.8622	R
LRINT	1.12	1.045	1.350	1,14	I	-0.1257	-2.7570	A
ΔLRINT	1.75	1.010	1.340	1,13	A	-2.344	-2.7760	A
ΔΔLRINT	2.03/1.97	0.971	1.331	1,12	A	-3.489	-2.7988	R
LRINTchange	1.73	1.010	1.340	1,13	A	-2.28	-2.7760	A
ΔLRINTchange	2.00	0.971	1.331	1,12	A	-3.389	-2.7988	R
MRINT	1.15	1.045	1.350	1,14	I	-0.1138	-2.7570	A
ΔMRINT	1.75	1.010	1.340	1,13	A	-2.355	-2.7760	A
ΔΔMRINT	2.04/1.96	0.971	1.331	1,12	A	-3.534	-2.7988	R
MRINTchange	1.90	1.010	1.340	1,13	A	-0.7801	-2.7760	A
ΔMRINTchange	2.01/1.99	0.971	1.331	1,12	A	-3.288	-2.7988	R
QRATIO	2.80/1.20	1.045	1.350	1,14	I	0.3826	-2.7570	A
ΔQRATIO	2.19/1.81	1.010	1.340	1,13	A	-5.089	-2.7760	R
ROCE	2.33/1.67	1.045	1.350	1,14	A	-0.06885	-2.7570	A
ΔROCE	1.86	1.010	1.340	1,13	A	-5.042	-2.7760	R
SMIND	2.35/1.65	1.045	1.350	1,14	A	1.143	-2.7570	A
ΔSMIND	2.00	1.010	1.340	1,13	A	-3.496	-2.7760	R
SRINT	2.21/1.79	0.971	1.331	1,12	A	-0.4438	-2.7988	A
ΔSRINT	1.34	0.927	1.324	1,11	A	-4.193	-2.8270	R

Table 7
Unit root tests for the Netherlands non-weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
TAXRATIO	2.57/1.43	1.045	1.350	1,14	A	-0.7215	-2.7570	A
ΔTAXRATIO	2.22/1.78	1.010	1.340	1,13	A	-5.321	-2.7760	R
WCRATIO	1.94	1.045	1.350	1,14	A	0.1294	-2.7570	A
ΔWCRATIO	1.96	1.010	1.340	1,13	A	-3.358	-2.7760	R

Table 8
Unit root tests for the Netherlands non-weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
GDPchch	1.87	0.595	1.928	3,11	I	-5.061	-5.1153	A
ΔGDPchch	2.25/1.75	0.525	2.016	3,10	I	-7.828	-5.2735	R

Table 9
Unit root tests for the German weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	2.02	0.927	1.324	1,11	A	1.799	-2.8270	A
ΔASSETS	1.77	0.879	1.320	1,10	A	-2.133	-2.8622	A
ΔΔASSETS	2.29/1.71	0.824	1.320	1,9	A	-3.815	-2.9076	R
ASSETSchange	1.82	0.879	1.320	1,10	A	-2.195	-2.8622	A
ΔASSETSchange	2.34/1.66	0.824	1.320	1,9	A	-3.781	-2.9076	R
DDERATIO	3.05/0.95	0.927	1.324	1,11	R	-2.12	-2.8270	A
ΔDDERATIO	1.31	0.879	1.320	1,10	I	-3.309	-2.8622	R
DIVCOVER	2.23/1.77	0.927	1.324	1,11	A	-0.2947	-2.8270	A
ΔDIVCOVER	0.969	0.879	1.320	1,10	I	-3.534	-2.8622	R
GNP	1.05	0.927	1.324	1,11	I	10.13	-2.8270	A
ΔGNP	1.42	0.879	1.320	1,10	A	0.01631	-2.8622	A
ΔΔGNP	1.57	0.824	1.320	1,9	A	-2.125	-2.9076	A
ΔΔΔGNP	1.64	0.763	1.332	1,8	A	-2.974	-2.9677	R
GNPchange	1.55	0.879	1.320	1,10	A	-0.2575	-2.8622	A
ΔGNPchange	1.62	0.824	1.320	1,9	A	-2.572	-2.9076	A
ΔΔGNPchange	1.79	0.763	1.332	1,8	A	-3.644	-2.9677	R
GNPchch	1.88	0.824	1.320	1,9	A	-3.565	-2.9076	R
INFLATE	0.552	0.927	1.324	1,11	R	5.289	-2.8270	A
ΔINFLATE	1.16	0.879	1.320	1,10	I	-0.7471	-2.8622	A
ΔΔINFLATE	2.14/1.86	0.824	1.320	1,9	A	-2.275	-2.9076	A
ΔΔΔINFLATE	2.20/1.80	0.763	1.332	1,8	A	-4.109	-2.9677	R
INFLATEchange	1.13	0.879	1.320	1,10	I	-1.266	-2.8622	A
ΔINFLATEchange	2.20/1.80	0.824	1.320	1,9	A	-2.44	-2.9076	A
ΔΔINFLATEchange	2.22/1.78	0.763	1.332	1,8	A	-4.054	-2.9677	R
INFLATEchch	2.08/1.92	0.824	1.320	1,9	A	-3.349	-2.9076	R
INTCOVER	1.29	0.927	1.324	1,11	I	-0.3031	-2.8270	A
ΔINTCOVER	1.76	0.879	1.320	1,10	A	-1.986	-2.8622	A
ΔΔINTCOVER	2.59	0.824	1.320	1,9	A	-5.736	-2.9076	R
INVEST	1.39	0.927	1.324	1,11	A	2.03	-2.8270	A
ΔINVEST	1.37	0.879	1.320	1,10	A	-1.75	-2.8622	A
ΔΔINVEST	1.15	0.824	1.320	1,9	I	-2.73	-2.9076	A
ΔΔΔINVEST	0.889	0.763	1.332	1,8	I	-4.576	-2.9677	R
INVESTchange	1.51	0.879	1.320	1,10	A	-1.929	-2.8622	A
ΔINVESTchange	1.17	0.824	1.320	1,9	I	-4.157	-2.9076	R
LRINT	1.48	0.927	1.324	1,11	A	-1.045	-2.8270	A
ΔLRINT	1.53	0.879	1.320	1,10	A	-3.098	-2.8622	R
MRINT	1.12	0.927	1.324	1,11	I	-1.068	-2.8270	A
ΔMRINT	1.27	0.879	1.320	1,10	I	-2.412	-2.8622	A
ΔΔMRINT	0.898	0.824	1.320	1,9	I	-3.765	-2.9076	R
MRINTchange	1.29	0.879	1.320	1,10	I	-1.997	-2.8622	A
ΔMRINTchange	1.08	0.824	1.320	1,9	I	-3.103	-2.9076	R
QRATIO	2.14/1.86	0.927	1.324	1,11	A	-0.9487	-2.8270	A
ΔQRATIO	1.85	0.879	1.320	1,10	A	-2.996	-2.8622	R
ROCE	1.02	0.927	1.324	1,11	I	-0.9138	-2.8270	A
ΔROCE	1.20	0.879	1.320	1,10	I	-1.622	-2.8622	A
ΔΔROCE	1.84	0.824	1.320	1,9	A	-3.851	-2.9076	R
ROCEchange	1.17	0.879	1.320	1,10	I	-1.246	-2.8622	A
ΔROCEchange	1.50	0.824	1.320	1,9	A	-4.185	-2.9076	R
SMIND	2.27/1.73	0.927	1.324	1,11	A	0.08977	-2.8270	A
ΔSMIND	2.10/1.90	0.879	1.320	1,10	A	-3.419	-2.8622	R
SRINT	1.22	0.927	1.324	1,11	I	-0.1963	-2.8270	A
ΔSRINT	2.17/1.83	0.879	1.320	1,10	A	-2.916	-2.8622	R
TAXRATIO	1.41	0.927	1.324	1,11	A	-1.848	-2.8270	A
ΔTAXRATIO	2.45/1.55	0.879	1.320	1,10	A	-1.715	-2.8622	A
ΔΔTAXRATIO	2.28/1.72	0.824	1.320	1,9	A	-6.977	-2.9076	R

Table 9
Unit root tests for the German weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
WCRATIO	1.67	0.927	1.324	1,11	A	-0.3287	-2.8270	A
ΔWCRATIO	1.62	0.879	1.320	1,10	A	-2.532	-2.8622	A
ΔΔWCRATIO	1.87	0.824	1.320	1,9	A	-3.711	-2.9076	R
WCRATIOchange	1.56	0.879	1.320	1,10	A	-2.5	-2.8622	A
ΔWCRATIOchange	1.77	0.824	1.320	1,9	A	-3.783	-2.9076	R

Table 10
Unit root tests for the German weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
INTCOVERchange	2.92/1.08	0.525	2.016	3,10	I	-8.04	-5.2735	R
TAXRATIOchange	2.54/1.46	0.525	2.016	3,10	I	-5.616	-5.2735	R

Table 11
Unit root tests for the German non-weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	2.02/1.98	0.927	1.324	1,11	A	1.799	-2.8270	A
ΔASSETS	1.77	0.879	1.320	1,10	A	-2.133	-2.8622	A
ΔΔASSETS	2.29/1.71	0.824	1.320	1,9	A	-3.815	-2.9076	R
DDERATIO	1.36	0.927	1.324	1,11	A	-1.49	-2.8270	A
ΔDDERATIO	1.77	0.879	1.320	1,10	A	-1.924	-2.8622	A
ΔΔDDERATIO	2.00	0.824	1.320	1,9	A	-3.724	-2.9076	R
DIVCOVER	2.64/1.36	0.927	1.324	1,11	A	-0.7931	-2.8270	A
ΔDIVCOVER	1.39	0.879	1.320	1,10	A	-4.631	-2.8622	R
GNP	1.05	0.927	1.324	1,11	I	10.13	-2.8270	A
ΔGNP	1.42	0.879	1.320	1,10	A	0.01631	-2.8622	A
ΔΔGNP	1.57	0.824	1.320	1,9	A	-2.125	-2.9076	A
ΔΔΔGNP	1.64	0.763	1.332	1,8	A	-2.974	-2.9677	R
GNPchange	1.55	0.879	1.320	1,10	A	-0.2575	-2.8622	A
ΔGNPchange	1.62	0.824	1.320	1,9	A	-2.572	-2.9076	A
ΔΔGNPchange	1.79	0.763	1.322	1,8	A	-3.644	-2.9677	R
INFLATE	0.552	0.927	1.324	1,11	R	5.289	-2.8270	A
ΔINFLATE	1.16	0.879	1.320	1,10	I	-0.7471	-2.8622	A
ΔΔINFLATE	2.14/1.86	0.824	1.320	1,9	A	-2.275	-2.9076	A
ΔΔΔINFLATE	2.20/1.80	0.763	1.332	1,8	A	-4.109	-2.9677	R
INFLATEchange	1.13	0.879	1.320	1,10	I	-1.266	-2.8622	A
ΔINFLATEchange	2.20/1.80	0.824	1.320	1,9	A	-2.44	-2.9076	A
ΔΔINFLATEchange	2.22/1.78	0.763	1.332	1,8	A	-4.054	-2.9677	R
INTCOVER	1.88	0.927	1.324	1,11	A	-0.8023	-2.8270	A
ΔINTCOVER	1.55	0.879	1.320	1,10	A	-3.76	-2.8622	R
INVEST	1.39	0.927	1.324	1,11	A	2.03	-2.8270	A
ΔINVEST	1.37	0.879	1.320	1,10	A	-1.75	-2.8622	A
ΔΔINVEST	1.15	0.824	1.320	1,9	I	-2.73	-2.9076	A
ΔΔΔINVEST	0.889	0.763	1.332	1,8	I	-4.576	-2.9677	R
INVESTchange	1.51	0.879	1.320	1,10	A	-1.929	-2.8622	A
ΔINVESTchange	1.17	0.824	1.320	1,9	I	-4.157	-2.9076	R
LRINT	1.48	0.927	1.324	1,11	A	-1.045	-2.8270	A
ΔLRINT	1.53	0.879	1.320	1,10	A	-3.098	-2.8622	R
MRINT	1.12	0.927	1.324	1,11	I	-1.068	-2.8270	A
ΔMRINT	1.27	0.879	1.320	1,10	I	-2.412	-2.8622	A
ΔΔMRINT	0.898	0.824	1.320	1,9	I	-3.765	-2.9076	R
QRATIO	1.98	0.927	1.324	1,11	A	-0.1058	-2.8270	A
ΔQRATIO	1.90	0.879	1.320	1,10	A	-2.975	-2.8622	R
ROCE	1.35	0.927	1.324	1,11	A	-0.4173	-2.8270	A
ΔROCE	1.18	0.879	1.320	1,10	I	-2.103	-2.8622	A
ΔΔROCE	1.95	0.824	1.320	1,9	A	-3.516	-2.9076	R
SMIND	2.27/1.73	0.927	1.324	1,11	A	0.08977	-2.8270	A
ΔSMIND	2.10/1.90	0.879	1.320	1,10	A	-3.419	-2.8622	R
SRINT	1.22	0.927	1.324	1,11	I	-0.1963	-2.8270	A
ΔSRINT	2.17/1.83	0.879	1.320	1,10	A	-2.916	-2.8622	R
TAXRATIO	2.35/1.65	0.927	1.324	1,11	A	-0.743	-2.8270	A
ΔTAXRATIO	1.56	0.879	1.320	1,10	A	-3.631	-2.8622	R
WCRATIO	2.04/1.96	0.927	1.324	1,11	A	-0.2626	-2.8270	A
ΔWCRATIO	1.85	0.879	1.320	1,10	A	-3.169	-2.8622	R

Table 12
Unit root tests for the French weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.22	0.824	1.320	1,9	I	4.997	-2.9076	A
ΔASSETS	1.83	0.763	1.332	1,8	A	0.5694	-2.9677	A
ΔΔASSETS	1.49	0.700	1.356	1,7	A	-1.813	-3.0507	A
ASSETSchange	1.84	0.763	1.332	1,8	A	-0.7944	-2.9677	A
ΔASSETSchange	1.89	0.700	1.356	1,7	A	-2.67	-3.0507	A
ASSETSchch	1.35	0.700	1.356	1,7	I	-2.321	-3.0507	A
CTAXRATIO	2.47/1.53	0.824	1.320	1,9	A	-0.8041	-2.9076	A
ΔCTAXRATIO	0.893	0.763	1.332	1,8	I	-3.098	-2.9677	R
CTRATE	1.94	0.824	1.320	1,9	A	-1.16	-2.9076	A
ΔCTRATE	1.92	0.763	1.332	1,8	A	-2.383	-2.9677	A
ΔΔCTRATE	2.30/1.70	0.700	1.356	1,7	A	-3.966	-3.0507	R
CTRATEchange	1.89	0.763	1.332	1,8	A	-2.192	-2.9677	A
ΔCTRATEchange	2.26/1.74	0.700	1.356	1,7	A	-3.876	-3.0507	R
DDERATIO	2.34/1.66	0.824	1.320	1,9	A	-0.2524	-2.9076	A
ΔDDERATIO	1.99	0.763	1.332	1,8	A	-3.292	-2.9677	R
DIVCOVER	1.72	0.824	1.320	1,9	A	-2.487	-2.9076	A
ΔDIVCOVER	2.55/1.45	0.763	1.332	1,8	A	-3.469	-2.9677	R
GDP	0.918	0.824	1.320	1,9	I	4.682	-2.9076	A
ΔGDP	1.52	0.763	1.332	1,8	A	-0.6508	-2.9677	A
ΔΔGDP	1.80	0.700	1.356	1,7	A	-2.043	-3.0507	A
GDPchange	1.53	0.763	1.332	1,8	A	-0.6622	-2.9677	A
ΔGDPchange	1.83	0.700	1.356	1,7	A	-2.061	-3.0507	A
GDPchch	1.78	0.700	1.356	1,7	A	-2.474	-3.0507	A
INFLATEchange	2.22/1.78	0.763	1.332	1,8	A	-2.507	-2.9677	A
ΔINFLATEchange	2.04/1.96	0.700	1.356	1,7	A	-2.289	-3.0507	A
INFLATEchch	1.61	0.700	1.356	1,7	A	-3.136	-3.0507	R
INTCOVERchange	1.50	0.763	1.332	1,8	A	-2.46	-2.9677	A
ΔINTCOVERchange	2.13/1.87	0.700	1.356	1,7	A	-3.77	-3.0507	R
INVEST	0.672	0.824	1.320	1,9	R	1.839	-2.9076	A
ΔINVEST	0.876	0.763	1.332	1,8	I	-0.9624	-2.9677	A
ΔΔINVEST	1.62	0.700	1.356	1,7	A	-1.968	-3.0507	A
INVESTchange	0.876	0.763	1.332	1,8	I	-0.9925	-2.9677	A
ΔINVESTchange	1.70	0.700	1.356	1,7	A	-2.191	-3.0507	A
INVESTchch	1.66	0.700	1.356	1,7	A	-3.853	-3.0507	R
LRINT	2.16/1.84	0.824	1.320	1,9	A	-2.115	-2.9076	A
ΔLRINT	2.18/1.82	0.763	1.332	1,8	A	-2.282	-2.9677	A
ΔΔLRINT	2.37/1.63	0.700	1.356	1,7	A	-4.597	-3.0507	R
LRINTchange	2.05/1.95	0.763	1.332	1,8	A	-2.469	-2.9677	A
ΔLRINTchange	2.46/1.54	0.700	1.356	1,7	A	-4.771	-3.0507	R
MRINT	2.16/1.84	0.824	1.320	1,9	A	-1.517	-2.9076	A
ΔMRINT	2.05/1.95	0.763	1.332	1,8	A	-2.521	-2.9677	A
ΔΔMRINT	2.44/1.56	0.700	1.356	1,7	A	-4.578	-3.0507	R
MRINTchange	1.99	0.763	1.332	1,8	A	-2.892	-2.9677	A
ΔMRINTchange	2.48/1.52	0.700	1.356	1,7	A	-4.715	-3.0507	R
QRATIO	2.63/1.37	0.824	1.320	1,9	A	-0.9675	-2.9076	A
ΔQRATIO	1.98	0.763	1.332	1,8	A	-3.312	-2.9677	R
ROCE	1.91	0.824	1.320	1,9	A	-1.434	-2.9076	A
ΔROCE	1.98	0.763	1.332	1,8	A	-2.248	-2.9677	A
ΔΔROCE	1.46	0.700	1.356	1,7	A	-3.984	-3.0507	R
ROCEchange	1.90	0.763	1.332	1,8	A	-2.124	-2.9677	A
ΔROCEchange	1.71	0.700	1.356	1,7	A	-3.844	-3.0507	R
SMIND	2.34/1.66	0.824	1.320	1,9	A	1.149	-2.9076	A
ΔSMIND	2.07/1.93	0.763	1.332	1,8	A	-2.609	-2.9677	A
ΔΔSMIND	2.67/1.33	0.700	1.356	1,7	I	-5.04	-3.0507	R
SMINDchange	2.30/1.70	0.763	1.332	1,8	A	-2.274	-2.9677	A
ΔSMINDchange	2.51/1.49	0.700	1.356	1,7	A	-4.838	-3.0507	R

Table 12
Unit root tests for the French weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
SRINT	1.39	0.824	1.320	1,9	A	-0.8089	-2.9076	A
ΔSRINT	1.99	0.763	1.332	1,8	A	-1.942	-2.9677	A
ΔΔSRINT	2.19/1.81	0.700	1.356	1,7	A	-3.93	-3.0507	R
SRINTchange	1.98	0.763	1.332	1,8	A	-2.171	-2.9677	A
ΔSRINTchange	2.19/1.81	0.700	1.356	1,7	A	-4.223	-3.0507	R
TAXADV	1.58	0.824	1.320	1,9	A	-0.8835	-2.9076	A
ΔTAXADV	1.92	0.763	1.332	1,8	A	-2.383	-2.9677	A
ΔΔTAXADV	2.30/1.70	0.700	1.356	1,7	A	-3.966	-3.0507	R
TAXADVchange	2.05/1.95	0.763	1.332	1,8	A	-3.033	-2.9677	R
TAXRATIO	2.64/1.36	0.824	1.320	1,9	A	-0.7761	-2.9076	A
ΔTAXRATIO	1.44	0.763	1.332	1,8	A	-4.667	-2.9677	R
WCRATIO	2.06/1.94	0.824	1.320	1,9	A	-1.53	-2.9076	A
ΔWCRATIO	2.01/1.99	0.763	1.332	1,8	A	-2.22	-2.9677	A
ΔΔWCRATIO	2.04/1.96	0.700	1.356	1,7	A	-4.204	-3.0507	R
WCRATIOchange	1.99	0.763	1.332	1,8	A	-2.137	-2.9677	A
ΔWCRATIOchange	2.01/1.99	0.700	1.356	1,7	A	-4.151	-3.0507	R

Table 13
Unit root tests for the French weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
INFLATE	2.42/1.58	0.455	2.128	3,9	I	-4.621	-5.4776	A
INTCOVER	2.07/1.93	0.455	2.128	3,9	I	-4.585	-5.4776	A

Table 14
Unit root tests for the French non-weighted sample, showing critical Dickey Fuller statistics (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
ASSETS	1.22	0.824	1.320	1,9	I	4.997	-2.9076	A
ΔASSETS	1.83	0.763	1.332	1,8	A	0.5694	-2.9677	A
ΔΔASSETS	1.49	0.700	1.356	1,7	A	-1.813	-3.0507	A
ASSETSchange	1.84	0.763	1.332	1,8	A	-0.7944	-2.9677	A
ΔASSETSchange	1.89	0.700	1.356	1,7	A	-2.67	-3.0507	A
CTAXRATIO	2.95/1.05	0.824	1.320	1,9	I	-0.9099	-2.9076	A
ΔCTAXRATIO	2.03/1.97	0.763	1.322	1,8	A	-5.659	-2.9677	R
CTRATE	2.34/1.66	0.824	1.320	1,9	A	-3.17	-2.9076	R
DDERATIO	2.11/1.89	0.824	1.320	1,9	A	-1.147	-2.9076	A
ΔDDERATIO	1.93	0.763	1.332	1,8	A	-2.646	-2.9677	A
ΔΔDDERATIO	2.70/1.30	0.700	1.356	1,7	I	-4.337	-3.0507	R
DIVCOVER	1.28	0.824	1.320	1,9	I	-1.452	-2.9076	A
ΔDIVCOVER	1.99	0.763	1.332	1,8	A	-1.58	-2.9677	A
ΔΔDIVCOVER	1.44	0.700	1.356	1,7	A	-3.266	-3.0507	R
GDP	0.918	0.824	1.320	1,9	I	4.682	-2.9076	A
ΔGDP	1.52	0.763	1.332	1,8	A	-0.6508	-2.9677	A
ΔΔGDP	1.80	0.700	1.356	1,7	A	-2.043	-3.0507	A
GDPchange	1.55	0.763	1.332	1,8	A	-0.6635	-2.9677	A
ΔGDPchange	1.83	0.700	1.356	1,7	A	-2.073	-3.0507	A
GDPchch	1.78	0.700	1.356	1,7	A	-2.474	-3.0507	A
INFLATEchange	2.22/1.78	0.763	1.332	1,8	A	-2.507	-2.9677	A
ΔINFLATEchange	2.04/1.96	0.700	1.356	1,7	A	-2.289	-3.0507	A
INFLATEchch	1.61	0.700	1.356	1,7	A	-3.136	-3.0507	R
INTCOVER	2.33/1.67	0.824	1.320	1,9	A	-1.142	-2.9076	A
ΔINTCOVER	1.66	0.763	1.332	1,8	A	-3.474	-2.9677	R
INVEST	0.672	0.824	1.320	1,9	R	1.839	-2.9076	A
ΔINVEST	0.876	0.763	1.332	1,8	I	-0.9624	-2.9677	A
ΔΔINVEST	1.62	0.700	1.356	1,7	A	-1.968	-3.0507	A
INVESTchange	0.876	0.763	1.332	1,8	I	-0.9925	-2.9677	A
ΔINVESTchange	1.70	0.700	1.356	1,7	A	-2.191	-3.0507	A
INVESTchch	1.66	0.700	1.356	1,7	A	-3.853	-3.0507	R
LRINT	2.16/1.84	0.824	1.320	1,9	A	-2.115	-2.9076	A
ΔLRINT	2.18/1.82	0.763	1.332	1,8	A	-2.282	-2.9677	A
ΔΔLRINT	2.37/1.63	0.700	1.356	1,7	A	-4.597	-3.0507	R
MRINT	2.16/1.84	0.824	1.320	1,9	A	-1.517	-2.9076	A
ΔMRINT	2.05/1.95	0.763	1.332	1,8	A	-2.521	-2.9677	A
ΔΔMRINT	2.44/1.56	0.700	1.356	1,7	A	-4.578	-3.0507	R
QRATIO	3.07/0.93	0.824	1.320	1,9	I	-0.08405	-2.9076	A
ΔQRATIO	2.56/1.44	0.763	1.332	1,8	A	-4.95	-2.9677	R
ROCE	2.35/1.65	0.824	1.320	1,9	A	-1.07	-2.9076	A
ΔROCE	1.48	0.763	1.332	1,8	A	-2.91	-2.9677	A
ΔΔROCE	0.806	0.700	1.356	1,7	A	-5.087	-3.0507	R
SMIND	2.34/1.66	0.824	1.320	1,9	A	1.149	-2.9076	A
ΔSMIND	2.07/1.93	0.763	1.332	1,8	A	-2.609	-2.9677	A
ΔΔSMIND	2.67/1.33	0.700	1.356	1,7	I	-5.04	-3.0507	R
SRINT	1.39	0.824	1.320	1,9	A	-0.8089	-2.9076	A
ΔSRINT	1.99	0.763	1.332	1,8	A	-1.942	-2.9677	A
ΔΔSRINT	2.19/1.81	0.700	1.356	1,7	A	-3.93	-3.0507	R
TAXADV	1.59	0.824	1.320	1,9	A	-2.322	-2.9076	A
ΔTAXADV	2.46/1.54	0.763	1.332	1,8	A	-1.587	-2.9677	A
ΔΔTAXADV	1.79	0.700	1.356	1,7	A	-5.571	-3.0507	R
TAXRATIO	2.53/1.47	0.824	1.320	1,9	A	-0.8903	-2.9076	A
ΔTAXRATIO	1.91	0.763	1.332	1,8	A	-5.34	-2.9677	R
WCRATIO	1.58	0.824	1.320	1,9	A	0.08651	-2.9076	A
ΔWCRATIO	1.64	0.763	1.332	1,8	A	-2.165	-2.9677	A
ΔΔWCRATIO	1.68	0.700	1.356	1,7	A	-2.454	-3.0507	A
WCRATIOchange	1.64	0.763	1.332	1,8	A	-2.164	-2.9677	A
ΔWCRATIOchange	1.66	0.700	1.356	1,7	A	-2.444	-3.0507	A

Table 15
Unit root tests for the French non-weighted sample, showing critical Dickey Fuller statistics (with trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
INFLATE	2.42/1.58	0.455	2.128	3,9	I	-4.621	-5.4776	A

APPENDIX G:
MACKINNON TABLES USED IN THE COINTEGRATION TESTING

Table 1
Mackinnon distribution critical value table at the 10 per cent level (N=2, no trend)

$$\hat{\beta}_{\infty} = -3.0462, \hat{\beta}_1 = -4.069, \hat{\beta}_2 = -5.73$$

T	-3.0462	$-4.069/T$	$-5.73/T^2$	**Mackinnon distribution**
5	"	-0.8138	-0.2292	**-4.0892**
6	"	-0.6782	-0.1592	**-3.8836**
7	"	-0.5813	-0.1169	**-3.7444**
8	"	-0.5086	-0.0895	**-3.6443**
9	"	-0.4521	-0.0707	**-3.5690**
10	"	-0.4069	-0.0573	**-3.5104**
11	"	-0.3699	-0.0474	**-3.4635**
12	"	-0.3391	-0.0398	**-3.4251**
13	"	-0.3130	-0.0339	**-3.3931**
14	"	-0.2906	-0.0292	**-3.3660**
15	"	-0.2713	-0.0255	**-3.3430**
16	"	-0.2543	-0.0224	**-3.3229**
17	"	-0.2394	-0.0198	**-3.3054**
18	"	-0.2261	-0.0177	**-3.2900**
19	"	-0.2142	-0.0159	**-3.2763**
20	"	-0.2035	-0.0143	**-3.2640**
21	"	-0.1938	-0.0130	**-3.2530**
22	"	-0.1850	-0.0118	**-3.2430**
23	"	-0.1769	-0.0108	**-3.2339**
24	"	-0.1695	-0.0099	**-3.2256**
25	"	-0.1628	-0.0092	**-3.2182**

Table 2
Mackinnon distribution critical value table at the 10 per cent level
(N=2, no trend)

$$\hat{\beta}_{\infty} = -3.4959, \hat{\beta}_1 = -1.960, \hat{\beta}_2 = -10.04$$

T	-3.4959	$-7.203/T$	$-4.01/T^2$	**Mackinnon distribution**
5	"	-1.4406	-0.1604	**-5.0969**
6	"	-1.2005	-0.1114	**-4.8078**
7	"	-1.0290	-0.0818	**-4.6067**
8	"	-0.9004	-0.0627	**-4.4590**
9	"	-0.8003	-0.0495	**-4.3457**
10	"	-0.7203	-0.0401	**-4.2563**
11	"	-0.6548	-0.0331	**-4.1838**
12	"	-0.6003	-0.0278	**-4.1240**
13	"	-0.5541	-0.0237	**-4.0737**
14	"	-0.5145	-0.0205	**-4.0309**
15	"	-0.4802	-0.0178	**-3.9939**
16	"	-0.4502	-0.0157	**-3.9618**
17	"	-0.4237	-0.0139	**-3.9335**
18	"	-0.4002	-0.0124	**-3.9085**
19	"	-0.3791	-0.0111	**-3.8861**
20	"	-0.3602	-0.0100	**-3.8661**
21	"	-0.3430	-0.0091	**-3.8480**
22	"	-0.3274	-0.0083	**-3.8316**
23	"	-0.3132	-0.0076	**-3.8167**
24	"	-0.3001	-0.0070	**-3.8030**
25	"	-0.2881	-0.0064	**-3.7904**

APPENDIX H:
F-TESTS FOR THE PRESENCE OF A DETERMINISTIC TREND WITHIN THE ERROR CORRECTION MECHANISM OF A BIVARIATE RELATIONSHIP BETWEEN THE DDERATIO AND EACH VARIABLE

Table 1
The F-test for the presence of a deterministic trend within the UK weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETSchange	2,21	5.051	accept
CTAXRATIO	2,22	4.2172	accept
CTRATE	2,22	3.9977	accept
DIVCOVER	2,19	6.2987	accept
GDPchange	2,20	4.1639	accept
INCTAX	2,22	4.283	accept
INFLATEchange	2,20	6.0726	accept
INTCOVER	2,22	4.3303	accept
INVESTchange	2,20	4.1441	accept
LRINT	2,21	3.6035	accept
MRINT	2,15	3.1894	accept
QRATIO	2,22	3.1537	accept
ROCE	2,22	5.2713	accept
SMIND	2,20	3.8201	accept
SRINT	2,21	4.1964	accept
TAXADV	2,22	3.9871	accept
TAXRATIO	2,22	4.5239	accept
WCRATIO	2,22	4.5717	accept

Table 2
The F-test for the presence of a deterministic trend within the UK non-weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETSchange	2,21	4.3048	accept
CTAXRATIO	2,22	4.1298	accept
CTRATEchange	2,21	6.6183	accept
DIVCOVER	2,19	3.9745	accept
GDPchange	2,20	4.08	accept
INCTAX	2,22	3.9377	accept
INFLATEchange	2,20	8.0612	accept
INTCOVER	2,22	4.4086	accept
INVESTchange	2,20	3.0443	accept
LRINT	2,21	2.601	accept
MRINT	2,15	3.9666	accept
QRATIO	2,22	3.8702	accept
ROCE	2,22	3.9845	accept
SMIND	2,20	2.7295	accept
SRINT	2,21	3.6742	accept
TAXADV	2,22	3.7893	accept
TAXRATIO	2,22	3.398	accept
WCRATIO	2,22	4.3286	accept

Table 3
The F-test for the presence of a deterministic trend within the Netherlands weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETSchange	2,10	4.0275	accept
CTRATE	2,11	2.3091	accept
GDPchch	2,8	2.5919	accept
INFLATEchange	2,10	6.8975	accept
INTCOVER	2,11	2.5143	accept
LRINTchange	2,10	2.5973	accept
MRINTchange	2,10	2.7274	accept
QRATIO	2,11	3.6608	accept
ROCE	2,11	2.5252	accept
SMIND	2,11	2.3698	accept
SRINT	2,9	3.7555	accept
TAXRATIO	2,11	2.4412	accept

Table 4
The F-test for the presence of a deterministic trend within the Netherlands non-weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETSchange	2,10	1.7627	accept
CTRATE	2,11	1.3043	accept
DIVCOVER	2,11	1.8162	accept
GDPchch	2,8	5.0828	accept
INFLATEchange	2,10	2.7552	accept
LRINTchange	2,10	1.9687	accept
MRINTchange	2,10	2.2933	accept
QRATIO	2,11	2.9944	accept
ROCE	2,11	1.5052	accept
SMIND	2,11	2.0457	accept
SRINT	2,9	3.2126	accept
TAXRATIO	2,11	2.4308	accept
WCRATIO	2,11	2.135	accept

Table 5
The F-test for the presence of a deterministic trend within the German weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETSchange	2,7	13.355	reject
DIVCOVER	2,8	4.3223	accept
INVESTchange	2,7	3.4215	accept
LRINT	2,8	9.689	accept
MRINTchange	2,7	1.9474	accept
QRATIO	2,8	2.2439	accept
ROCEchange	2,7	16.943	reject
SMIND	2,8	3.5243	accept
SRINT	2,8	2.9592	accept
WCRATIOchange	2,7	11.832	reject

Table 6
The F-test for the presence of a deterministic trend within the German non-weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
ASSETS	2,8	2.2147	accept
GNPchange	2,7	2.5455	accept
INFLATEchange	2,7	2.5524	accept
MRINT	2,8	1.7135	accept
ROCE	2,8	4.147	accept

Table 7
The F-test for the presence of a deterministic trend within the French weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
CTAXRATIO	2,6	3.4752	accept
CTRATEchange	2,5	2.9079	accept
DIVCOVER	2,6	2.5538	accept
INTCOVERchange	2,5	2.7094	accept
LRINTchange	2,5	2.5444	accept
MRINTchange	2,5	2.6861	accept
QRATIO	2,6	2.4425	accept
ROCEchange	2,5	3.0128	accept
SMINDchange	2,5	3.4794	accept
SRINTchange	2,5	2.6668	accept
TAXRATIO	2,6	3.0424	accept
WCRATIOchange	2,5	3.3218	accept

Table 8
The F-test for the presence of a deterministic trend within the French non-weighted sample error correction mechanisms

error correction mechanism	degrees of freedom	F-statistic	accept/reject
DIVCOVER	2,6	2.4892	accept
LRINT	2,6	1.7033	accept
MRINT	2,6	1.1995	accept
ROCE	2,6	2.0515	accept
SMIND	2,6	2.835	accept
SRINT	2,6	2.2785	accept
TAXADV	2,6	3.1944	accept

APPENDIX I: TESTING FOR THE EXISTENCE OF COINTEGRATION WITHIN BIVARIATE EUROPEAN CORPORATE CAPITAL STRUCTURE RELATIONSHIPS

Table 1
Cointegration tests for the UK weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchangelag0	2.08/1.92	1.273	1.446	1,24	A	-3.219	-3.2256	A
ASSETSchangelag1	1.98	1.168	1.543	2,23	A	-2.29	-3.2339	A
ASSETSchangelag2	2.02/1.98	1.053	1.664	3,22	A	-2.031	-3.2430	A
ASSETSchangelag3	2.08/1.92	0.927	1.812	4,21	A	-2.602	-3,2530	A
ASSETSchangelag4	1.63	0.792	1.991	5,20	I	-2.392	-3.2640	A
ASSETSchangelag5	2.18/1.81	0.649	2.206	6,19	I	-2.056	-3.2763	A
CTAXRATIOlag0	1.85	1.288	1.454	1,25	A	-2.762	-3.2182	A
CTAXRATIOlag1	1.96	1.188	1.546	2,24	A	-2.492	-3.2256	A
CTAXRATIOlag2	1.97	1.078	1.660	3,23	A	-2.169	-3.2339	A
CTAXRATIOlag3	2.03/1.97	0.958	1.797	4,22	A	-2.434	-3.2430	A
CTAXRATIOlag4	1.95	0.829	1.964	5,21	I	-2.447	-3.2530	A
CTAXRATIOlag5	1.72	0.692	2.162	6,20	I	-2.044	-3.2640	A
CTRATElag0	1.98	1.288	1.454	1,25	A	-2.912	-3.2182	A
CTRATElag1	1.99	1.188	1.546	2,24	A	-2.478	-3.2256	A
CTRATElag2	2.02/1.98	1.078	1.660	3,23	A	-2.16	-3.2339	A
CTRATElag3	2.14/1.86	0.958	1.797	4,22	A	-2.608	-3.2430	A
CTRATElag4	2.09/1.91	0.829	1.964	5,21	I	-2.706	-3.2530	A
CTRATElag5	1.65	0.692	2.162	6,20	I	-2.494	-3.2640	A
DIVCOVERlag0	1.73	1.239	1.429	1,22	A	-3.285	-3.2430	R
DIVCOVERlag1	1.88	1.125	1.538	2,21	A	-3.302	-3.2530	R
DIVCOVERlag2	1.98	0.998	1.676	3,20	A	-2.471	-3.2640	A
DIVCOVERlag3	1.85	0.859	1.848	4,19	A	-2.389	-3.2763	A
DIVCOVERlag4	1.93	0.710	2.060	5,18	I	-2.213	-3.2900	A
DIVCOVERlag5	1.89	0.554	2.318	6,17	I	-1.829	-3.3054	A
GDPchangelag0	1.91	1.257	1.437	1,23	A	-2.839	-3.2339	A
GDPchangelag1	1.95	1.147	1.541	2,22	A	-2.432	-3.2430	A
GDPchangelag2	1.96	1.026	1.669	3,21	A	-2.087	-3.2530	A
GDPchangelag3	1.89	0.894	1.828	4,20	A	-2.449	-3.2640	A
GDPchangelag4	2.01/1.99	0.752	2.023	5,19	I	-1.884	-3.2763	A
GDPchangelag5	1.97	0.603	2.257	6,18	I	-2.05	-3.2900	A
INCTAXlag0	1.84	1.288	1.454	1,25	A	-2.738	-3.2182	A
INCTAXlag1	1.95	1.188	1,546	2,24	A	-2.466	-3.2256	A
INCTAXlag2	1.96	1.078	1.660	3,23	A	-2.118	-3.2339	A
INCTAXlag3	2.02/1.98	0.958	1.797	4,22	A	-2.385	-3.2430	A
INCTAXlag4	1.94	0.829	1.964	5,21	I	-2.343	-3.2530	A
INCTAXlag5	1.71	0.692	2.162	6,20	I	-1.927	-3.2640	A
INFLATEchangelag0	1.98	1.257	1.437	1,23	A	-3.649	-3.2339	R
INFLATEchangelag1	1.99	1.147	1.541	2,22	A	-2.793	-3.2430	A
INFLATEchangelag2	1.99	1.026	1.669	3,21	A	-2.171	-3.2530	A
INFLATEchangelag3	2.00	0.894	1.828	4,20	A	-2.11	-3.2640	A
INFLATEchangelag4	1.91	0.752	2.023	5,19	I	-1.753	-3.2763	A
INFLATEchangelag5	1.69	0.603	2.257	6,18	I	-2.017	-3.2900	A
INTCOVERlag0	1.70	1.288	1.454	1,25	A	-2.689	-3.2182	A
INTCOVERlag1	1.97	1.188	1.546	2,24	A	-2.578	-3.2256	A
INTCOVERlag2	1.97	1.078	1.660	3,23	A	-2.299	-3.2339	A
INTCOVERlag3	1.97	0.958	1.797	4,22	A	-2.42	-3.2430	A
INTCOVERlag4	1.89	0.829	1.964	5,21	I	-2.244	-3.2530	A
INTCOVERlag5	1.66	0.692	2.162	6,20	I	-1.979	-3.2640	A

Table 1
Cointegration tests for the UK weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
INVESTchangelag0	1.98	1.257	1.437	1,23	A	-2.997	-3.2339	A
INVESTchangelag1	1.97	1.147	1.541	2,22	A	-2.368	-3.2430	A
INVESTchangelag2	2.00	1.026	1.669	3,21	A	-2.064	-3.2530	A
INVESTchangelag3	2.08/1.92	0.894	1.828	4,20	A	-2.482	-3.2640	A
INVESTchangelag4	1.68	0.752	2.023	5,19	I	-2.233	-3.2763	A
INVESTchangelag5	1.86	0.603	2.257	6,18	I	-2.145	-3.2900	A
LRINTlag0	1.96	1.273	1.446	1,24	A	-2.801	-3.2256	A
LRINTlag1	1.97	1.168	2.543	2,23	A	-2.327	-3.2339	A
LRINTlag2	1.95	1.053	1.664	3,22	A	-1.839	-3.2430	A
LRINTlag3	2.02/1.98	0.927	1.812	4,21	A	-2.062	-3.2530	A
LRINTlag4	1.99	0.792	1.991	5,20	I	-1.807	-3.2640	A
LRINTlag5	1.87	0.752	2.023	6,19	I	-1.887	-3.2763	A
MRINTlag0	1.93	1.158	1.391	1,18	A	-2.673	-3.2900	A
MRINTlag1	1.95	1.015	1.536	2,17	A	-2.406	-3.3054	A
MRINTlag2	1.96	0.857	1.728	3,16	A	-2.113	-3.3229	A
MRINTlag3	1.93	0.685	1.977	4,15	A	-2.409	-3.3430	A
MRINTlag4	1.67	0.505	2.296	5,14	I	-2.29	-3.3660	A
MRINTlag5	1.87	0.328	2.692	6,13	I	-0.9632	-3.3931	A
QRATIOlag0	1.99	1.288	1.454	1,25	A	-2.544	-3.2182	A
QRATIOlag1	2.00	1.188	1.546	2,24	A	-2.167	-3.2256	A
QRATIOlag2	2.04/1.96	1.078	1.660	3,23	A	-1.967	-3.2339	A
QRATIOlag3	2.05/1.95	0.958	1.797	4,22	A	-2.348	-3.2430	A
QRATIOlag4	2.01/1.99	0.829	1.964	5,21	A	-2.12	-3.2530	A
QRATIOlag5	1.76	0.692	2.162	6,20	I	-1.943	-3.2640	A
ROCElag0	1.65	1.288	1.454	1,25	A	-3.367	-3.2182	R
ROCElag1	1.88	1.188	1.546	2,24	A	-3.552	-3.2256	R
ROCElag2	1.89	1.078	1.660	3,23	A	-2.707	-3.2339	A
ROCElag3	2.15/1.85	0.958	1.797	4,22	A	-3.114	-3.2430	A
ROCElag4	2.18/1.82	0.829	1.964	5,21	I	-3.771	-3.2530	R
ROCElag5	1.86	0.692	2.162	6,20	I	-3.396	-3.2640	R
SMINDlag0	1.93	1.257	1.437	1,23	A	-2.86	-3.2339	A
SMINDlag1	1.97	1.147	1.541	2,22	A	-2.454	-3.2430	A
SMINDlag2	2.00	1.026	1.669	3,21	A	-2.137	-3.2530	A
SMINDlag3	2.08/1.92	0.894	1.828	4,20	A	-2.631	-3.2640	A
SMINDlag4	1.77	0.752	2.023	5,19	I	-2.312	-3.2763	A
SMINDlag5	1.92	0.603	2.257	6,18	I	-2.146	-3.2900	A
SRINTlag0	1.90	1.273	1.446	1,24	A	-2.902	-3.2256	A
SRINTlag1	1.96	1.168	1.543	2,23	A	-2.587	-3.2339	A
SRINTlag2	1.92	1.053	1.664	3,22	A	-1.882	-3.2430	A
SRINTlag3	2.00	0.927	1.812	4,21	A	-2.067	-3.2530	A
SRINTlag4	1.99	0.792	1.991	5,20	I	-1.998	-3.2640	A
SRINTlag5	1.68	0.752	2.023	6,19	I	-1.846	-3.2763	A
TAXADVlag0	2.02/1.98	1.288	1.454	1,25	A	-2.814	-3.2182	A
TAXADVlag1	1.98	1.188	1.546	2,24	A	-2.232	-3.2256	A
TAXADVlag2	2.01/1.99	1.078	1.660	3,23	A	-1.933	-3.2339	A
TAXADVlag3	2.10/1.90	0.958	1.797	4,22	A	-2.297	-3.2430	A
TAXADVlag4	2.03/1.97	0.829	1.964	5,21	A	-2.293	-3.2530	A
TAXADVlag5	1.62	0.692	2.162	6,20	A	-2.033	-3.2640	A
TAXRATIOlag0	1.86	1.288	1.454	1,25	A	-3.132	-3.2182	A
TAXRATIOlag1	1.97	1.186	1,546	2,24	A	-2.955	-3.2256	A
TAXRATIOlag2	1.95	1.078	1.660	3,23	A	-2.39	-3.2339	A
TAXRATIOlag3	2.17/1.83	0.958	1,797	4,22	A	-2.924	-3.2430	A
TAXRATIOlag4	2.19/1.81	0.829	1.964	5,21	I	-3.359	-3.2530	R
TAXRATIOlag5	1.71	0.692	2.162	6,20	I	-3.126	-3.2640	A

Table 1
Cointegration tests for the UK weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
WCRATIOlag0	1.82	1.288	1.454	1,25	A	-3.074	-3.2182	A
WCRATIOlag1	1.95	1.188	1.546	2,24	A	-2.908	-3.2256	A
WCRATIOlag2	1.96	1.078	1.660	3,23	A	-2.479	-3.2339	A
WCRATIOlag3	2.10/1.90	0.958	1.797	4,22	A	-2.819	-3.2430	A
WCRATIOlag4	2.10/1.90	0.829	1.964	5,21	I	-3.178	-3.250	A
WCRATIOlag5	1.58	0.692	2.162	6,20	I	-2.81	-3.2640	A

Table 2
Cointegration tests for the UK non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchangelag0	2.05/1.95	1.273	1.446	1,24	A	-2.549	-3.2256	A
ASSETSchangelag1	1.99	1.168	1.543	2,23	A	-2.005	-3.2339	A
ASSETSchangelag2	2.00	1.053	1.664	3,22	A	-1.824	-3.2430	A
ASSETSchangelag3	1.94	0.927	1.812	4,21	A	-1.821	-3.2530	A
ASSETSchangelag4	1.42	0.792	1.991	5,20	I	-1.336	-3.2640	A
ASSETSchangelag5	1.95	0.649	2.206	6,19	I	-2.039	-3.2763	A
CTAXRATIOlag0	1.66	1.288	1.454	1,25	A	-2.033	-3.2182	A
CTAXRATIOlag1	1.94	1.188	1.546	2,24	A	-2.098	-3.2256	A
CTAXRATIOlag2	1.92	1.078	1.660	3,23	A	-1.679	-3.2339	A
CTAXRATIOlag3	1.95	0.958	1.797	4,22	A	-1.43	-3.2430	A
CTAXRATIOlag4	1.85	0.829	1.964	5,21	I	-1.34	-3.2530	A
CTAXRATIOlag5	1.72	0.692	2.162	6,20	I	-1.176	-3.2640	A
CTRATEchangelag0	1.31	1.273	1.446	1,24	I	-2.824	-3.2256	A
CTRATEchangelag1	1.69	1.168	1.543	2,23	A	-3.489	-3.2339	R
CTRATEchangelag2	1.98	1.053	1.664	3,22	A	-2.071	-3.2430	A
CTRATEchangelag3	1.95	0.927	1.812	4,21	A	-1.479	-3.2530	A
CTRATEchangelag4	1.42	0.792	1.991	5,20	I	-1.366	-3.2640	A
CTRATEchangelag5	2.17/1.83	0.649	2.206	6,19	I	-0.8897	-3.2763	A
DIVCOVERlag0	1.76	1.239	1.429	1,22	A	-2.67	-3.2430	A
DIVCOVERlag1	1.97	1.125	1.538	2,21	A	-2.412	-3.2530	A
DIVCOVERlag2	1.76	0.998	1.676	3,20	A	-2.238	-3.2640	A
DIVCOVERlag3	1.85	0.859	1.8484	4,19	A	-3.258	-3.2763	A
DIVCOVERlag4	2.03/1.97	0.710	2.060	5,18	I	-1.881	-3.2900	A
DIVCOVERlag5	1.94	0.554	2.318	6,17	I	-1.461	-3.3054	A
GDPchangelag0	1.86	1.257	1.437	1,23	A	-1.965	-3.2339	A
GDPchangelag1	1.91	1.147	1.541	2,22	A	-1.815	-3.2430	A
GDPchangelag2	1.94	1.026	1.669	3,21	A	-1.365	-3.2530	A
GDPchangelag3	1.61	0.894	1.828	4,20	A	-1.436	-3.2640	A
GDPchangelag4	2.19/1.81	0.752	2.023	5,19	I	-1.068	-3.2763	A
GDPchangelag5	1.77	0.603	2.257	6,18	I	-1.669	-3.2900	A
INCTAXlag0	1.61	1.288	1.454	1,25	A	-2.47	-3.2182	A
INCTAXlag1	1.95	1.188	1.546	2,24	A	-2.632	-3.2256	A
INCTAXlag2	1.93	1.078	1.660	3,23	A	-2.076	-3.2339	A
INCTAXlag3	1.99	0.958	1.797	4,22	A	-2.058	-3.2430	A
INCTAXlag4	1.80	0.829	1.964	5,21	I	-2.102	-3.2530	A
INCTAXlag5	1.83	0.692	2.162	6,20	I	-1.736	-3.2640	A
INFLATEchangelag0	1.98	1.257	1.437	1,23	A	-3.982	-3.2339	R
INFLATEchangelag1	1.99	1.147	1.541	2,22	A	-3.142	-3.2430	A
INFLATEchangelag2	1.98	1.026	1.669	3,21	A	-2.583	-3.2530	A
INFLATEchangelag3	1.98	0.894	1.828	4,20	A	-1.819	-3.2640	A
INFLATEchangelag4	1.77	0.752	2.023	5,19	I	-1.523	-3.2763	A
INFLATEchangelag5	1.44	0.603	2.257	6,18	I	-2.479	-3.2900	A
INTCOVERlag0	1.81	1.288	1.454	1,25	A	-2.376	-3.2182	A
INTCOVERlag1	1.90	1.188	1,546	2,24	A	-2.255	-3.2256	A
INTCOVERlag2	1.91	1.078	1.660	3,23	A	-1.681	-3.2339	A
INTCOVERlag3	1.89	0.958	1.797	4,22	A	-1.707	-3.2430	A
INTCOVERlag4	1.87	0.829	1.964	5,21	I	-1.542	-3.2530	A
INTCOVERlag5	1.67	0.692	2.162	6,20	I	-1.292	-3.2640	A
INVESTchangelag0	1.84	1.257	1.437	1,23	A	-2.277	-3.2339	A
INVESTchangelag1	1.95	1.147	1.541	2,22	A	-2.162	-3.2430	A
INVESTchangelag2	1.97	1.026	1.669	3,21	A	-1.974	-3.2530	A
INVESTchangelag3	1.93	0.894	1.828	4,20	A	-1.741	-3.2640	A
INVESTchangelag4	1.49	0.752	2.023	5,19	I	-1.484	-3.2763	A
INVESTchangelag5	1.49	0.603	2.257	6,18	I	-1.958	-3.2900	A

Table 2
Cointegration tests for the UK non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics (cont.)

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
LRINTlag0	1.86	1.273	1.446	1,24	A	-2.127	-3.2256	A
LRINTlag1	1.93	1.168	1.543	2,23	A	-2.073	-3.2339	A
LRINTlag2	1.99	1.053	1.664	3,22	A	-1.765	-3.2430	A
LRINTlag3	1.96	0.927	1.812	4,21	A	-1.574	-3.2530	A
LRINTlag4	1.93	0.792	1.991	5,20	I	-1.305	-3.2640	A
LRINTlag5	1.73	0.649	2.206	6,19	I	-1.391	-3.2763	A
MRINTlag0	1.70	1.158	1.391	1,18	A	-2.979	-3.2900	A
MRINTlag1	1.87	1.015	1.536	2,17	A	-3.663	-3.3054	R
MRINTlag2	1.93	0.857	1.728	3,16	A	-2.306	-3.3229	A
MRINTlag3	1.84	0.685	1.977	4,15	I	-1.986	-3.3430	A
MRINTlag4	1.26	0.505	2.296	5,14	I	-2.415	-3.3660	A
MRINTlag5	1.94	0.328	2.692	6,13	I	-1.186	-3.3931	A
QRATIOlag0	1.66	1.288	1.454	1,25	A	-2.503	-3.2182	A
QRATIOlag1	2.02/1.98	1.188	1.546	2,24	A	-2.659	-3.2256	A
QRATIOlag2	1.97	1.078	1.660	3,23	A	-2.313	-3.2339	A
QRATIOlag3	1.98	0.958	1.797	4,22	A	-2.163	-3.2430	A
QRATIOlag4	1.92	0.829	1.964	5,21	I	-1.82	-3.2530	A
QRATIOlag5	1.69	0.692	2.162	6,20	I	-1.621	-3.2640	A
ROCElag0	1.66	1.288	1.454	1,25	A	-2.072	-3.2182	A
ROCElag1	1.95	1.188	1.546	2,24	A	-2.149	-3.2256	A
ROCElag2	1.93	1.078	1.660	3,23	A	-1.725	-3.2339	A
ROCElag3	1.96	0.958	1.797	4,22	A	-1.533	-3.2430	A
ROCElag4	1.85	0.829	1.964	5,21	I	-1.446	-3.2530	A
ROCElag5	1.72	0.692	2.162	6,20	A	-1.292	-3.2640	A
SMINDlag0	1.72	1.257	1.437	1,23	A	-2.45	-3.2339	A
SMINDlag1	1.99	1.147	1.541	2,22	A	-2.511	-3.2430	A
SMINDlag2	2.05/1.95	1.026	1.669	3,21	A	-2.328	-3.2530	A
SMINDlag3	2.03/1.97	0.894	1.828	4,20	A	-2.495	-3.2640	A
SMINDlag4	1.60	0.752	2.023	5,19	I	-2.299	-3.2763	A
SMINDlag5	1.46	0.603	2.257	6,18	I	-2.332	-3.2900	A
SRINTlag0	1.72	1.273	1.446	1,24	A	-2.161	-3.2256	A
SRINTlag1	1.93	1.168	1.543	2,23	A	-2.19	-3.2339	A
SRINTlag2	1.95	1.053	1.664	3,22	A	-1.591	-3.2430	A
SRINTlag3	1.96	0.927	1.812	4,21	A	-1.502	-3.2530	A
SRINTlag4	1.91	0.792	1.991	5,20	I	-1.429	-3.2640	A
SRINTlag5	1.56	0.649	2.206	6,19	I	-1.289	-3.2763	A
TAXADVlag0	1.82	1.288	1.454	1,25	A	-2.017	-3.2182	A
TAXADVlag1	1.94	1.188	1.546	2,24	A	-1.904	-3.2256	A
TAXADVlag2	1.93	1.078	1.660	3,23	A	-1.739	-3.2339	A
TAXADVlag3	1.92	0.958	1.797	4,22	A	-1.437	-3.2430	A
TAXADVlag4	1.93	0.829	1.964	5,21	I	-1.331	-3.2530	A
TAXADVlag5	1.45	0.692	2.162	6,20	I	-1.217	-3.2640	A
TAXRATIOlag0	1.73	1.288	1.454	1,25	A	-2.443	-3.2182	A
TAXRATIOlag1	2.00	1.188	1.546	2,24	A	-2.466	-3.2256	A
TAXRATIOlag2	1.98	1.078	1.660	3,23	A	-2.125	-3.2339	A
TAXRATIOlag3	2.00	0.958	1.797	4,22	A	-2.042	-3.2430	A
TAXRATIOlag4	1.95	0.829	1.964	5,21	I	-1.911	-3.2530	A
TAXRATIOlag5	1.66	0.692	2.162	6,20	I	-1.791	-3.2640	A
WCRATIOlag0	1.82	1.288	1.454	1,25	A	-1.963	-3.2182	A
WCRATIOlag1	1.92	1.188	1.546	2,24	A	-1.779	-3.2256	A
WCRATIOlag2	1.91	1.078	1.660	3,23	A	-1.416	-3.2339	A
WCRATIOlag3	1.92	0.958	1.797	4,22	A	-1.224	-3.2430	A
WCRATIOlag4	1.85	0.829	1.964	5,21	I	-1.239	-3.2530	A
WCRATIOlag5	1.64	0.692	2.162	6,20	I	-0.9387	-3.2640	A

Table 3
Cointegration tests for the Netherlands weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchangelag0	1.99	1.010	1.340	1,13	A	-2.838	-3.3931	A
ASSETSchangelag1	1.69	0.812	1.579	2,12	A	-1.568	-3.4251	A
ASSETSchangelag2	2.02/1.98	0.595	1.928	3,11	A	-1.827	-3.4635	A
ASSETSchangelag3	1.95	0.376	2.414	4,10	I	-2.35	-3.5104	A
CTRATElag0	1.94	1.045	1.350	1,14	A	-2.311	-3.3660	A
CTRATElag1	1.91	0.861	1.562	2,13	A	-1.97	-3.3931	A
CTRATElag2	1.69	0.658	1.862	3,12	I	-1.296	-3.4251	A
CTRATElag3	1.82	0.444	2.283	4,11	I	-2.408	-3.4635	A
INFLATEchangelag0	1.86	1.010	1.340	1,13	A	-4.053	-3.391	R
INFLATEchangelag1	1.71	0.812	1.579	2,12	A	-3.346	-3.4251	A
INFLATEchangelag2	2.01/1.99	0.595	1.928	3,11	A	-2.067	-3.4635	A
INFLATEchangelag3	1.98	0.376	2.414	4,10	I	-2.12	-3.5104	A
INTCOVERlag0	2.00	1.045	1.350	1,14	A	-2.269	-3.3660	A
INTCOVERlag1	1.96	0.861	1.562	2,13	A	-2.026	-3.3931	A
INTCOVERlag2	1.55	0.658	1.864	3,12	I	-1.248	-3.4251	A
INTCOVERlag3	1.83	0.444	2.283	4,11	I	-2.482	-3.4635	A
LRINTchangelag0	1.79	1.010	1.340	1,13	A	-2.327	-3.3931	A
LRINTchangelag1	1.61	0.812	1.579	2,12	A	-2.007	-3.4251	A
LRINTchangelag2	2.11/1.89	0.595	1.928	3,11	I	-1.604	-3.4635	A
LRINTchangelag3	1.96	0.376	2.414	4,10	I	-2.122	-3.5104	A
MRINTchangelag0	1.83	1.010	1.340	1,13	A	-2.384	-3.3961	A
MRINTchangelag1	1.66	0.812	1.579	2,12	A	-1.963	-3.4251	A
MRINTchangelag2	2.09/1.91	0.595	1.928	3,11	I	-1.604	-3.4635	A
MRINTchangelag3	1.96	0.376	2.414	4,10	I	-2.132	-3.5104	A
QRATIOlag0	2.17/1.83	1.045	1.350	1,14	A	-2.165	-3.3660	A
QRATIOlag1	1.97	0.861	1.562	2,13	A	-1.562	-3.3931	A
QRATIOlag2	1.88	0.658	1.864	3,12	A	-1.676	-3.4251	A
QRATIOlag3	2.22/1.78	0.444	2.283	4,11	I	-2.378	-3.4635	A
ROCElag0	1.92	1.045	1.350	1,14	A	-2.427	-3.3660	A
ROCElag1	1.93	0.861	1.562	2,13	A	-2.217	-3.3931	A
ROCElag2	1.64	0.658	1.864	3,12	I	-1.31	-3.4251	A
ROCElag3	1.76	0.444	2.283	4,11	I	-2.198	-3.4635	A
SMINDlag0	1.94	1.045	1.350	1,14	A	-2.144	-3.3660	A
SMINDlag1	1.84	0.861	1.562	2,13	A	-1.669	-3.3931	A
SMINDlag2	1.59	0.658	1.864	3,12	I	-1.065	-3.4251	A
SMINDlag3	1.67	0.444	2.283	4,11	I	-2.048	-3.4635	A
SRINTlag0	1.84	0.971	1.331	1,12	A	-2.755	-3.4251	A
SRINTlag1	1.85	0.758	1.604	2,11	A	-2.789	-3.4635	A
SRINTlag2	1.83	0.525	2.016	3,10	I	-1.522	-3.5104	A
TAXRATIOlag0	1.82	1.045	1.350	1,14	A	-2.399	-3.3660	A
TAXRATIOlag1	1.88	0.861	1.562	2,13	A	-2.478	-3.3931	A
TAXRATIOlag2	1.57	0.658	1.864	3,12	I	-1.506	-3.4251	A
TAXRATIOlag3	1.96	0.444	2.283	4,11	I	-2.258	-3.4635	A

Table 4
Cointegration tests for the Netherlands weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
GDPchchlag0	1.86	0.595	1.928	3,11	I	-2.27	-3.4635	A
GDPchchlag1	1.84	0.376	2.414	4,10	I	-2.388	-3.5104	A

Table 5
Cointegration tests for the Netherlands non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchangelag0	1.51	1.010	1.340	1,13	A	-1.097	-3.3931	A
ASSETSchangelag1	2.27/1.73	0.812	1.579	2,12	A	-1.777	-3.4251	A
ASSETSchangelag2	2.14	0.595	1.928	3,11	I	-1.844	-3.4635	A
ASSETSchangelag3	1.36	0.376	2.414	4,10	A	-1.946	-3.5104	A
CTRATElag0	1.67	1.045	1.350	1,14	A	-1.743	-3.3660	A
CTRATElag1	1.62	0.861	1.562	2,13	A	-1.903	-3.3931	A
CTRATElag2	2.25/1.75	0.658	1.864	3,12	I	-2.336	-3.4251	A
CTRATElag3	2.13/1.87	0.444	2.283	4,11	I	-2.018	-3.4635	A
DIVCOVERlag0	1.77	1.045	1.350	1,14	A	-1.267	-3.3660	A
DIVCOVERlag1	1.63	0.861	1.562	2,13	A	-1.146	-3.3931	A
DIVCOVERlag2	1.98	0.658	1.864	3,12	A	-1.439	-3.4251	A
DIVCOVERlag3	1.94	0.444	2.283	4,11	I	-1.328	-3.4635	A
INFLATEchangelag0	1.66	1.010	1.340	1,13	A	-1.551	-3.3931	A
INFLATEchangelag1	1.88	0.812	1.579	2,12	A	-1.881	-3.4251	A
INFLATEchangelag2	1.90	0.595	1.928	3,11	I	-1.068	-3.4635	A
INFLATEchangelag3	1.96	0.376	2.414	4,10	I	-1.44	-3.5104	A
LRINTchangelag0	1.45	1.010	1.340	1,13	A	-1.09	-3.3931	A
LRINTchangelag1	2.22/1.78	0.812	1.579	2,12	A	-1.767	-3.4251	A
LRINTchangelag2	2.05/1.95	0.595	1.928	3,11	A	-1.718	-3.4635	A
LRINTchangelag3	1.38	0.376	2.414	4,10	I	-1.84	-3.5104	A
MRINTchangelag0	1.93	1.010	1.340	1,13	A	-1.407	-3.3931	A
MRINTchangelag1	2.18/1.82	0.812	1.579	2,12	A	-1.829	-3.4251	A
MRINTchangelag2	2.10/1.90	0.595	1.928	3,11	I	-1.912	-3.4635	A
MRINTchangelag3	1.28	0.376	2.414	4,10	I	-1.972	-3.5104	A
QRATIOlag0	1.80	1.045	1.350	1,14	A	-2.639	-3.3660	A
QRATIOlag1	1.71	0.861	1.562	2,13	A	-2.741	-3.3931	A
QRATIOlag2	2.30/1.70	0.658	1.864	3,12	I	-2.37	-3.4251	A
QRATIOlag3	1.64	0.444	2.283	4,11	I	-3.36	-3.4635	A
ROCElag0	1.66	1.045	1.350	1,14	A	-1.772	-3.3660	A
ROCElag1	1.66	0.861	1.562	2,13	A	-1.8	-3.3931	A
ROCElag2	1.85	0.658	1.864	3,12	I	-1.678	-3.4251	A
ROCElag3	2.12/1.88	0.444	2.283	4,11	I	-2.032	-3.4635	A
SMINDlag0	1.73	1.045	1.350	1,14	A	-2.218	-3.3660	A
SMINDlag1	1.36	0.861	1.562	2,13	I	-2.564	-3.3931	A
SMINDlag2	1.48	0.658	1.864	3,12	I	-2.758	-3.4251	A
SMINDlag3	1.61	0.444	2.283	4,11	I	-1.025	-3.4635	A
SRINTlag0	1.98	0.971	1.331	1,12	A	-1.34	-3.4251	A
SRINTlag1	1.50	0.758	1.604	2,11	I	-0.7668	-3.4635	A
SRINTlag2	2.03/1.97	0.525	2.016	3,10	I	-1.144	-3.5104	A
TAXRATIOlag0	1.96	1.045	1.350	1,14	A	-1.786	-3.3660	A
TAXRATIOlag1	1.92	0.861	1.562	2,13	A	-1.53	-3.3931	A
TAXRATIOlag2	2.06/1.94	0.658	1.864	3,12	A	-1.731	-3.4251	A
TAXRATIOlag3	1.98	0.444	2.283	4,11	I	-1.355	-3.4635	A
WCRATIOlag0	1.76	1.045	1.350	1,14	A	-1.154	-3.3660	A
WCRATIOlag1	1.73	0.861	1.562	2,13	A	-1.124	-3.3931	A
WCRATIOlag2	2.19/1.81	0.658	1.864	3,12	I	-1.508	-3.4251	A
WCRATIOlag3	2.06/1.94	0.444	2.283	4,11	I	-1.359	-3.4635	A

Table 6
Cointegration tests for the Netherlands non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
GDPchchlag0	1.95	0.595	1.928	3,11	A	-3.139	-3.4635	A
GDPchchlag1	1.75	0.376	2.414	4,10	I	-1.465	-3.5104	A

Table 7
Cointegration tests for the German weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
DIVCOVERlag0	2.16/1.84	0.927	1.324	1,11	A	-1.58	-3.4635	A
DIVCOVERlag1	1.13	0.697	1.641	2,10	I	-2.13	-3.5104	A
DIVCOVERlag2	2.67/1.33	0.455	2.128	3,9	I	-0.01851	-3.5690	A
INVESTchangelag0	1.75	0.879	1.320	1,10	A	-0.7097	-3.5104	A
INVESTchangelag1	1.66	0.629	1.699	2,9	I	-0.5265	-3.5690	A
LRINTlag0	2.14/1.86	0.927	1.324	1,11	A	-0.9484	-3.4635	A
LRINTlag1	1.11	0.697	1.641	2,10	I	-1.152	-3.5104	A
LRINTlag2	1.85	0.455	2.128	3,9	I	-0.5105	-3.5690	A
MRINTchangelag0	1.38	0.879	1.320	1,10	A	-1.148	-3.5104	A
MRINTchangelag1	1.99	0.629	1.699	2,9	A	-0.9501	-3.5690	A
QRATIOlag0	2.40/1.60	0.927	1.324	1,11	A	-2.258	-3.4635	A
QRATIOlag1	1.21	0.697	1.641	2,10	I	-3.142	-3.5104	A
QRATIOlag2	2.63/1.37	0.455	2.128	3,9	I	-1.151	-3.5690	A
SMINDlag0	1.66	0.927	1.324	1,11	A	-1.825	-3.4635	A
SMINDlag1	1.26	0.697	1.641	2,10	I	-2.379	-3.5104	A
SMINDlag2	1.51	0.455	2.128	3,9	I	-0.07367	-3.5690	A
SRINTlag0	1.96	0.927	1.324	1,11	A	-2.203	-3.4635	A
SRINTlag1	1.44	0.697	1.641	2,10	I	-2.252	-3.5104	A
SRINTlag2	2.50/1.50	0.455	2.128	3,9	I	-0.2483	-3.5690	A

Table 8
Cointegration tests for the German weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (with trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchange lag0	2.28/1.72	0.525	2.016	3,10	I	-4.697	-4.2563	R
ROCEchange lag0	1.71	0.525	2.016	3,10	I	-5.347	-4.2563	R
WCRATIOchange lag0	1.59	0.525	2.016	3,10	I	-4.579	-4.2563	R

Table 9
Cointegration tests for the German non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSlag0	1.39	0.927	1.324	1,11	A	-1.978	-3.4635	A
ASSETSlag1	1.78	0.697	1.641	2,10	A	-2.52	-3.5104	A
ASSETSlag2	1.84	0.455	2.128	3,9	I	-1.591	-3.5690	A
GNPchangelag0	1.90	0.879	1.320	1,10	A	-2.343	-3.5104	A
GNPchangelag1	2.22/1.78	0.629	1.699	2,9	A	-2.264	-3.5690	A
INFLATEchangelag0	1.66	0.879	1.320	1,10	A	-2.036	-3.5104	A
INFLATEchangelag1	1.89	0.629	1.699	2,9	A	-1.908	-3.5690	A
MRINTlag0	1.51	0.927	1.324	1,11	A	-1.81	-2.4635	A
MRINTlag1	1.80	0.697	1.641	2,10	A	-2.537	-3.5104	A
MRINTlag2	1.68	0.455	2.128	3,9	I	-1.342	-3.5690	A
ROCElag0	1.59	0.927	1.324	1,11	A	-1.667	-3.4635	A
ROCElag1	1.87	0.697	1.641	2,10	A	-0.8917	-3.5104	A
ROCElag2	1.73	0.455	2.128	3,9	I	-0.7376	-3.5690	A

Table 10
Cointegration tests for the French weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
CTAXRATIOlag0	1.87	0.824	1.320	1,9	A	-2.886	-3.5690	A
CTAXRATIOlag1	1.51	0.559	1.777	2,8	I	-1.356	-3.6443	A
CTRATEchangelag0	1.85	0.763	1.332	1,8	A	-1.705	-3.6443	A
DIVCOVERlag0	1.87	0.824	1.320	1,9	A	-1.885	-3.5690	A
DIVCOVERlag1	2.03/1.97	0.559	1.777	2,8	I	-1.403	-3.6443	A
INTCOVERchangelag0	1.90	0.763	1.332	1,8	A	-1.628	-3.6443	A
LRINTchangelag0	1.83	0.763	1.332	1,8	A	-1.614	-3.6443	A
MRINTchangelag0	1.85	0.763	1.332	1,8	A	-1.632	-3.6443	A
QRATIOlag0	1.86	0.824	1.320	1,9	A	-1.844	-3.5690	A
QRATIOlag1	2.04/1.96	0.559	1.777	2,8	A	-1.417	-3.6443	A
ROCEchangelag0	1.92	0.763	1.332	1,8	A	-1.653	-3.6443	A
SMINDchangelag0	1.08	0.763	1.332	1,8	I	-1.719	-3.6443	A
SRINTchangelag0	1.91	0.763	1.332	1,8	A	-1.804	-3.6443	A
TAXRATIOlag0	1.83	0.824	1.320	1,9	A	-2.256	-3.5690	A
TAXRATIOlag1	1.68	0.559	1.777	2,8	I	-1.318	-3.6443	A
WCRATIOchangelag0	1.78	0.763	1.332	1,8	A	-1.572	-3.6443	A

Table 11
Cointegration tests for the French non-weighted sample, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
DIVCOVERlag0	1.99	0.824	1.320	1,9	A	-2.354	-3.5690	A
DIVCOVERlag1	1.98	0.559	1.777	2,8	A	-2.399	-3.6443	A
LRINTlag0	1.50	0.824	1.320	1,9	A	-1.552	-3.5690	A
LRINTlag1	1.59	0.559	1.777	2,8	I	-2.066	-3.6443	A
MRINTlag0	1.32	0.824	1.320	1,9	A	-1.589	-3.5690	A
MRINTlag1	1.98	0.559	1.777	2,8	A	-3.145	-3.6443	A
ROCElag0	1.97	0.824	1.320	1,9	A	-2.056	-3.5690	A
ROCElag1	2.13/1.87	0.559	1.777	2,8	A	-1.808	-3.6443	A
SMINDlag0	1.91	0.824	1.320	1,9	A	-2.072	-3.5690	A
SMINDlag1	1.70	0.559	1.777	2,8	I	-1.743	-3.6443	A
SRINTlag0	1.68	0.824	1.320	1,9	A	-1.84	-3.5690	A
SRINTlag1	1.47	0.559	1.777	2,8	I	-2.091	-3.6443	A
TAXADVlag0	1.58	0.824	1.320	1,9	A	-1.911	-3.5690	A
TAXADVlag1	1.86	0.559	1.777	2,8	A	-2.067	-3.6443	A

APPENDIX J: GRANGER CAUSALITY TESTING OF EUROPEAN BIVARIATE CORPORATE CAPITAL STRUCTURE RELATIONSHIPS

Table 1
Granger causality testing of the UK weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETSchange	0.291144	23	5	2	9	0.410724	3.696516	2,18	3.55	YES
ASSETSchange	DDERATIO	0.162129	23	5	2	9	0.193501	1.741509	2,18	3.55	NO
DDERATIO	CTAXRATIO	0.419167	24	5	2	9.5	0.721665	6.855818	2,19	3.52	YES
CTAXRATIO	DDERATIO	0.327005	24	5	2	9.5	0.485895	4.616003	2,19	3.52	YES
DDERATIO	CTRATE	0.384436	24	5	2	9.5	0.624526	5.932997	2,19	3.52	YES
CTRATE	DDERATIO	0.790415	24	5	2	9.5	3.771334	35.827673	2,19	3.52	YES
DDERATIO	DIVCOVER	0.261251	21	5	2	8	0.353640	2.82912	2,16	3.63	NO
DIVCOVER	DDERATIO	0.557896	21	5	2	8	1.261911	10.095288	2,16	3.63	YES
DDERATIO	GDPchange	0.315594	23	5	2	9	0.461121	4.150089	2,18	3.55	YES
GDPchange	DDERATIO	0.209317	22	5	2	8.5	0.264729	2.250197	2,17	3.59	NO
DDERATIO	INCTAX	0.369235	24	5	2	9.5	0.585376	5.561072	2,19	3.52	YES
INCTAX	DDERATIO	0.852022	24	5	2	9.5	5.757761	54.698730	2,19	3.52	YES
DDERATIO	INFLATEchange	0.305604	23	5	2	9	0.440100	3.9609	2,18	3.55	YES
INFLATEchange	DDERATIO	0.59637	22	5	2	8.5	1.477516	12.558886	2,17	3.59	YES
DDERATIO	INTCOVER	0.273914	24	5	2	9.5	0.377247	3.583847	2,19	3.52	YES
INTCOVER	DDERATIO	0.275999	24	5	2	9.5	0.381214	3.621533	2,19	3.52	YES
DDERATIO	INVESTchange	0.373868	23	5	2	9	0.597107	5.373963	2,18	3.55	YES
INVESTchange	DDERATIO	0.431376	22	5	2	8.5	0.758631	6.448364	2,17	3.59	YES
DDERATIO	LRINT	0.340955	24	5	2	9.5	0.517347	4.914797	2,19	3.52	YES
LRINT	DDERATIO	0.733302	23	5	2	9	2.749560	24.74604	2,18	3.55	YES
DDERATIO	MRINT	0.274319	17	5	2	6	0.378016	2.268096	2,12	3.89	NO
MRINT	DDERATIO	0.572249	17	5	2	6	1.337809	8.026854	2,12	3.89	YES
DDERATIO	QRATIO	0.348424	24	5	2	9.5	0.534740	5.080034	2,19	3.52	YES
QRATIO	DDERATIO	0.549226	24	5	2	9.5	1.218407	11.574862	2,19	3.52	YES
DDERATIO	ROCE	0.400665	24	5	2	9.5	0.668516	6.350902	2,19	3.52	YES
ROCE	DDERATIO	0.527036	24	5	2	9.5	1.114326	10.586097	2,19	3.52	YES
DDERATIO	SMIND	0.34552	23	5	2	9	0.527931	4.751379	2,18	3.55	YES
SMIND	DDERATIO	0.963969	22	5	2	8.5	26.753879	227.407972	2,17	3.59	YES
DDERATIO	SRINT	0.253211	24	5	2	9.5	0.339066	3.221127	2,19	3.52	NO
SRINT	DDERATIO	0.175029	23	5	2	9	0.212164	1.909476	2,18	3.55	NO
DDERATIO	TAXADV	0.440336	24	5	2	9.5	0.786786	7.474467	2,19	3.52	YES
TAXADV	DDERATIO	0.585611	24	5	2	9.5	1.413191	13.425315	2,19	3.52	YES
DDERATIO	TAXRATIO	0.274441	24	5	2	9.5	0.378248	3.593356	2,19	3.52	YES
TAXRATIO	DDERATIO	0.742072	24	5	2	9.5	2.877051	27.331985	2,19	3.52	YES
DDERATIO	WCRATIO	0.325434	24	5	2	9.5	0.482435	4.583133	2,19	3.52	YES
WCRATIO	DDERATIO	0.832103	24	5	2	9.5	4.956033	47.082314	2,19	3.52	YES

Table 2

Granger causality testing of the UK non-weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}.\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETSchange	0.504369	23	5	2	9	1.017630	9.15867	2,18	3.55	YES
ASSETSchange	DDERATIO	0.0627715	23	5	2	9	0.066976	0.602784	2,18	3.55	NO
DDERATIO	CTAXRATIO	0.503134	24	5	2	9.5	1.012615	9.619843	2,19	3.52	YES
CTAXRATIO	DDERATIO	0.644123	24	5	2	9.5	1.809960	17.19462	2,19	3.52	YES
DDERATIO	CTRATEchange	0.734431	23	5	2	9	2.765500	24.8895	2,18	3.55	YES
CTRATEchange	DDERATIO	0.637129	23	5	2	9	1.755800	15.8022	2,18	3.55	YES
DDERATIO	DIVCOVER	0.493251	21	5	2	8	0.973364	7.786912	2,16	3.63	YES
DIVCOVER	DDERATIO	0.525002	21	5	2	8	1.105272	8.842176	2,16	3.63	YES
DDERATIO	GDPchange	0.560968	23	5	2	9	1.277738	11.499642	2,18	3.55	YES
GDPchange	DDERATIO	0.253944	22	5	2	8.5	0.340382	2.893247	2,17	3.59	NO
DDERATIO	INCTAX	0.658701	24	5	2	9.5	1.929982	18.334829	2,19	3.52	YES
INCTAX	DDERATIO	0.88531	24	5	2	9.5	7.719156	73.331982	2,19	3.52	YES
DDERATIO	INFLATEchange	0.563143	23	5	2	9	1.289079	11.601711	2,18	3.55	YES
INFLATEchange	DDERATIO	0.698059	22	5	2	8.5	2.311905	19.651193	2,17	3.59	YES
DDERATIO	INTCOVER	0.46972	24	5	2	9.5	0.885796	8.415062	2,19	3.52	YES
INTCOVER	DDERATIO	0.252055	24	5	2	9.5	0.336997	3.201472	2,19	3.52	NO
DDERATIO	INVESTchange	0.572505	23	5	2	9	1.339209	12.052881	2,18	3.55	YES
INVESTchange	DDERATIO	0.417589	22	5	2	8.5	0.717001	6.094509	2,17	3.59	YES
DDERATIO	LRINT	0.548398	24	5	2	9.5	1.214339	11.536221	2,19	3.52	YES
LRINT	DDERATIO	0.733829	23	5	2	9	2.756983	24.812847	2,18	3.52	YES
DDERATIO	MRINT	0.60651	17	5	2	6	1.541361	9.248166	2,12	3.89	YES
MRINT	DDERATIO	0.648423	17	5	2	6	1.844327	11.065962	2,12	3.89	YES
DDERATIO	QRATIO	0.477715	24	5	2	9.5	0.914663	8.689303	2,19	3.52	YES
QRATIO	DDERATIO	0.662223	24	5	2	9.5	1.960533	18.625065	2,19	3.52	YES
DDERATIO	ROCE	0.483258	24	5	2	9.5	0.935202	8.884419	2,19	3.52	YES
ROCE	DDERATIO	0.488657	24	5	2	9.5	0.955634	9.078523	2,19	3.52	YES
DDERATIO	SMIND	0.557818	23	5	2	9	1.261512	11.353608	2,18	3.55	YES
SMIND	DDERATIO	0.9581	22	5	2	8.5	22.866348	194.363958	2,17	3.59	YES
DDERATIO	SRINT	0.493557	24	5	2	9.5	0.974556	9.258282	2,19	3.52	YES
SRINT	DDERATIO	0.19248	18	5	2	6.5	0.238359	1.549334	2,13	3.81	NO
DDERATIO	TAXADV	0.795509	24	5	2	9.5	3.890191	36.956815	2,19	3.52	YES
TAXADV	DDERATIO	0.84514	24	5	2	9.5	5.457445	51.845728	2,19	3.52	YES
DDERATIO	TAXRATIO	0.510464	24	5	2	9.5	1.042751	9.906135	2,19	3.52	YES
TAXRATIO	DDERATIO	0.823687	24	5	2	9.5	4.671732	44.381454	2,19	3.52	YES
DDERATIO	WCRATIO	0.469085	24	5	2	9.5	0.883541	8.393640	2,19	3.52	YES
WCRATIO	DDERATIO	0.154951	24	5	2	9.5	0.183363	1.741949	2,19	3.52	NO

Table 3
Granger causality testing of the Netherlands weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}.\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETSchange	0.205483	12	5	2	3.5	0.258626	0.905191	2,7	4.74	NO
ASSETSchange	DDERATIO	0.455653	12	5	2	3.5	0.837063	2.929721	2,7	4.74	NO
DDERATIO	CTRATE	0.279031	13	5	2	4	0.387022	1.548088	2,8	4.46	NO
CTRATE	DDERATIO	0.871126	13	5	2	4	6.759517	27.038068	2,8	4.46	YES
DDERATIO	GDPchch	0.323712	11	5	2	3	0.478660	1.435980	2,6	5.14	NO
GDPchch	DDERATIO	0.316662	10	5	2	2.5	0.463405	1.158512	2,5	5.79	NO
DDERATIO	INFLATEchange	0.361197	12	5	2	3.5	0.565428	1.978998	2,7	4.74	NO
INFLATEchange	DDERATIO	0.798956	12	5	2	3.5	3.974036	13.909126	2,7	4.74	YES
DDERATIO	INTCOVER	0.327763	13	5	2	4	0.487571	0.951490	2,8	4.46	NO
INTCOVER	DDERATIO	0.743096	13	5	2	4	2.892505	11.57002	2,8	4.46	YES
DDERATIO	LRINTchange	0.45359	12	5	2	3.5	0.830128	2.905448	2,7	4.74	NO
LRINTchange	DDERATIO	0.571596	12	5	2	3.5	1.334245	4.669858	2,7	4.74	NO
DDERATIO	MRINTchange	0.46611	12	5	2	3.5	0.873045	3.055658	2,7	4.74	NO
MRINTchange	DDERATIO	0.521868	12	5	2	3.5	1.091473	3.820156	2,7	4.74	NO
DDERATIO	QRATIO	0.644546	13	5	2	4	1.813304	7.253214	2,8	4.46	YES
QRATIO	DDERATIO	0.404987	13	5	2	4	0.680636	2.722542	2,8	4.46	NO
DDERATIO	ROCE	0.281984	13	5	2	4	0.392727	1.570908	2,8	4.46	NO
ROCE	DDERATIO	0.822376	13	5	2	4	4.629870	18.51948	2,8	4.46	YES
DDERATIO	SMIND	0.203726	13	5	2	4	0.255849	1.023396	2,8	4.46	NO
SMIND	DDERATIO	0.821907	13	5	2	4	4.615044	18.460176	2,8	4.46	YES
DDERATIO	SRINT	0.598148	12	5	2	3.5	1.488478	5.209673	2,7	4.74	YES
SRINT	DDERATIO	0.494541	11	5	2	3	0.978400	2.9352	2,6	5.14	NO
DDERATIO	TAXRATIO	0.574502	13	5	2	4	1.350187	5.400748	2,8	4.46	YES
TAXRATIO	DDERATIO	0.659662	13	5	2	4	1.938255	7.75302	2,8	4.46	YES

Table 4
Granger causality testing of the Netherlands non-weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETSchange	0.805623	12	5	2	3.5	4.144642	14.506247	2,7	4.74	YES
ASSETSchange	DDERATIO	0.157085	12	5	2	3.5	0.186359	0.652257	2,7	4.74	NO
DDERATIO	CTRATE	0.739038	13	5	2	4	2.831976	11.327904	2,8	5.32	YES
CTRATE	DDERATIO	0.877283	13	5	2	4	7.148830	28.59532	2,8	5.32	YES
DDERATIO	DIVCOVER	0.732431	13	5	2	4	2.737354	10.949416	2,8	4.46	YES
DIVCOVER	DDERATIO	0.204459	13	5	2	4	0.257006	1.028024	2,8	4.46	NO
DDERATIO	INFLATEchange	0.7906	12	5	2	3.5	3.775549	13.214422	2,7	4.74	YES
INFLATEchange	DDERATIO	0.762883	12	5	2	3.5	3.217327	11.260645	2,7	4.74	YES
DDERATIO	GDPchch	0.77889	11	5	2	3	3.522636	10.567907	2,6	5.14	YES
GDPchch	DDERATIO	0.371536	10	5	2	2.5	0.591181	1.477953	2,5	5.79	NO
DDERATIO	LRINTchange	0.787414	12	5	2	3.5	3.703979	12.963927	2,7	4.74	YES
LRINTchange	DDERATIO	0.362057	12	5	2	3.5	0.567538	1.986383	2,7	4.74	NO
DDERATIO	MRINTchange	0.758805	12	5	2	3.5	3.146023	11.011081	2,7	4.74	YES
MRINTchange	DDERATIO	0.57127	12	5	2	3.5	1.332470	4.663645	2,7	4.74	NO
DDERATIO	QRATIO	0.748114	13	5	2	4	2.970050	11.880200	2,8	4.46	YES
QRATIO	DDERATIO	0.682386	13	5	2	4	2.148758	8.593903	2,8	4.46	YES
DDERATIO	ROCE	0.715154	13	5	2	4	2.510669	12.042676	2,8	5.32	YES
ROCE	DDERATIO	0.770183	13	5	2	4	3.351288	13.405152	2,8	5.32	YES
DDERATIO	SMIND	0.75088	13	5	2	4	3.014130	12.05652	2,8	5.32	YES
SMIND	DDERATIO	0.828173	13	5	2	4	4.819807	19.279228	2,8	5.32	YES
DDERATIO	SRINT	0.89843	12	5	2	3.5	8.845427	30.958995	2,7	4.74	YES
SRINT	DDERATIO	0.636129	11	5	2	3	1.748227	5.244681	2,6	5.14	YES
DDERATIO	TAXRATIO	0.74471	13	5	2	4	2.917114	11.668456	2,8	5.32	YES
TAXRATIO	DDERATIO	0.277105	13	5	2	4	0.383327	1.533308	2,8	5.32	NO
DDERATIO	WCRATIO	0.847581	13	5	2	4	5.560861	22.243444	2,8	5.32	YES
WCRATIO	DDERATIO	0.343223	13	5	2	4	0.522587	2.090348	2,8	5.32	NO

Table 5

Granger causality testing of the German weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETSchange	0.941601	9	5	2	2	16.123581	32.24716	2,4	6.94	YES
ASSETSchange	DDERATIO	0.801005	9	5	2	2	4.025252	8.050504	2,4	6.94	YES
DDERATIO	DIVCOVER	0.980312	10	5	2	2.5	49.792361	124.480903	2,5	5.79	YES
DIVCOVER	DDERATIO	0.884713	10	5	2	2.5	7.674005	19.185013	2,5	5.79	YES
DDERATIO	INTCOVERchange	0.945241	9	5	2	2	17.261838	34.523676	2,4	6.94	YES
INTCOVERchange	DDERATIO	0.812304	9	5	2	2	4.327764	8.655528	2,4	6.94	YES
DDERATIO	INVESTchange	0.904834	9	5	2	2	9.507955	19.01591	2,4	6.94	YES
INVESTchange	DDERATIO	0.71921	9	5	2	2	2.561380	5.12276	2,4	6.94	NO
DDERATIO	LRINT	0.934774	10	5	2	2.5	14.331310	35.828275	2,5	5.79	YES
LRINT	DDERATIO	0.49672	10	5	2	2.5	0.986966	2.467415	2,5	5.79	NO
DDERATIO	MRINTchange	0.893553	9	5	2	2	8.394346	16.788692	2,4	6.94	YES
MRINTchange	DDERATIO	0.640546	9	5	2	2	1.781997	3.563994	2,4	6.94	NO
DDERATIO	QRATIO	0.932017	10	5	2	2.5	13.709560	34.273900	2,5	5.79	YES
QRATIO	DDERATIO	0.819412	10	5	2	2.5	4.537466	11.343666	2,5	5.79	YES
DDERATIO	ROCEchange	0.957173	9	5	2	2	22.349756	44.699512	2,4	6.94	YES
ROCEchange	DDERATIO	0.803781	9	5	2	2	4.096346	8.192692	2,4	6.94	YES
DDERATIO	SMIND	0.937877	10	5	2	2.5	15.097098	37.742745	2,5	5.79	YES
SMIND	DDERATIO	0.613953	10	5	2	2.5	1.590358	3.975895	2,5	5.79	NO
DDERATIO	SRINT	0.939562	10	5	2	2.5	15.545882	38.864705	2,5	5.79	YES
SRINT	DDERATIO	0.764894	10	5	2	2.5	3.253373	8.133433	2,5	5.79	YES
DDERATIO	TAXRATIOchange	0.962044	9	5	2	2	25.346296	50.692592	2,4	6.94	YES
TAXRATIOchange	DDERATIO	0.805413	9	5	2	2	4.139090	8.27818	2,4	6.94	YES
DDERATIO	WCRATIOchange	0.936649	9	5	2	2	14.785070	29.57014	2,4	6.94	YES
WCRATIOchange	DDERATIO	0.440819	9	5	2	2	0.788330	1.57666	2,4	6.94	NO

Table 6

Granger causality testing of the German non-weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	ASSETS	0.626319	10	5	2	2.5	1.676079	4.190198	2,5	5.79	NO
ASSETS	DDERATIO	0.761648	10	5	2	2.5	3.195476	7.98869	2,5	5.79	YES
DDERATIO	GNPchange	0.398976	9	5	2	2	0.663827	1.327654	2,4	6.94	NO
GNPchange	DDERATIO	0.507663	9	5	2	2	1.031129	2.062258	2,4	6.94	NO
DDERATIO	INFLATEchange	0.713298	9	5	2	2	2.487942	4.975884	2,4	6.94	NO
INFLATEchange	DDERATIO	0.755678	9	5	2	2	3.092960	6.185919	2,4	6.94	NO
DDERATIO	MRINT	0.677783	10	5	2	2.5	2.103499	5.258748	2,5	5.79	NO
MRINT	DDERATIO	0.625213	10	5	2	2.5	1.668182	4.170455	2,5	5.79	NO
DDERATIO	ROCE	0.711914	10	5	2	2.5	2.471186	6.177965	2,5	5.79	YES
ROCE	DDERATIO	0.656989	10	5	2	2.5	1.915358	4.788395	2,5	5.79	NO

Table 7
Granger causality testing of the French weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	CTAXRATIO	0.538229	9	3	1	6	1.165562	6.993372	1,6	5.99	YES
CTAXRATIO	DDERATIO	0.0441829	9	3	1	6	0.046225	0.27735	1,6	5.99	NO
DDERATIO	CTRATEchange	0.272073	8	3	1	5	0.373764	1.86882	1,5	6.61	NO
CTRATEchange	DDERATIO	0.014381	8	3	1	5	0.014591	0.072955	1,5	6.61	NO
DDERATIO	DIVCOVER	0.21246	9	3	1	6	0.269777	1.618662	1,6	5.99	NO
DIVCOVER	DDERATIO	0.564275	9	3	1	6	1.295026	7.770156	1,6	5.99	YES
DDERATIO	INTCOVERchange	0.152673	8	3	1	5	0.180182	0.90091	1,5	6.61	NO
INTCOVERchange	DDERATIO	0.052712	8	3	1	5	0.055645	0.278225	1,5	6.61	NO
DDERATIO	LRINTchange	0.410654	8	3	1	5	0.696796	3.48398	1,5	6.61	NO
LRINTchange	DDERATIO	0.340931	8	3	1	5	0.517292	2.58646	1,5	6.61	NO
DDERATIO	MRINTchange	0.484258	8	3	1	5	0.938954	4.69477	1,5	6.61	NO
MRINTchange	DDERATIO	0.30686	8	3	1	5	0.442710	2.21355	1,5	6.61	NO
DDERATIO	QRATIO	0.307313	9	3	1	6	0.443653	2.661921	1,6	5.99	NO
QRATIO	DDERATIO	0.68851	9	3	1	6	2.210376	13.262256	1,6	5.99	YES
DDERATIO	ROCEchange	0.228026	8	3	1	5	0.295380	1.4769	1,5	6.61	NO
ROCEchange	DDERATIO	0.0063254	8	3	1	5	0.006366	0.03183	1,5	6.61	NO
DDERATIO	SMINDchange	0.152708	8	3	1	5	0.180231	0.901155	1,5	6.61	NO
SMINDchange	DDERATIO	0.053223	8	3	1	5	0.056215	0.281075	1,5	6.61	NO
DDERATIO	SRINTchange	0.718751	8	3	1	5	2.555568	12.77784	1,5	6.61	YES
SRINTchange	DDERATIO	0.107623	8	3	1	5	0.120603	0.603015	1,5	6.61	NO
DDERATIO	TAXRATIO	0.308407	9	3	1	6	0.445937	2.675622	1,6	5.99	NO
TAXRATIO	DDERATIO	0.0723262	9	3	1	6	0.077965	0.46779	1,6	5.99	NO
DDERATIO	WCRATIOchange	0.317364	8	3	1	5	0.464907	2.324535	1,5	6.61	NO
WCRATIOchange	DDERATIO	0.225287	8	3	1	5	0.290801	1.454005	1,5	6.61	NO

Table 8
Granger causality testing of the French non-weighted variables with respect to the bivariate regression relationship with the corporate capital structure ratio

dependent	independent	R^2	T	h	k	$\frac{T-h}{k}$	$\frac{R^2}{1-R^2}$	$\frac{T-h}{k}\cdot\frac{R^2}{1-R^2}$	k,(T-h) df's	F crit.	does indep. Granger cause depend?
DDERATIO	DIVCOVER	0.446026	9	3	1	6	0.805139	4.830834	1,6	5.99	NO
DIVCOVER	DDERATIO	0.761306	9	3	1	6	3.189464	19.136784	1,6	5.99	YES
DDERATIO	LRINT	0.407608	9	3	1	6	0.688071	4.128426	1,6	5.99	NO
LRINT	DDERATIO	0.679434	9	3	1	6	2.119482	12.716892	1,6	5.99	YES
DDERATIO	MRINT	0.423635	9	3	1	6	0.735017	4.410102	1,6	5.99	NO
MRINT	DDERATIO	0.494921	9	3	1	6	0.979889	5.879334	1,6	5.99	NO
DDERATIO	ROCE	0.410026	9	3	1	6	0.694990	4.16994	1,6	5.99	NO
ROCE	DDERATIO	0.226489	9	3	1	6	0.292806	1.756836	1,6	5.99	NO
DDERATIO	SMIND	0.442079	9	3	1	6	0.792368	4.754208	1,6	5.99	NO
SMIND	DDERATIO	0.898138	9	3	1	6	8.817204	52.903224	1,6	5.99	YES
DDERATIO	SRINT	0.554595	9	3	1	6	1.245148	7.470888	1,6	5.99	YES
SRINT	DDERATIO	0.540896	9	3	1	6	1.178156	7.068936	1,6	5.99	YES
DDERATIO	TAXADV	0.479684	9	3	1	6	0.921909	5.531454	1,6	5.99	NO
TAXADV	DDERATIO	0.940236	9	3	1	6	15.732481	94.394886	1,6	5.99	YES

APPENDIX K:
AUTOREGRESSIVE DISTRIBUTED LAG MODELS OF THE DDE RATIO AND THE EUROPEAN TIME SERIES VARIABLES

Note:

1) Figures in parentheses are computed t-values which measure the distance in terms of standard errors that the variable coefficient is away from zero.
2) Figures in bold give those variable coefficients which are significant in a two-tail test at the 5 per cent level, along with the t-value relating to each coefficient.

Table 1
Autoregressive distributed lag models of the DDE ratio and the tax advantage to debt, TAXADV

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	**0.18446** (3.732)	**0.38146** (2.318)	-	**0.40028** (2.804)	-	**-0.47624** (-3.341)	0.52944 (2.086)
UKNW	**0.10646** (4.457)	**0.46978** (3.767)	-	-	**0.61064** (4.829)	**-0.63880** (-5.544)	0.782604 (2.086)
NLW	-	-	-	-	-	-	-
NLNW	-	-	-	-	-	-	-
BDW	-	-	-	-	-	-	-
BDNW	-	-	-	-	-	-	-
FRW	-	-	-	-	-	-	-
FRNW	**0.34904** (11.070)	-	-	**1.5563** (2.903)	**-1.4988** (-2.615)	-	0.597133 (2.447)

Table 2
Autoregressive distributed lag models of the DDE ratio and the corporate tax rate, CTRATE

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	**0.37044** **(4.554)**	-	-	0.0095055 (4.476)	-	**-0.011318** **(-4.281)**	0.515856 (2.080)
UKNW change	**0.20552** **(39.55)**	-	-	**0.56932** **(6.650)**	-	**0.48682** **(5.813)**	0.803982 (2.086)
NLW	0.098850 (0.744)	-	-	0.0066209 (2.103)	-	-	0.253769 (2.160)
NLNW	**-0.32431** **(-3.414)**	-	-	**0.015007** **(6.673)**	-	-	0.774041 (2.160)
BDW	-	-	-	-	-	-	-
BDNW	-	-	-	-	-	-	-
FRW change	0.21708 (1.426)	0.41538 (1.035)	-	-	-0.21709 (-0.907)	-	0.272073 (2.571)
FRNW	-	-	-	-	-	-	-

Table 3
Autoregressive distributed lag models of the DDE ratio and the corporate tax ratio, CTAXRATIO

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	-0.0090998 (-0.116)	**0.51594** **(3.107)**	-	-	**0.66092** **(2.352)**	-	0.401422 (2.074)
UKNW	-0.011895 (-0.202)	**0.73873** **(4.599)**	-	0.26679 (1.485)	-	-	0.492058 (2.074)
NLW	-	-	-	-	-	-	-
NLNW	-	-	-	-	-	-	-
BDW	-	-	-	-	-	-	-
BDNW	-	-	-	-	-	-	-
FRW	**0.45329** **(16.366)**	-	-	-	**-0.31662** **(-2.832)**	-	0.53389 (2.365)
FRNW	-	-	-	-	-	-	-

Table 4
Autoregressive distributed lag models of the DDE ratio and the total tax ratio, TAXRATIO

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.083963 (1.315)	**0.41652 (2.204)**	-	0.0019649 (1.384)	-	-	0.310906 (2.074)
UKNW	0.090130 (2.034)	**0.39228 (2.209)**	-	**0.0057305 (3.233)**	-	-0.0049950 (-3.105)	0.645468 (2.086)
NLW	0.010678 (0.097)	**0.87446 (3.312)**	-	-	**0.061642 (2.740)**	**-0.043656 (-2.309)**	0.572928 (2.262)
NLNW	0.082425 (1.280)	**0.77406 (4.731)**	-	-	-0.036960 (-0.988)	-	0.734641 (2.201)
BDW	-	-	-	-	-	-	-
BDNW	-	-	-	-	-	-	-
FRW	**0.43198 (11.602)**	-	-	-	-0.13093 (-1.461)	-	0.233563 (2.365)
FRNW	-	-	-	-	-	-	-

Table 5
Autoregressive distributed lag models of the DDE ratio and the inflation index, INFLATE

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW change	**0.13652 (2.433)**	0.40853 (1.874)	-	-	0.29033 (0.886)	-	0.263474 (2.080)
UKNW change	**0.13859 (9.205)**	-	-	**0.64530 (4.616)**	-	-	0.491961 (2.074)
NLW change	**0.30754 (11.985)**	-	-	**2.0868 (3.072)**	-	-	0.440223 (2.179)
NLNW change	0.074064 (1.658)	**0.56097 (3.180)**	-	**1.6659 (2.294)**	-	-	0.804568 (2.201)
BDW	-	-	-	-	-	-	-
BDNW change	**0.26494 (22.308)**	-	-	-	-	1.0348 (2.342)	0.439223 (2.365)
FRW	-	-	-	-	-	-	-
FRNW	-	-	-	-	-	-	-

Table 6
Autoregressive distributed lag models of the DDE ratio and the stock market index, SMIND

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.18527 (3.664)	0.40974 (2.629)	-	-0.00047734 (-3.835)	-	0.00055085 (3.716)	0.571958 (2.101)
UKNW	0.10976 (3.046)	0.53464 (3.655)	-	-0.00025686 (-4.088)	-	0.00027527 (3.718)	0.719224 (2.101)
NLW	0.13105 (1.578)	0.74033 (4.439)	-	-0.0026420 (-7.188)	0.0025462 (5.733)	-	0.879313 (2.228)
NLNW	0.50088 (23.867)	-	-	-0.0015569 (-10.180)	-	-	0.888543 (2.160)
BDW	-0.0081374 (-0.084)	-	0.88437 (7.187)	-	0.000023934 (1.462)	-	0.922214 (2.365)
BDNW	-	-	-	-	-	-	-
FRW change	0.14846 (2.132)	0.68854 (3.712)	-	-0.17780 (-4.349)	-	-	0.805167 (2.447)
FRNW	0.36140 (7.452)	-	-	-	-0.00029822 (-1.035)	-	0.132777 (2.365)

Table 7
Autoregressive distributed lag models of the DDE ratio and the short-term interest rate variable, SRINT

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.091609 (1.302)	0.46471 (2.586)	-	0.0056653 (1.145)	-	-	0.290622 (2.080)
UKNW	0.033802 (0.776)	0.66941 (4.243)	-	0.0030692 (1.180)	-	-	0.472993 (2.080)
NLW	0.20289 (3.923)	-	-	-	0.022781 (3.426)	-	0.516207 (2.201)
NLNW	-0.042086 (-1.094)	0.63442 (5.643)	-	-	0.019507 (4.304)	-	0.895492 (2.228)
BDW	0.24805 (5.005)	-	0.57423 (8.335)	-0.013426 (-4.107)	0.0085923 (2.537)	-	0.974184 (2.447)
BDNW	-	-	-	-	-	-	-
FRW change	0.38518 (31.033)	-	-	-	0.28659 (2.967)	-	0.594665 (2.447)
FRNW	0.20909 (2.893)	-	-	-	-	0.0095249 (1.293)	0.218027 (2.447)

Table 8
Autoregressive distributed lag models of the DDE ratio and the medium-term interest rate variable, MRINT

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	**0.22725 (2.256)**	0.39891 (1.683)	-	-	-	-0.0071901 (-0.935)	0.196912 (2.145)
UKNW	0.021386 (0.748)	**0.58520 (4.558)**	-	0.0047855 (1.510)	-	-	0.743085 (2.120)
NLW change	**0.35847 (21.568)**	-	-	-	**0.28175 (2.431)**	-	0.349524 (2.201)
NLNW change	-0.064995 (-0.628)	**0.93624 (5.045)**	-	-	0.56130 (1.192)	-	0.734226 (2.228)
BDW change	0.14365 (2.036)	-	**0.70027 (6.198)**	-	-0.038166 (-0.790)	-	0.906784 (2.365)
BDNW	0.057395 (1.247)	**0.57550 (4.304)**	-	-	0.0088842 (1.718)	-	0.793252 (2.306)
FRW change	**0.45846 (9.037)**	**-1.1800 (-7.021)**	**1.0438 (8.502)**	-	**0.61748 (13.052)**	**0.47688 (8.754)**	0.990149 (4.303)
FRNW	-0.017569 (-0.351)	-	**-1.2633 (-5.697)**	**0.016636 (3.126)**	-	**0.053566 (5.911)**	0.944239 (2.776)

Table 9
Autoregressive distributed lag models of the DDE ratio and the long-term interest rate variable, LRINT

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.14307 (1.618)	**0.38001 (2.109)**	-	**0.020230 (2.445)**	-	**-0.017512 (-2.367)**	0.45111 (2.093)
UKNW	0.026107 (0.809)	**0.65232 (4.316)**	-	**0.022106 (4.735)**	**-0.018359 (-3.795)**	-	0.737768 (2.086)
NLW change	0.16471 (1.915)	**0.54013 (2.417)**	-	0.23478 (1.923)	-	-	0.430783 (2.201)
NLNW change	0.024675 (0.530)	**0.87834 (6.103)**	-	0.17447 (1.746)	-	-	0.773763 (2.201)
BDW	**0.17799 (2.806)**	-	0.75400 (9.408)	-	-0.0091536 (-1.721)	-	0.928664 (2.365)
BDNW	-	-	-	-	-	-	-
FRW change	**0.32596 (36.519)**	**-0.80670 (-23.671)**	1.0794 (60.473)	**0.10462 (16.004)**	**0.65407 (82.611)**	**0.34309 (36.675)**	0.999947 (12.706)
FRNW	**0.25051 (3.701)**	-	-	-	-	0.0047297 (0.764)	0.0886204 (2.447)

Table 10
Autoregressive distributed lag models of the DDE ratio and aggregate investment, INVEST

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW change	**0.12245 (2.324)**	**0.40973 (2.226)**	-	-	0.38068 (2.056)	-	0.363959 (2.080)
UKNW change	0.052178 (1.639)	**0.61974 (3.894)**	-	-	0.19557 (1.997)	-	0.535472 (2.080)
NLW	-	-	-	-	-	-	-
NLNW	-	-	-	-	-	-	-
BDW change	0.084729 (1.478)	-	**0.78296 (8.818)**	0.13744 (1.309)	-	-	0.918446 (2.365)
BDNW	-	-	-	-	-	-	-
FRW	-	-	-	-	-	-	-
FRNW	-	-	-	-	-	-	-

Table 11
Autoregressive distributed lag models of the DDE ratio and aggregate output, GDP (GNP)

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW change	0.099518 (1.667)	**0.56843 (2.975)**	-	-	0.99085 (1.543)	-	0.313766 (2.080)
UKNW change	0.014326 (0.384)	**0.84256 (5.041)**	-	-	**0.74145 (2.158)**	-	0.54761 (2.080)
NLW chch	**0.35942 (17.992)**	-	-	-	-0.026312 (-1.475)	-	0.17869 (2.228)
NLNW chch	0.077534 (1.851)	**0.67471 (4.959)**	-	-	-0.020345 (-1.792)	-	0.809121 (2.262)
BDW	-	-	-	-	-	-	-
BDNW change	0.066622 (0.802)	**0.64553 (3.114)**	-	-	0.56485 (1.163)	-	0.606033 (2.365)
FRW	-	-	-	-	-	-	-
FRNW	-	-	-	-	-	-	-

Table 12
Autoregressive distributed lag models of the DDE ratio and the interest cover ratio, INTCOVER

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.080476 (1.516)	**0.56291 (3.367)**	-	**0.0033041 (2.394)**	-	-	0.405713 (2.074)
UKNW	0.097053 (1.924)	**0.75370 (3.131)**	-0.18728 (-0.844)	-0.00046366 (-0.769)	-	-	0.482045 (2.086)
NLW	0.12243 (0.920)	0.42946 (1.688)	-	-	-	0.013495 (0.949)	0.263948 (2.228)
NLNW	-	-	-	-	-	-	-
BDW	-	-	-	-	-	-	-
BDNW	-	-	-	-	-	-	-
FRW change	0.19056 (1.025)	0.48388 (0.985)	-	-	-	-0.13204 (-0.721)	0.230676 (2.776)
FRNW	-	-	-	-	-	-	-

Table 13
Autoregressive distributed lag models of the DDE ratio and dividend cover, DIVCOVER

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	**0.36808 (9.615)**	-	-	**-0.042004 (-2.541)**	-	-	0.235121 (2.080)
UKNW	0.024085 (0.525)	**0.60113 (3.140)**	-	0.016285 (1.040)	-	-	0.485153 (2.086)
NLW	-	-	-	-	-	-	-
NLNW	-0.16722 (-0.780)	**0.77492 (4.486)**	-	-	-	0.076961 (1.007)	0.724454 (2.228)
BDW	0.041327 (1.167)	-	**0.75494 (15.033)**	-	-	**0.028057 (4.287)**	0.971995 (2.365)
BDNW	-	-	-	-	-	-	-
FRW	**0.39232 (6.924)**	-	-	-0.0011963 (-0.080)	-	-	0.00079234 (2.306)
FRNW	0.26637 (2.113)	0.53313 (2.397)	-	-0.031904) (-1.057)	-	-	0.500002 (2.447)

Table 14
Autoregressive distributed lag models of the DDE ratio and the firm size measure, ASSETS

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW change	**0.15869** **(2.650)**	**0.51437** **(2.622)**	-	-	-	-0.18845 (-1.257)	0.288192 (2.086)
UKNW change	0.063420 (1.994)	**0.62523** **(3.883)**	-	0.086714 (1.455)	-	-	0.49026 (2.074)
NLW change	**0.36194** **(16.894)**	-	-	0.15546 (1.105)	-	-	0.0790612 (2.179)
NLNW change	0.063334 (1.271)	**1.0110** **(3.174)**	-0.28942 (-0.887)	-	-	0.13042 (0.772)	0.767107 (2.306)
BDW change	-0.0062336 (-0.090)	**0.94772** **(8.363)**	-	0.14651 (2.548)	-	**0.24406** **(3.836)**	0.938446 (2.571)
BDNW	0.059799 (0.607)	-	**0.54581** **(3.442)**	**0.000025467** **(3.951)**	**-0.000019118** **(-2.594)**	-	0.812559 (2.447)
FRW	-	-	-	-	-	-	-
FRNW	-	-	-	-	-	-	-

Table 15
Autoregressive distributed lag models of the DDE ratio and the liquidity ratio, WCRATIO

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.087742 (1.411)	**0.44234** **(2.411)**	-	-	0.053119 (1.389)	-	0.311323 (2.074)
UKNW	**0.26035** **(2.562)**	**0.64572** **(4.278)**	-	-0.12026 (-2.049)	-	-	0.530741 (2.074)
NLW	-	-	-	-	-	-	-
NLNW	**0.94420** **(3.001)**	**0.67051** **(4.837)**	-	-	-	**-0.56781** **(-2.891)**	0.834649 (2.228)
BDW change	0.14250 (2.129)	-	**0.70269** **(6.578)**	0.071199 (0.883)	-	-	0.908646 (2.365)
BDNW	-	-	-	-	-	-	-
FRW change	0.15085 (0.933)	0.57893 (1.386)	-	-	-0.26194 (-1.100)	-	0.317364 (2.571)
FRNW	-	-	-	-	-	-	-

Table 16
Autoregressive distributed lag models of the DDE ratio and the profitability ratio, ROCE

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.013472 (0.229)	0.31811 (1.936)	-	**0.011595 (3.184)**	-	-	0.487242 (2.074)
UKNW	0.0084539 (0.123)	**0.68716 (4.270)**	-	-	0.0026549 (0.876)	-	0.460014 (2.074)
NLW	0.16565 (1.456)	0.37448 (1.419)	-	-	-	0.0040061 (0.757)	0.241171 (2.228)
NLNW	0.10852 (1.016)	**0.73138 (3.486)**	-	-0.0022170 (-0.712)	-	-	0.723803 (2.201)
BDW change	**0.15942 (3.179)**	-	**0.67598 (8.300)**	-	-	**0.096814 (3.057)**	0.948438 (2.447)
BDNW	**0.31775 (6.570)**	-	**0.53362 (4.256)**	**-0.013930 (-3.380)**	-	-	0.736683 (2.365)
FRW change	0.070401 (0.376)	0.79890 (1.622)	-	-	-	-0.23869 (-1.466)	0.434602 (2.776)
FRNW	0.22393 (1.976)	-	-	0.0058319 (0.934)	-	-	0.098376 (2.306)

Table 17
Autoregressive distributed lag models of the DDE ratio and the Q-proxy ratio, QRATIO

country, sample and variable type	constant	DDERATIO variable lagged 1 year	DDERATIO variable lagged 2 years	independent variable	independent variable lagged 1 year	independent variable lagged 2 years	R^2 statistic/ (t-critical)
UKW	0.094098 (1.215)	**0.57945 (3.820)**	-	**-0.30183 (-3.699)**	**0.33180 (3.553)**	-	0.566175 (2.080)
UKNW	0.10903 (1.711)	**0.79351 (3.496)**	-0.25940 (-1.081)	-0.015666 (-0.738)	-	-	0.480863 (2.086)
NLW	0.25488 (1.732)	-	-	-	-	0.15869 (0.753)	0.0489726 (2.201)
NLNW	**0.72517 (17.305)**	-	-	**-0.46688 (-10.235)**	-	-	0.88961 (2.160)
BDW	0.073101 (1.737)	-	**0.55563 (5.998)**	**0.18455 (2.938)**	-	-	0.954545 (2.365)
BDNW	-	-	-	-	-	-	-
FRW	**0.34362 (2.645)**	0.72767 (2.199)	-	-0.29794 (-1.826)	-	-	0.479872 (2.571)
FRNW	-	-	-	-	-	-	-

APPENDIX L:
A BRIEF DISCUSSION OF THE DIAGNOSTIC STATISTICS COMPUTED FOR THE TIME SERIES MODELS

The **t-test (or Student-t ratio)** is employed to determine whether certain individual regressors are significant components of a regression model. The t-test statistic is defined by equation 1:

$$t = \frac{b-0}{se(b)} = \frac{b}{se(b)} \qquad \text{Equation 1}$$

Where:
t = the t-statistic
b = the regression coefficient estimate of the individual variable to be tested
$se(b)$ = the standard errors associated with the regression coefficient estimate

The null hypothesis of the t-test is that the regressor is zero. This hypothesis is rejected if the t-statistic exceeds the t-distribution critical value. Therefore, if the null hypothesis is rejected then the regressor tested is significant.

The **R-squared statistic** is calculated as a "goodness of fit" measure of the whole model, and is defined by equation 2:

$$R^2 = 1 - \frac{\sum_{t=1}^{T} \hat{u}_t^2}{\sum_{t=1}^{T} \tilde{y}_t^2} \qquad \text{Equation 2}$$

Where:
R^2 = the coefficient of determination

$\sum_{t=1}^{T} \hat{u}_t^2$ = the sum of squared errors

$\sum_{t=1}^{T} \tilde{y}_t^2$ = the total sum of squares

In an intuitive sense, the R^2 measure represents the proportion of the dependent variable explained by the regressors in the regression equation. The statistic has a value of unity in the case of a perfect model and zero where the model explains none of the variation in the dependent variable. The "better" models are models with higher R^2 statistics, although it must be noted that adding extra variables will not cause the R^2 statistic of a model to decrease, and may cause it to increase, even in the case where the new variables are nonsensical.

The F-statistic enables testing of the proportion of variation in the dependent variables explained by the regression, and is defined by equation 3:

$$F = \frac{R^2 / (k-1)}{(1-R^2)/(T-k)} \qquad \text{Equation 3}$$

Where:
F = the F-statistic
R^2 = the coefficient of determination
k = the number of regressors
T = the number of observations

The null hypothesis is that the vector of regression coefficients is equal to zero. This hypothesis is rejected if the F-statistic exceeds the F distribution critical value for k-1 and T-k degrees of freedom. In this research the probability value of F is also presented, representing the probability that the regression explains none of the variation in the dependent variable. Therefore, significant models may be considered those models for which the probability of the null hypothesis being accepted is close to zero. The significance level chosen in this capital structure study is the 5 per cent level, or 0.05.

The **LM test for autocorrelated residuals** is the Lagrange Multiplier test for residual autocorrelation. The test regresses the residuals of the model to be tested upon the regressors of that model and the lagged residuals. The null hypothesis is that no autocorrelation is present within the model, that is, that the errors are essentially a white-noise process, and this hypothesis is tested by conducting an F-test upon the coefficients of the lagged residuals (which are the error autocorrelation coefficients). If the F statistic exceeds the F critical value then the null hypothesis of no autocorrelation is rejected and the model thus contains significantly autocorrelated residuals.

The **autoregressive conditional heteroscedasticity test** (hereafter referred to as the ARCH test). It basically determines whether the (conditional) variance of the error term depends on the past history of the errors. The ARCH test involves the regression of the residuals upon lagged residual values and a constant. The null hypothesis is that the variance of the error term is not dependent on the past history of the errors, and this hypothesis is tested by conducting an F-test upon the coefficients of the lagged residuals. If the statistic exceeds the F critical value then the null hypothesis of no ARCH process is rejected.

The **Chi-squared test for normality** involves computation of the Jarque and Bera (1980) statistic. This statistic basically tests whether skewness and excess kurtosis are jointly zero, and it is calculated by using equation 4:

$$\text{Chi-squared (2)} = \frac{(T-k)}{6}(SK^2 + \frac{1}{4}EK^2) \quad \text{Equation 4}$$

Where:

$$SK = \frac{1}{T-1}\sum_{t=1}^{T}\tilde{x}_t^3 \,/\, (\frac{1}{T-1}\sum_{t=1}^{T}\tilde{x}_t^2)^{1.5} = \text{skewness}$$

$$EK = \left[\frac{1}{T-1}\sum_{t=1}^{T}\tilde{x}_t^4 \,/\, (\frac{1}{T-1}\sum_{t=1}^{T}\tilde{x}_t^2)^2\right] - 3 = \text{excess kurtosis}$$

The null hypothesis in this test is that the residuals of the regression model are normally distributed. The test statistic is compared to a critical value from a Chi-squared distribution, and if the statistic exceeds the critical value then the null hypothesis is rejected and the model residuals come from a non-normal distribution.

The **F-test for heteroscedasticity** basically tests for unequal error variance between observations, and in this case, through time. The test involves the regression of the squared residuals from the model in question upon the regressor variables of that model and the squared variables. The null hypothesis of the test is that the errors are unconditionally homoscedastic. The null hypothesis is rejected if the F statistic exceeds the F critical value in a test of the joint significance of the coefficients of this secondary regression. Thus, a rejection of the null hypothesis highlights the problem of unequal error variance in the model.

The **regression specification (RESET) test**, developed by Ramsey (1969), determines whether some alternative specification form might be more appropriate. The test basically adds powers of linear combinations of the independent variables by construction as shown in equation 5.

$$\hat{y}_t = x_t'\beta_t \quad \text{Equation 5}$$

The null hypothesis is that the model is correctly specified. This null is tested against the alternative hypothesis that powers of the dependent variable have been omitted in the model. The null hypothesis is rejected if the F statistic computed exceeds the F critical value, and this result highlights the fact that the model should be re-specified and re-estimated.

APPENDIX M:
DIAGNOSTIC TESTS FOR THE AUTOREGRESSIVE DISTRIBUTED LAG MODELS OF THE DDE RATIO AND THE EUROPEAN TIME SERIES VARIABLES

Note:

1) Figures in parentheses are computed probabilities that the null hypothesis of the test is rejected. For the model F-ratio, a rejection signals a significant model, whereas for the other tests a model rejection signals a statistical problem with the model.
2) Figures in bold reveal cases where the null hypothesis is rejected at the 5 per cent level or less.
3) The critical value for the normality Chi-squared tests for two degrees of freedom at the 5 per cent level is 5.991.

Table 1
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the tax advantage to debt, TAXADV

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**7.5009 (0.0015)**	**23.999 (0.0000)**	-	-	-	-	-	4.4466 (0.0654)
Autocorrelation F-test	0.79355 (0.4674)	2.9487 (0.0780)	-	-	-	-	-	0.0002422 (0.9882)
ARCH F-test	0.0098001 (0.9222)	0.037653 (0.8483)	-	-	-	-	-	0.87979 (0.4014)
Normality Chi-squared	0.72521	0.1042	-	-	-	-	-	0.55315
Heteroscedasticity F-test	0.5928 (0.7311)	0.11268 (0.9932)	-	-	-	-	-	-
RESET F-test	0.72703 (0.4045)	0.0045056 (0.9472)	-	-	-	-	-	2.3143 (0.1887)

Table 2
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the corporate tax rate, CTRATE

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**11.188 (0.0005)**	**41.016 (0.0000)**	4.4209 (0.0556)	**44.533 (0.0000)**	-	-	0.93441 (0.4521)	-
Autocorrelation F-test	0.60028 (0.5587)	1.4489 (0.2609)	1.1664 (0.3472)	3.286 (0.0761)	-	-	0.036335 (0.8581)	-
ARCH F-test	0.09035 (0.7670)	0.20787 (0.6539)	0.54632 (0.4753)	1.3663 (0.2672)	-	-	0.34067 (0.6004)	-
Normality Chi-squared	0.52807	0.9643	0.76424	0.82004	-	-	0.041824	-
Heteroscedasticity F-test	0.57087 (0.6876)	1.2639 (0.3273)	0.87533 (0.4464)	0.97127 (0.4116)	-	-	-	-
RESET F-test	0.16559 (0.6884)	2.0832 (0.1652)	**10.647 (0.0068)**	**14.284 (0.0026)**	-	-	0.030767 (0.8693)	-

Table 3
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the corporate tax ratio, CTAXRATIO

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**7.3769 (0.0035)**	**10.656 (0.0006)**	-	-	-	-	**8.0179 (0.0253)**	-
Autocorrelation F-test	0.49536 (0.6166)	0.29495 (0.7478)	-	-	-	-	1.0962 (0.3354)	-
ARCH F-test	0.0041496 (0.9493)	0.05066 (0.8242)	-	-	-	-	0.011091 (0.9202)	-
Normality Chi-squared	2.4606	**19.834**	-	-	-	-	0.83362	-
Heteroscedasticity F-test	1.2967 (0.3107)	0.66413 (0.6255)	-	-	-	-	0.32398 (0.7406)	-
RESET F-test	0.096719 (0.7589)	0.16154 (0.6918)	-	-	-	-	1.3455 (0.2901)	-

Table 4
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the total tax ratio, TAXRATIO

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**4.963 (0.0166)**	**12.137 (0.0001)**	**4.0246 (0.0453)**	**15.227 (0.0007)**	-	-	2.1332 (0.1875)	-
Autocorrelation F-test	0.181 (0.8358)	0.45206 (0.6433)	0.081309 (0.7828)	0.15342 (0.7035)	-	-	0.73032 (0.4256)	-
ARCH F-test	0.4562 (0.5071)	0.015104 (0.9036)	0.30234 (0.5995)	1.1131 (0.3189)	-	-	0.63003 (0.4633)	-
Normality Chi-squared	4.1245	0.15374	1.7067	0.72396	-	-	0.37561	-
Heteroscedasticity F-test	0.80032 (0.5415)	1.2804 (0.3314)	0.13435 (0.9763)	0.75842 (0.5882)	-	-	0.82876 (0.4999)	-
RESET F-test	0.44807 (0.5105)	0.36967 (0.5504)	0.55458 (0.4778)	3.2578 (0.1012)	-	-	0.11973 (0.7411)	-

Table 5
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the inflation index, INFLATE

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**3.7561 (0.0403)**	**21.304 (0.0001)**	**9.4371 (0.0097)**	**22.643 (0.0001)**	-	5.4827 (0.0517)	-	-
Autocorrelation F-test	0.66552 (0.5256)	0.34346 (0.7134)	0.9367 (0.4238)	0.047568 (0.8317)	-	0.055166 (0.8221)	-	-
ARCH F-test	0.31439 (0.5816)	0.60543 (0.4456)	0.2096 (0.6569)	0.57949 (0.4660)	-	0.017796 (0.8991)	-	-
Normality Chi-squared	**6.5454**	2.2564	0.84172	1.7781	-	1.0554	-	-
Heteroscedasticity F-test	0.20236 (0.9334)	1.0552 (0.3677)	1.2846 (0.3230)	1.2485 (0.3841)	-	1.0551 (0.4286)	-	-
RESET F-test	0.11285 (0.7404)	1.3852 (0.2524)	0.86172 (0.3732)	**6.1626 (0.0324)**	-	0.48772 (0.5111)	-	-

Table 6
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the stock market index, SMIND

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**8.0173** **(0.0013)**	**15.369** **(0.0000)**	**24.286** **(0.0001)**	**103.64** **(0.0000)**	**41.495** **(0.0001)**	-	**12.398** **(0.0074)**	1.0717 (0.3350)
Autocorrelation F-test	0.4733 (0.6314)	0.81415 (0.4605)	0.30717 (0.5929)	1.3359 (0.3024)	1.6646 (0.2445)	-	0.062885 (0.8120)	0.064283 (0.8083)
ARCH F-test	0.025115 (0.8761)	0.92045 (0.3516)	0.24963 (0.6308)	**6.1918** **(0.0301)**	0.16807 (0.6988)	-	0.032932 (0.8648)	2.2043 (0.1978)
Normality Chi-squared	0.022835	3.5353	0.050187	1.5517	0.24665	-	0.5221	0.48978
Heteroscedasticity F-test	0.28011 (0.9346)	1.4936 (0.2668)	0.44266 (0.8181)	**4.364** **(0.0434)**	0.17246 (0.9342)	-	-	0.85262 (0.4916)
RESET F-test	0.055343 (0.8168)	0.93631 (0.3468)	0.85567 (0.3791)	2.6022 (0.1327)	**6.8871** **(0.0394)**	-	4.9324 (0.0770)	**8.1325** **(0.0291)**

Table 7
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the short-term interest rate, SRINT

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**4.3017** **(0.0272)**	**9.4238** **(0.0012)**	**11.737** **(0.0057)**	**42.843** **(0.0000)**	**75.47** **(0.0000)**	-	**8.8026** **(0.0251)**	1.6729 (0.2434)
Autocorrelation F-test	0.10972 (0.8967)	0.48065 (0.6257)	0.49616 (0.4973)	0.065321 (0.8040)	0.026225 (0.8777)	-	0.11277 (0.7506)	0.31331 (0.5998)
ARCH F-test	0.32987 (0.5725)	0.061761 (0.8064)	0.45192 (0.5183)	0.48962 (0.5039)	1.426 (0.2984)	-	0.43308 (0.5464)	0.89232 (0.3983)
Normality Chi-squared	4.3755	**36.207**	1.3483	0.34114	0.37852	-	0.85304	0.94727
Heteroscedasticity F-test	0.49348 (0.7407)	0.40388 (0.8031)	0.97103 (0.4192)	0.22663 (0.9123)	-	-	0.52903 (0.6356)	0.041403 (0.9600)
RESET F-test	0.0022939 (0.9623)	0.35495 (0.5580)	3.0532 (0.1112)	2.5347 (0.1458)	0.86883 (0.3941)	-	0.78316 (0.4167)	0.5114 (0.5065)

Table 8
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the medium-term interest rate, MRINT

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	1.7164 (0.2154)	**23.139** **(0.0000)**	**5.9107** **(0.0333)**	**13.813** **(0.0013)**	**34.047** **(0.0002)**	**15.347** **(0.0018)**	**50.256** **(0.0196)**	**22.578** **(0.0057)**
Autocorrelation F-test	0.47468 (0.6333)	0.14238 (0.8685)	0.49482 (0.4978)	0.1386 (0.7183)	0.085751 (0.7795)	0.089301 (0.7737)	-	1.5568 (0.3006)
ARCH F-test	5.13e-005 (0.9944)	0.0020513 (0.9645)	0.16732 (0.6921)	0.002064 (0.9649)	0.020384 (0.8920)	1.1859 (0.3180)	-	0.069799 (0.8164)
Normality Chi-squared	0.49102	1.3351	1.032	0.31769	0.76833	0.20364	0.27037	0.42321
Heteroscedasticity F-test	1.9318 (0.1893)	1.4686 (0.2770)	0.16021 (0.8546)	0.36487 (0.8249)	0.87689 (0.5944)	0.2619 (0.8858)	-	-
RESET F-test	0.84914 (0.3736)	0.079866 (0.7813)	0.31933 (0.5845)	1.3621 (0.2732)	2.6284 (0.1561)	1.4427 (0.2688)	-	1.2536 (0.3444)

Table 9
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the long-term interest rate, LRINT

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**5.2051 (0.0086)**	**18.756 (0.0000)**	**4.1624 (0.0451)**	**18.811 (0.0003)**	**45.563 (0.0001)**	-	**3757.8 (0.0124)**	0.58343 (0.4739)
Autocorrelation F-test	0.42133 (0.6628)	1.6091 (0.2275)	0.52872 (0.4838)	0.073662 (0.7916)	0.35472 (0.5732)	-	-	0.036126 (0.8567)
ARCH F-test	0.29512 (0.5940)	2.097 (0.1648)	0.082489 (0.7805)	0.31819 (0.5865)	0.21515 (0.6623)	-	-	1.5848 (0.2765)
Normality Chi-squared	1.949	0.056482	0.6843	0.45223	0.26456	-	0.13859	1.0206
Heteroscedasticity F-test	0.35597 (0.8929)	0.59605 (0.7288)	0.48122 (0.7502)	0.11835 (0.9710)	0.51951 (0.7403)	-	-	0.17652 (0.8463)
RESET F-test	0.049649 (0.8262)	0.84864 (0.3685)	0.0012067 (0.9730)	1.3385 (0.2742)	2.1583 (0.1922)	-	-	0.002485 (0.9622)

Table 10
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and aggregate investment, INVEST

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**6.0084 (0.0086)**	**12.104 (0.0003)**	-	-	**39.416 (0.0002)**	-	-	-
Autocorrelation F-test	0.45537 (0.6410)	0.52622 (0.5992)	-	-	0.0003852 (0.9850)	-	-	-
ARCH F-test	0.29894 (0.5909)	0.014114 (0.9067)	-	-	3.1741 (0.1349)	-	-	-
Normality Chi-squared	0.48712	**9.2869**	-	-	0.76281	-	-	-
Heteroscedasticity F-test	**3.632 (0.0274)**	2.102 (0.1281)	-	-	0.18336 (0.9280)	-	-	-
RESET F-test	0.0004039 (0.9842)	0.68715 (0.4169)	-	-	4.1112 (0.0890)	-	-	-

Table 11
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and aggregate output, GDP (GNP)

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**4.8009 (0.0192)**	**12.71 (0.0002)**	2.1757 (0.1710)	**19.075 (0.0006)**	-	**5.384 (0.0384)**	-	-
Autocorrelation F-test	0.31333 (0.7347)	0.21725 (0.8067)	0.89965 (0.3676)	0.13985 (0.7184)	-	3.47e-006 (0.9986)	-	-
ARCH F-test	0.029075 (0.8664)	0.015905 (0.9010)	0.5199 (0.4914)	0.013517 (0.9107)	-	2.0221 (0.2143)	-	-
Normality Chi-squared	0.96502	3.1539	0.65204	0.4121	-	0.31589	-	-
Heteroscedasticity F-test	**4.8383 (0.0095)**	**8.8259 (0.0006)**	0.5155 (0.6182)	0.29791 (0.8661)	-	0.30583 (0.8560)	-	-
RESET F-test	3.935 (0.0612)	0.25122 (0.6217)	0.23672 (0.6382)	4.7906 (0.0600)	-	0.30951 (0.5981)	-	-

Table 12
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the interest cover ratio, INTCOVER

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**7.5096 (0.0033)**	**6.2045 (0.0037)**	1.793 (0.2160)	-	-	-	0.59968 (0.5919)	-
Autocorrelation F-test	0.10419 (0.9015)	0.062669 (0.9395)	0.0018407 (0.9667)	-	-	-	0.55896 (0.5089)	-
ARCH F-test	0.042889 (0.8380)	0.0002699 (0.9871)	0.25341 (0.6283)	-	-	-	0.042214 (0.8562)	-
Normality Chi-squared	**9.4185**	**12.724**	0.44941	-	-	-	0.58845	-
Heteroscedasticity F-test	0.13095 (0.9689)	0.45456 (0.8294)	1.089 (0.4518)	-	-	-	-	-
RESET F-test	0.08652 (0.7715)	0.56342 (0.4621)	**11.271 (0.0084)**	-	-	-	0.0565538 (0.8274)	-

Table 13
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and dividend cover, DIVCOVER

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**6.4553 (0.0190)**	**9.4233 (0.0013)**	-	**13.146 (0.0016)**	**121.48 (0.0000)**	-	0.0063437 (0.9385)	3.000 (0.1250)
Autocorrelation F-test	1.6651 (0.2156)	0.41053 (0.6694)	-	0.0039072 (0.9515)	2.1163 (0.1960)	-	1.4425 (0.2688)	1.78 (0.2397)
ARCH F-test	0.053602 (0.8194)	0.068427 (0.7966)	-	0.75288 (0.4108)	0.037767 (0.8536)	-	0.048862 (0.8324)	0.23668 (0.6521)
Normality Chi-squared	0.67943	**17.143**	-	0.83261	3.6172	-	1.018	0.74782
Heteroscedasticity F-test	0.047339 (0.9539)	0.57966 (0.6820)	-	0.29922 (0.8671)	0.21757 (0.9081)	-	0.20432 (0.8217)	-
RESET F-test	0.3103 (0.5837)	0.7564 (0.3953)	-	**5.5498 (0.0429)**	0.23948 (0.6420)	-	4.0767 (0.0832)	6.4916 (0.0514)

Table 14
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the firm size measure, ASSETS

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**4.0487 (0.0334)**	**10.58 (0.0006)**	1.0302 (0.3301)	**8.7835 (0.0065)**	**25.41 (0.0019)**	**8.67 (0.0134)**	-	-
Autocorrelation F-test	1.0897 (0.3575)	0.24311 (0.7865)	0.80244 (0.4751)	1.7756 (0.2244)	6.7738 (0.0599)	0.23428 (0.6488)	-	-
ARCH F-test	0.075357 (0.7868)	0.083046 (0.7762)	0.19915 (0.6649)	0.26742 (0.6236)	0.033372 (0.8667)	0.39555 (0.5635)	-	-
Normality Chi-squared	3.1473	**41.982**	1.1354	0.59513	0.57171	0.20788	-	-
Heteroscedasticity F-test	0.78797 (0.5507)	0.10791 (0.9781)	1.5782 (0.2585)	-	-	-	-	-
RESET F-test	0.07401 (0.7885)	0.21061 (0.6510)	0.83167 (0.3813)	3.0369 (0.1249)	0.12013 (0.7464)	0.091564 (0.7744)	-	-

Table 15
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the liquidity ratio, WCRATIO

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**4.9726 (0.0165)**	**12.441 (0.0002)**	-	**25.239 (0.0001)**	**34.813 (0.0002)**	-	1.1623 (0.3850)	-
Autocorrelation F-test	0.10235 (0.9032)	0.32245 (0.7281)	-	1.7157 (0.2227)	0.0089974 (0.9275)	-	0.064672 (0.8118)	-
ARCH F-test	0.49717 (0.4889)	0.057648 (0.8127)	-	6.21e-005 (0.9939)	0.20292 (0.6712)	-	0.57382 (0.5038)	-
Normality Chi-squared	**6.2179**	**19.011**	-	0.62886	0.85025	-	0.4807	-
Heteroscedasticity F-test	0.48668 (0.7454)	1.151 (0.3666)	-	0.38695 (0.8107)	0.28805 (0.8664)	-	-	-
RESET F-test	0.63994 (0.4327)	0.12264 (0.7297)	-	0.60927 (0.4551)	5.91 (0.0511)	-	0.014897 (0.9087)	-

Table 16
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the profitability ratio, ROCE

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**10.453 (0.0006)**	**9.3709 (0.0011)**	1.5891 (0.2516)	**14.413 (0.0008)**	**55.182 (0.0001)**	**9.7919 (0.0094)**	1.5373 (0.3197)	0.87284 (0.3775)
Autocorrelation F-test	0.53814 (0.5921)	0.3044 (0.7409)	0.21728 (0.6522)	1.3272 (0.2761)	0.065603 (0.8081)	0.034106 (0.8596)	0.0025052 (0.9632)	2.1362 (0.1872)
ARCH F-test	0.12601 (0.7263)	0.0065475 (0.9363)	0.85036 (0.3834)	1.1929 (0.3031)	0.2362 (0.6524)	0.025229 (0.8800)	0.68154 (0.4959)	0.12184 (0.7390)
Normality Chi-squared	0.41744	**26.153**	0.76461	0.2888	0.20768	0.73133	0.50004	0.49219
Heteroscedasticity F-test	0.42968 (0.7852)	0.43256 (0.7832)	0.53221 (0.7195)	0.26866 (0.8880)	-	0.21861 (0.9075)	-	3.6219 (0.1066)
RESET F-test	1.0008 (0.3285)	0.33274 (0.5702)	2.8332 (0.1266)	0.6352 (0.4440)	**10.193 (0.0242)**	0.039102 (0.8498)	0.087956 (0.7891)	3.2587 (0.1140)

Table 17
Diagnostic tests for the autoregressive distributed lag models of the DDE ratio and the Q-proxy ratio, QRATIO

Statistic\ Model	UKW	UKNW	NLW	NLNW	BDW	BDNW	FRW	FRNW
Model F-ratio	**9.1355 (0.0005)**	**6.1752 (0.0038)**	0.56644 (0.4675)	**104.76 (0.0000)**	**73.498 (0.0000)**	-	2.7678 (0.1407)	-
Autocorrelation F-test	0.63892 (0.5388)	0.073871 (0.9291)	2.6227 (0.1364)	1.1971 (0.3385)	2.9118 (0.1388)	-	1.7506 (0.2431)	-
ARCH F-test	0.010428 (0.9197)	0.0031525 (0.9558)	0.0005889 (0.9812)	0.93434 (0.3545)	1.3602 (0.2961)	-	0.040537 (0.8503)	-
Normality Chi-squared	0.48947	**10.104**	0.49343	1.9619	0.14198	-	0.6361	-
Heteroscedasticity F-test	1.9369 (0.1445)	0.89773 (0.5249)	0.13264 (0.8777)	0.72588 (0.5077)	0.8107 (0.6174)	-	-	-
RESET F-test	3.5149 (0.0755)	0.92266 (0.3488)	1.2025 (0.2985)	**7.3672 (0.0188)**	0.0045842 (0.9482)	-	3.3813 (0.1253)	-

APPENDIX N:
ADDITIONAL COINTEGRATION AND DIAGNOSTIC TESTING TO SUPPORT THE EUROPEAN CORPORATE CAPITAL STRUCTURE ERROR CORRECTION MODELS

Table 1
The F-test for the presence of a deterministic trend within the European corporate error correction mechanisms with the DDE ratio as independent

error correction mechanism dependent variable	country sample	degrees of freedom	F-statistic	accept/reject
INFLATEchange	UK weighted	2,20	5.4082	accept
INFLATEchange	UK non-weighted	2,20	7.4381	accept
INFLATEchange	NL weighted	2,10	4.0345	accept
MRINT	UK non-weighted	2,15	5.6692	accept
TAXRATIO	UK weighted	2,22	3.7996	accept
CTRATEchange	UK non-weighted	2,21	5.6696	accept
ROCE	UK weighted	2,22	4.0177	accept
ROCEchange	BD weighted	2,7	10.921	reject
DIVCOVER	UK weighted	2,19	7.2039	accept
ASSETSchange	BD weighted	2,7	4.1803	accept
WCRATIOchange	BD weighted	2,7	5.3047	accept

Table 2
Cointegration tests for the UK weighted sample with the DDE ratio as independent variable, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
DIVCOVERlag0	1.45	1.239	1.429	1,22	A	-3.92	-3.2430	R
DIVCOVERlag1	1.90	1.125	1.538	2,21	A	-4.545	-3.2530	R
DIVCOVERlag2	1.52	0.998	1.676	3,20	I	-2.711	-3.2640	A
DIVCOVERlag3	2.10/1.90	0.859	1.848	4,19	A	-2.024	-3.2763	A
DIVCOVERlag4	2.03/1.97	0.710	2.060	5,18	I	-2.273	-3.2900	A
DIVCOVERlag5	1.95	0.554	2.318	6,17	I	-2.245	-3.3054	A
INFLATEchangelag0	2.00	1.257	1.437	1,23	A	-2.786	-3.2339	A
INFLATEchangelag1	1.98	1.147	1.541	2,22	A	-2.229	-3.2430	A
INFLATEchangelag2	2.03/1.97	1.026	1.669	3,21	A	-1.651	-3.2530	A
INFLATEchangelag3	2.10/1.90	0.894	1.828	4,20	A	-1.022	-3.2640	A
INFLATEchangelag4	1.84	0.752	2.023	5,19	I	-0.6001	-3.2763	A
INFLATEchangelag5	1.80	0.603	2.257	6,18	I	-0.994	-3.2900	A
ROCElag0	1.64	1.288	1.454	1,25	A	-2.531	-3.2182	A
ROCElag1	1.73	1.188	1.546	2,24	A	-2.353	-3.2256	A
ROCElag2	1.60	1.078	1.660	3,23	I	-1.402	-3.2339	A
ROCElag3	1.69	0.958	1.797	4,22	I	-1.707	-3.2430	A
ROCElag4	1.80	0.829	1.964	5,21	I	-1.351	-3.2530	A
ROCElag5	1.84	0.692	2.162	6,20	I	-1.324	-3.2640	A
TAXRATIOlag0	2.12/1.88	1.288	1.454	1,25	A	-1.743	-3.2182	A
TAXRATIOlag1	2.04/1.96	1.186	1.546	2,24	A	-1.523	-3.2256	A
TAXRATIOlag2	1.74	1.078	1.660	3,23	A	-0.9072	-3.2339	A
TAXRATIOlag3	1.97	0.958	1.797	4,22	A	-1.38	-3.2430	A
TAXRATIOlag4	1.98	0.829	1.964	5,21	I	-1.217	-3.2530	A
TAXRATIOlag5	1.97	0.692	2.162	6,20	I	-1.017	-3.2640	A

Table 3
Cointegration tests for the UK non-weighted sample with the DDE ratio as independent variable, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
CTRATEchange lag0	1.22	1.273	1.446	1,24	R	-3.442	-3.2256	R
CTRATEchange lag1	1.83	1.68	1.543	2,23	A	-5.998	-3.2339	R
CTRATEchange lag2	1.98	1.053	1.664	3,22	A	-3.238	-3.2430	A
CTRATEchange lag3	1.91	0.927	1.812	4,21	A	-2.427	-3.2530	A
CTRATEchange lag4	2.00	0.792	1.991	5,20	A	-2.688	-3.2640	A
CTRATEchange lag5	1.84	0.649	2.206	6,19	I	-2.431	-3.2763	A
INFLATEchangelag0	1.98	1.257	1.437	1,23	A	-3.91	-3.2339	R
INFLATEchangelag1	1.98	1.147	1.541	2,22	A	-3.193	-3.2430	A
INFLATEchangelg2	1.93	1.026	1.669	3,21	A	-2.62	-3.2530	A
INFLATEchangelag3	2.05/1.95	0.894	1.828	4,20	A	-1.676	-3.2640	A
INFLATEchangelag4	1.86	0.752	2.023	5,19	A	-1.216	-3.2763	A
INFLATEchangelag5	1.43	0.603	2.257	6,18	I	-1.635	-3.2900	A
MRINTlag 0	1.66	1.158	1.391	1,18	A	-2.484	-3.2900	A
MRINTlag1	1.60	1.015	1.536	2,17	A	-2.797	-3.3054	A
MRINTlag2	2.34/1.66	0.857	1.728	3,16	I	-1.49	-3.3229	A
MRINTlag3	1.60	0.685	1.977	4,15	I	-0.9659	-3.3430	A
MRINTlag4	1.39	0.505	2.296	5,14	I	-1.023	-3.3660	A
MRINTlag5	1.91	0.328	2.692	6,13	I	-1.761	-3.3931	A

Table 4
Cointegration tests for the Netherlands weighted sample with the DDE ratio as independent variable, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
INFLATEchangelag0	1.48	1.010	1.340	1,13	A	-2.616	-3.391	A
INFLATEchangelag1	1.98	0.812	1.579	2,12	A	-2.444	-3.4251	A
INFLATEchangelg2	1.95	0.595	1.928	3,11	A	-1.519	-3.4635	A
INFLATEchangelag3	1.91	0.376	2.414	4,10	I	-1.425	-3.5104	A

Table 5
Cointegration tests for the German weighted sample with the DDE ratio as independent variable, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSchange lag 0	2.07/1.93	0.879	1.320	1,10	A	-3.261	-3.5104	A
ASSETSchange lag 1	2.53/1.47	0.629	1.699	2,9	I	-4.006	-3.5690	R
ROCEchange lag 0*	1.35	0.525	2.016	3,10	I	-4.383	-4.2563	R
WCRATIOchangelag0	1.58	0.879	1.320	1,10	A	-3.443	-3.5104	A
WCRATIOchangelag1	1.38	0.629	1.699	2,9	I	-4.351	-3.5690	R

* = cointegration test includes a trend

Table 6
Diagnostic tests for the UK weighted error correction models

dependent variable (independent)	ΔDDERATIO (ΔDIVCOVER)	ΔDIVCOVER (ΔDDERATIO)	ΔDDERATIO (ΔINFLATEchange)	ΔDDERATIO (ΔROCE)	ΔDDERATIO (ΔTAXRATIO)
R-Squared	0.363941	0.611365	0.309702	0.475559	0.317923
Model F-ratio	**5.4357 [2,19] (0.0136)**	**8.9143 [3,17] (0.0009)**	**4.4865 [2,20] (0.0246)**	**9.9747 [2,22] (0.0008)**	**5.1272 [2,22] (0.0149)**
DW statistic	1.71	1.96	1.93	1.74	1.86
Autocorrelation F-test	0.39913 [2,17] (0.6770)	0.76986 [2,15] (0.4805)	0.14278 [2,18] (0.8679)	0.5508 [2,20] (0.5850)	0.46365 [2,20] (0.6356)
ARCH F-test	0.0017037 [1,17] (0.9676)	0.32012 [1,15] (0.5799)	0.31862 [1,18] (0.5794)	0.22465 [1,20] (0.6407)	0.463 [1,20] (0.5040)
Normality Chi-squared	0.59621	3.6219	2.5846	0.35906	2.1529
Heteroscedasticity F-test	1.4298 [4,14] (0.2755)	1.4441 [6,10] (0.2893)	2.1146 [4,15] (0.1295)	1.0661 [4,17] (0.4035)	1.4383 [4,17] (0.2643)
RESET F-test	1.1971 [1,18] (0.2883)	2.4837 [1,16] (0.1346)	0.032847 [1,19] (0.8581)	**7.174 [1,21] (0.0141)**	1.7931 [1,21] (0.1949)

Table 7
Diagnostic tests for the UK non-weighted error correction models

dependent variable (independent)	ΔDDERATIO (ΔCTRATEchange)	ΔCTRATEchange (ΔDDERATIO)	ΔDDERATIO (ΔINFLATEchange)	ΔINFLATEchange (ΔDDERATIO)	ΔDDERATIO (ΔMRINT)
R-Squared	0.540839	0.713947	0.304899	0.482618	0.28601
Model F-ratio	**12.368 [2,21] (0.0003)**	**11.231 [4,18] (0.0001)**	**4.3864 [2,20] (0.0263)**	**9.3281 [2,20] (0.0014)**	3.0044 [2,15] (0.0799)
DW statistic	1.56	1.84	1.90	1.36	1.60
Autocorrelation F-test	1.0984 [2,19] (0.3537)	0.066938 [2,16] (0.9355)	0.095197 [2,18] (0.9096)	3.3466 [2,18] (0.0581)	0.15791 [2,13] (0.8555)
ARCH F-test	0.61674 [1,19] (0.4419)	0.91565 [1,16] (0.3529)	0.090158 [1,18] (0.7674)	0.71896 [1,18] (0.4076)	0.048399 [1,13] (0.8293)
Normality Chi-squared	3.2441	0.0094251	**10.502**	0.48217	1.4762
Heteroscedasticity F-test	2.3086 [4,16] (0.1026)	0.40296 [8,9] (0.8925)	**4.4863 [4,15] (0.0139)**	0.70453 [4,15] (0.6010)	1.1052 [4,10] (0.4061)
RESET F-test	**9.7403 [1,20] (0.0054)**	0.050221 [1,17] (0.8254)	0.2624 [1,19] (0.6144)	0.019773 [1,19] (0.8897)	4.0717 [1,14] (0.0632)

Table 8
Diagnostic tests for the Netherlands weighted error correction models

dependent variable (independent)	ΔDDERATIO (ΔINFLATEchange)
R-Squared	0.537516
Model F-ratio	**5.8112 [2,10] (0.0212)**
DW statistic	1.88
Autocorrelation F-test	0.096482 [1,9] (0.7632)
ARCH F-test	0.14393 [1,8] (0.7143)
Normality Chi-squared	0.52457
Heteroscedasticity F-test	0.70798 [4,5] (0.6200)
RESET F-test	2.8546 [1,9] (0.1254)

Table 9
Diagnostic tests for the German weighted error correction models

dependent variable (independent)	ΔDDERATIO (ΔASSETSchange)	ΔASSETSchange (ΔDDERATIO)	ΔDDERATIO (ΔROCEchange)	ΔROCEchange (ΔDDERATIO)
R-Squared	0.78403	0.903711	0.841334	0.830617
Model F-ratio	**6.0504 [3,5] (0.0406)**	**15.642 [3,5] (0.0057)**	**8.8376 [3,5] (0.0192)**	**9.8076 [3,6] (0.0099)**
DW statistic	2.66	3.03	1.99	1.96
Autocorrelation F-test	1.4095 [1,4] (0.3008)	2.5745 [1,4] (0.1839)	0.02077 [1,4] (0.8924)	0.084898 [1,5] (0.7825)
ARCH F-test	6.0375 [1,3] (0.0911)	0.14692 [1,3] (0.7270)	0.0010093 [1,3] (0.9767)	0.07919 [1,4] (0.7924)
Normality Chi-squared	0.57887	0.31895	0.20454	0.465
Heteroscedasticity F-test	-	-	-	-
RESET F-test	0.018672 [1,4] (0.8979)	1.8032 [1,4] (0.2505)	0.87066 [1,4] (0.4036)	2.7285 [1,5] (0.1595)

Table 9
Diagnostic tests for the German weighted error correction models (cont.)

dependent variable (independent)	ΔDDERATIO (ΔWCRATIOchange)	ΔWCRATIOchange (ΔDDERATIO)
R-Squared	0.90804	0.830808
Model F-ratio	**9.8743 [4,4] (0.0238)**	**8.1841 [3,5] (0.0225)**
DW statistic	3.04	0.802
Autocorrelation F-test	4.1028 [1,3] (0.1359)	1.6621 [1,4] (0.2668)
ARCH F-test	0.0079741 [1,2] (0.9371)	0.099895 [1,3] (0.7727)
Normality Chi-squared	0.43856	0.17968
Heteroscedasticity F-test	-	-
RESET F-test	0.29411 [1,3] (0.6253)	0.39716 [1,4] (0.5628)

APPENDIX O: JOHANSEN PROCEDURE TESTS AND DIAGNOSTIC TESTS FOR MODEL SYSTEM 1 FOR THE UK WEIGHTED SAMPLE

Table 1
Johansen Maximum Likelihood Procedure (Non-trended case) Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

List of eigenvalues in descending order:				
.97073 .59374 .48772 .35621 .093160 .0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r = 1	70.6266	34.4000	31.6640
r<= 1	r = 2	18.0151	28.1380	25.5590
r<= 2	r = 3	13.3778	22.0020	19.7660
r<= 3	r = 4	8.8078	15.6720	13.7520
r<= 4	r = 5	1.9558	9.2430	7.5250

Table 2
Johansen Maximum Likelihood Procedure (Non-trended case) Cointegration LR Test Based on Trace of the Stochastic Matrix

List of eigenvalues in descending order:				
.97073 .59374 .48772 .35621 .093160 .0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r>= 1	112.7830	76.0690	71.8620
r<= 1	r>= 2	42.1564	53.1160	49.6480
r<= 2	r>= 3	24.1413	34.9100	32.0030
r<= 3	r>= 4	10.7636	19.9640	17.8520
r<= 4	r = 5	1.9558	9.2430	7.5250

Table 3
Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)

Variable	Coefficient	Standardised coefficient
DDERATIO	1.0116	(-1.0000)
DIVCOVER	.42205	(-.41723)
ROCE	.14188	(-.14025)
INFLATEchange	-2.2212	(2.1958)
TAXRATIO	-.016198	(.016013)
Intercept	-2.4847	(2.4563)

Table 4
Long-run coefficient estimates of the Johansen procedure compared with a static long-run model of an ADL(2) representation of the same model

variable	Johansen procedure estimated long-run coefficients	coefficients of a static long-run representation of an ADL(2) model
DDERATIO	(dependent)	(dependent)
DIVCOVER	-0.41723	-0.8398
ROCE	-0.14025	-0.3237
INFLATEchange	+2.1958	+4.308
TAXRATIO	+0.016013	+0.04091
constant	+2.4563	+4.949

Table 5
Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)

Variable	Coefficient	Standardised coefficient
DDERATIO	.025064	(-.025353)
DIVCOVER	-1.4716	(1.4887)
ROCE	-.13462	(.13617)
INFLATEchange	.091377	(-.092434)
TAXRATIO	4.9246	(-4.9816)

Table 6
Estimated Long Run Matrix in Johansen Estimation

	DDERATIO	DIVCOVER	ROCE	INFLATEchange	TAXRATIO	Intercept
DDERATIO	.025353	.010578	.0035559	-.055672	-.4060E-3	-.062276
DIVCOVER	-1.4887	-.62111	-.20879	3.2689	.023837	3.6566
ROCE	-.13617	-.056815	-.019099	.29902	.0021805	.33449
INFLATEchange	.092434	.038566	.012964	-.20297	-.0014801	-.22705
TAXRATIO	4.9816	2.0785	.69869	-10.9388	-.079769	-12.2364

Table 7
The UK weighted multivariate error correction models for model system 1

Dependent variable	ΔDDERATIO	ΔDIVCOVER	ΔROCE	ΔINFLATEchange	ΔTAXRATIO
Constant	0.0094466 (0.693)	-0.010550 (-0.107)	-0.043798 (-0.334)	0.00040991 (0.153)	-0.048106 (-0.058)
ΔDDERATIO	-	-	11.456 (7.978)	-0.22833 (-6.775)	-66.819 (-5.264)
ΔDDERATIO-1	-	-	-	-	-
ΔDIVCOVER	-	-	-1.0437 (-3.970)	0.019995 (3.375)	5.9175 (3.111)
ΔDIVCOVER-1	0.066579 (2.302)	-	-0.91197 (-3.683)	0.019022 (3.945)	4.6088 (2.370)
ΔROCE	0.058840 (5.726)	-0.12789 (-3.121)	-	0.019746 (11.282)	5.8039 (7.158)
ΔROCE-1	0.051800 (4.056)	-0.10476 (-2.713)	-1.0376 (-11.832)	0.021377 (15.786)	5.9395 (5.586)
ΔINFLATEchange	-2.8330 (-4.728)	-	47.648 (11.282)	-	-275.38 (-5.783)
ΔINFLATEchange-1	-1.6485 (-2.681)	-	30.918 (6.309)	-0.65322 (-8.339)	-182.16 (-4.798)
ΔTAXRATIO	-0.0087502 (-3.307)	-	0.14903 (7.158)	-0.0029303 (-5.783)	-
ΔTAXRATIO-1	-	-	0.072832 (2.470)	-0.0016135 (-2.899)	-0.46555 (-2.579)
ECM-2	0.36165 (3.783)	-1.0264 (-4.532)	-7.1930 (-11.122)	0.14746 (12.671)	41.418 (5.650)

Table 8
Diagnostic test for the UK weighted multivariate error correction models for model system 1

dependent variable	ΔDDERATIO	ΔDIVCOVER	ΔROCE	ΔINFLATEchange	ΔTAXRATIO
R-Squared	0.789557	0.620753	0.985642	0.979923	0.906439
Model F-ratio	**5.3598 [7,10] (0.0090)**	**8.184 [3,15] (0.0018)**	**61.019 [9,8] (0.0000)**	**43.384 [9,8] (0.0000)**	**8.6118 [9,8] (0.0029)**
DW statistic	2.72	1.96	2.42	2.29	2.36
Autocorrelation F-test	2.3478 [1,9] (0.1598)	1.9923 [2,13] (0.1759)	0.61882 [1,7] (0.4573)	0.35954 [1,7] (0.5677)	0.41035 [1,7] (0.5422)
ARCH F-test	0.72398 [1,8] (0.4196)	0.7578 [1,13] (0.3998)	0.99091 [1,6] (0.3580)	1.0068 [1,6] (0.3544)	0.81124 [1,6] (0.4025)
Normality Chi-squared	0.36448 [2]	0.49356 [2]	0.84095 [2]	0.080655 [2]	0.6397 [2]
Heteroscedasticity F-test	-	0.34856 [6,8] (0.8920)	-	-	-
RESET F-test	**9.4636 [1,9] (0.0132)**	**7.2878 [1,14] (0.0173)**	1.1088 [1,7] (0.3273)	1.3232 [1,7] (0.2878)	1.3146 [1,7] (0.2892)

APPENDIX P:
JOHANSEN PROCEDURE TESTS AND DIAGNOSTIC TESTS FOR MODEL SYSTEM 2 FOR THE UK WEIGHTED SAMPLE

Table 1
Estimated Adjustment Matrix in Johansen Estimation(Normalized in Brackets)

Variable	Coefficient	Standardised coefficient
DDERATIO	-.0021363	(.0045840)
DIVCOVER	-2.4365	(5.2284)
ROCE	-.75514	(1.6204)

Table 2
Estimated Long Run Matrix in Johansen Estimation

	DDERATIO	DIVCOVER	ROCE	Intercept
DDERATIO	-.0045840	-.8169E-3	-.6299E-4	.0039862
DIVCOVER	-5.2284	-.93178	-.071844	4.5465
ROCE	-1.6204	-.28878	-.022266	1.4091

Table 3
Diagnostic test for the UK weighted multivariate error correction models for model system 2

dependent variable	ΔDDERATIO	ΔDIVCOVER	ΔROCE
R-Squared	0.120593	0.657093	0.519588
Model F-ratio	0.68565 [3,15] (0.5746)	**9.5812 [3,15] (0.0009)**	**5.4077 [3,15] (0.0101)**
DW statistic	1.96	2.57	2.67
Autocorrelation F-test	0.20886 [2,13] (0.8142)	3.0658 [2,13] (0.0811)	**4.8311 [2,13] (0.0270)**
ARCH F-test	0.092768 [1,13] (0.7655)	0.0086199 [1,13] (0.9274)	0.023975 [1,13] (0.8793)
Normality Chi-squared	8.7035 [2]	1.1455 [2]	0.33744
Heteroscedasticity F-test	0.31769 [6,8] (0.9102)	0.3196 [6,8] (0.9091)	2.0412 [6,8] (0.1725)
RESET F-test	1.5088 [1,14] (0.2396)	1.539 [1,14] (0.2352)	0.11293 [1,14] (0.7418)

APPENDIX Q:
JOHANSEN PROCEDURE TESTS AND DIAGNOSTIC TESTS FOR MODEL SYSTEM 3 FOR THE UK NON-WEIGHTED SAMPLE

Table 1
Johansen Maximum Likelihood Procedure (Non-trended case) Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

List of eigenvalues in descending order:				
.87373 .83358 .39411 .20849 -.0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r = 1	33.1094	28.1380	25.5590
r<= 1	r = 2	28.6914	22.0020	19.7660
r<= 2	r = 3	8.0169	15.6720	13.7520
r<= 3	r = 4	3.7409	9.2430	7.5250

Table 2
Johansen Maximum Likelihood Procedure (Non-trended case) Cointegration LR Test Based on Trace of the Stochastic Matrix

List of eigenvalues in descending order:				
.87373 .83358 .39411 .20849 -.0000				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r>= 1	73.5586	53.1160	49.6480
r<= 1	r>= 2	40.4492	34.9100	32.0030
r<= 2	r>= 3	11.7578	19.9640	17.8520
r<= 3	r = 4	3.7409	9.2430	7.5250

Table 3
Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)

Variable	Vector 1 coefficient	Vector 1 coefficient (normalised)	Vector 2 coefficient	Vector 2 coefficient (normalised)
DDERATIO	2.7235	(-1.0000)	-14.1677	(-1.0000)
CTRATEchange	1.6630	(-.61061)	12.8774	(.90893)
INFLATEchange	-9.5233	(3.4967)	1.5868	(.11200)
MRINT	.14241	(-.052288)	-.075899	(-.0053572)
Intercept	-1.0643	(.39080)	3.5715	(.25209)

Table 4
Estimated Adjustment Matrix in Johansen Estimation
(Normalized in Brackets)

Variable	Vector 1 coefficient	Vector 1 coefficient (normalised)	Vector 2 coefficient	Vector 2 coefficient (normalised)
DDERATIO	-.0054457	(.014831)	.067956	(.96277)
CTRATEchange	-.013064	(.035580)	-.018051	(-.25574)
INFLATEchange	.015394	(-.041924)	-.019487	(-.27608)
MRINT	-5.8008	(15.7983)	-.22447	(-3.1802)

Table 5
Estimated Long Run Matrix in Johansen Estimation

	DDERATIO	CTRATEchange	INFLATEchange	MRINT	Intercept
DDERATIO	-.97760	.86603	.15970	-.0059333	.24850
CTRATEchange	.22016	-.25417	.095771	-.4904E-3	-.050563
INFLATEchange	.31801	-.22534	-.17752	.0036712	-.085981
MRINT	-12.6181	-12.5372	54.8863	-.80903	5.3724

Table 6
The UK non-weighted multivariate error correction models for model system 3

Dependent variable	ΔDDERATIO	ΔCTRATEchange	ΔINFLATEchange	ΔMRINT
Constant	-0.0083744 (-1.194)	0.016203 (2.372)	-0.014012 (-2.464)	0.35094 (0.746)
ΔDDERATIO	-	-	-	20.137 (1.402)
ΔDDERATIO-1	-0.92481 (-2.168)	-	0.51625 (1.622)	-
ΔCTRATEchange	0.26746 (1.063)	-	0.52921 (2.498)	-12.354 (-0.684)
ΔCTRATEchange-1	0.63612 (2.624)	-	-	-18.844 (-1.566)
ΔINFLATEchange	-	0.82822 (3.355)	-	29.361 (1.457)
ΔINFLATEchange-1	-	-	-0.21744 (-1.246)	18.375 (1.963)
ΔMRINT	-	-	0.0093915 (1.566)	-
ΔMRINT-1	-	0.011199 (2.459)	-0.0052849 (-0.957)	-0.27057 (-0.783)
ECMV1-2	0.035241 (0.650)	-0.17230 (-3.084)	0.20847 (3.849)	-11.033 (-2.730)
ECMV2-2	-1.1213 (-2.328)	0.83164 (3.215)	-0.18250 (-0.463)	12.170 (0.601)

Table 7
Diagnostic test for the UK non-weighted multivariate error correction models for model system 3

dependent variable	ΔDDERATIO	ΔCTRATEchange	ΔINFLATEchange	ΔMRINT
R-Squared	0.576956	0.722303	0.876837	0.853069
Model F-ratio	2.4549 [5,9] (0.1144)	**5.8524 [4,9] (0.0133)**	**6.1023 [7,6] (0.0212)**	3.6287 [8,5] (0.0860)
DW statistic	1.39	2.35	1.12	1.21
Autocorrelation F-test	0.041193 [1,8] (0.8442)	0.68539 [1,8] (0.4317)	1.5275 [1,5] (0.2714)	0.68672 [1,4] (0.4539)
ARCH F-test	0.041878 [1,7] (0.8437)	1.7423 [1,7] (0.2284)	0.056458 [1,4] (0.8239)	0.089692 [1,3] (0.7841)
Normality Chi-squared	2.1648 [2]	0.28663 [2]	0.28477 [2]	0.2402 [2]
Heteroscedasticity F-test	-	-	-	-
RESET F-test	0.78015 [1,8] (0.4029)	0.33451 [1,8] (0.5789)	2.4976 [1,5] (0.1749)	2.0944 [1,4] (0.2214)

APPENDIX R:
A COINTEGRATION ANALYSIS TO DETERMINE THE EXISTENCE OF INTRA-RATIO TARGETING BEHAVIOUR WITHIN EUROPEAN QUOTED FIRMS
Table 1
The F-test for the presence of a deterministic trend in the capital structure constituent variables

variable	country	degrees of freedom	F-statistic	accept / reject
LRLOANS	UK weighted	2,22	14.714	reject
HMVEQUITY	UK weighted	2,22	2.9014	accept
LNPLUSEQ	UK weighted	2,22	3.7667	accept
ASSETS	UK weighted	2,22	2.0343	accept
LRLOANS	UK non-weighted	2,22	3.0681	accept
HMVEQUITY	UK non-weighted	2,22	5.3763	accept
LNPLUSEQ	UK non-weighted	2,22	5.0189	accept
ASSETS	UK non-weighted	2,22	2.0343	accept
LRLOANS	NL weighted	2,11	2.3701	accept
HMVEQUITY	NL weighted	2,11	5.6959	accept
LNPLUSEQ	NL weighted	2,11	6.1577	accept
ASSETS	NL weighted	2,11	1.375	accept
LRLOANS	NL non-weighted	2,11	1.2928	accept
HMVEQUITY	NL non-weighted	2,11	9.5679	accept
LNPLUSEQ	NL non-weighted	2,11	9.8452	accept
ASSETS	NL non weighted	2,11	1.375	accept
LRLOANS	BD weighted	2,8	2.9134	accept
HMVEQUITY	BD weighted	2,8	4.3613	accept
LNPLUSEQ	BD weighted	2,8	2.039	accept
ASSETS	BD weighted	2,8	2.1826	accept
LRLOANS	BD non-weighted	2,8	3.9809	accept
HMVEQUITY	BD non-weighted	2,8	3.3709	accept
LNPLUSEQ	BD non-weighted	2,8	3.0528	accept
ASSETS	BD non-weighted	2,8	2.1826	accept
LRLOANS	FR weighted	2,6	3.199	accept
HMVEQUITY	FR weighted	2,6	5.5961	accept
LNPLUSEQ	FR weighted	2,6	2.7975	accept
ASSETS	FR weighted	2,6	7.3275	accept
LRLOANS	FR non-weighted	2,6	2.0789	accept
HMVEQUITY	FR non-weighted	2,6	5.2082	accept
LNPLUSEQ	FR non-weighted	2,6	3.2929	accept
ASSETS	FR non-weighted	2,6	7.3275	accept

Table 2
Unit root tests conducted upon UK capital structure constituent measures

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
LRLOANS(W) *	1.92	1.123	1.654	3,25	A	-5.33	-4.3738	R
HMVEQUITY(W)	1.93	1.288	1.454	1,25	A	1.492	-2.6603	A
ΔHMVEQUITY(W)	1.98	1.273	1.446	1,24	A	-3.959	-2.6649	R
LNPLUSEQ(W)	2.19/1.81	1.288	1.454	1,25	A	1.402	-2.6603	A
ΔLNPLUSEQ(W)	1.98	1.273	1.446	1,24	A	-4.562	-2.6649	R
ASSETS(W)	1.19	1.288	1.454	1,25	R	0.8185	-2.6603	A
ΔASSETS(W)	1.67	1.273	1.446	1,24	A	-2.382	-2.6649	A
ΔΔASSETS(W)	1.65	1.257	1.437	1,23	A	-6.045	-2.6700	R
LRLOANS(NW)	1.75	1.288	1.454	1,25	A	0.5295	-2.6603	A
ΔLRLOANS(NW)	1.59	1.273	1.446	1,24	A	-4.087	-2.6649	R
HMVEQUITY(NW)	2.90/1.10	1.288	1.454	1,25	R	3.975	-2.6603	A
ΔHMVEQUITY(NW)	2.12/1.88	1.273	1.446	1,24	A	-3.792	-2.6649	R
LNPLUSEQ(NW)	2.76/1.24	1.288	1.454	1,25	R	3.876	-2.6603	A
ΔLNPLUSEQ(NW)	2.26/1.74	1.273	1.446	1,24	A	-3.793	-2.6649	R
ASSETS(NW)	1.19	1.288	1.454	1,25	R	0.8185	-2.6603	A
ΔASSETS(NW)	1.67	1.273	1.446	1,24	A	-2.382	-2.6649	A
ΔΔASSETS(NW)	1.65	1.257	1.437	1,23	A	-6.045	-2.6700	R

* DF test with trend included

Table 3
Unit root tests conducted upon the Netherlands capital structure constituent measures

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
LRLOANS(W)	1.34	1.045	1.350	1,14	I	-0.1091	-2.7570	A
ΔLRLOANS(W)	2.09/1.91	1.010	1.340	1,13	A	-2.674	-2.7760	A
ΔΔLRLOANS(W)	2.06/1.94	0.971	1.331	1,12	A	-5	-2.7988	R
HMVEQUITY(W)	2.65/1.35	1.045	1.350	1,14	A	-0.5566	-2.7570	A
ΔHMVEQUITY(W)	2.03/1.97	1.010	1.340	1,13	A	-5.197	-2.7760	R
LNPLUSEQ(W)	2.66/1.34	1.045	1.350	1,14	A	-0.3286	-2.7570	A
ΔLNPLUSEQ(W)	2.00	1.010	1.340	1,13	A	-5.104	-2.7760	R
ASSETS(W)	1.83	1.045	1.350	1,14	A	1.63	-2.7570	A
ΔASSETS(W)	1.74	1.010	1.340	1,13	A	-2.638	-2.7760	A
ΔΔASSETS(W)	2.07/1.93	0.971	1.331	1,12	A	-4.188	-2.7988	R
LRLOANS(NW)	1.96	1.045	1.350	1,14	A	0.4365	-2.7570	A
ΔLRLOANS(NW)	1.94	1.010	1.340	1,13	A	-3.348	-2.7760	R
HMVEQUITY(NW)	2.83/1.17	1.045	1.350	1,14	A	0.3319	-2.7570	A
ΔHMVEQUITY(NW)	2.04/1.96	1.010	1.340	1,13	A	-5.15	-2.7760	R
LNPLUSEQ(NW)	2.95/1.05	1.045	1.350	1,14	A	0.6857	-2.7570	A
ΔLNPLUSEQ(NW)	1.89	1.010	1.340	1,13	A	-5.207	-2.7760	R
ASSETS(NW)	1.83	1.045	1.350	1,14	A	1.63	-2.7570	A
ΔASSETS(NW)	1.74	1.010	1.340	1,13	A	-2.638	-2.7760	A
ΔΔASSETS(NW)	2.07/1.93	0.971	1.331	1,12	A	-4.188	-2.7988	R

Table 4
Unit root tests conducted upon the German capital structure constituent measures

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
LRLOANS(W)	1.96	0.927	1.324	1,11	A	2.998	-2.8270	A
ΔLRLOANS(W)	2.20/1.80	0.879	1.320	1,10	A	-1.681	-2.8622	A
ΔΔLRLOANS(W)	1.99	0.824	1.320	1,9	A	-5.475	-2.9076	R
HMVEQUITY(W)	2.50/1.50	0.927	1.324	1,11	A	1.001	-2.8270	A
ΔHMVEQUITY(W)	1.85	0.879	1.320	1,10	A	-3.19	-2.8622	R
LNPLUSEQ(W)	1.58	0.927	1.324	1,11	A	3.926	-2.8270	A
ΔLNPLUSEQ(W)	2.22/1.78	0.879	1.320	1,10	A	-1.082	-2.8622	A
ΔΔLNPLUSEQ(W)	2.11	0.824	1.320	1,9	A	-5.465	-2.9076	R
ASSETS(W)	2.02/1.98	0.927	1.324	1,11	A	1.799	-2.8270	A
ΔASSETS(W)	1.77	0.879	1.320	1,10	A	-2.133	-2.8622	A
ΔΔASSETS(W)	2.29/1.71	0.824	1.320	1,9	A	-3.815	-2.9076	R
LRLOANS(NW)	2.53/1.47	0.927	1.324	1,11	A	1.047	-2.8270	A
ΔLRLOANS(NW)	1.65	0.879	1.320	1,10	R	-3.598	-2.8622	R
HMVEQUITY(NW)	2.79/1.21	0.927	1.324	1,11	A	0.5629	-2.8270	A
ΔHMVEQUITY(NW)	1.45	0.879	1.320	1,10	A	-4.127	-2.8622	R
LNPLUSEQ(NW)	2.51/1.49	0.927	1.324	1,11	A	1.329	-2.8270	A
ΔLNPLUSEQ(NW)	1.72	0.879	1.320	1,10	R	-3.13	-2.8622	R
ASSETS(NW)	2.02/1.98	0.927	1.324	1,11	A	1.799	-2.8270	A
ΔASSETS(NW)	1.77	0.879	1.320	1,10	A	-2.133	-2.8622	A
ΔΔASSETS(NW)	2.29/1.71	0.824	1.320	1,9	A	-3.815	-2.9076	R

Table 5
Unit root tests conducted upon the French capital structure constituent measures

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	Dickey Fuller stat.	Mack. critical	Inference A=accept R=reject
LRLOANS(W)	2.89/1.11	0.824	1.320	1,9	I	1.225	-2.9076	A
ΔLRLOANS(W)	1.80	0.763	1.332	1,8	A	-2.918	-2.9677	A
ΔΔLRLOANS(W)	2.50/1.50	0.700	1.356	1,7	A	-5.886	-3.0507	R
HMVEQUITY(W)	2.93/1.07	0.824	1.320	1,9	I	0.9982	-2.9076	A
ΔHMVEQUITY(W)	1.94	0.763	1.332	1,8	A	-3.151	-2.9677	R
LNPLUSEQ(W)	2.50/1.50	0.824	1.320	1,9	A	1.999	-2.9076	A
ΔLNPLUSEQ(W)	2.00	0.763	1.332	1,8	A	-1.952	-2.9677	A
ΔΔLNPLUSEQ(W)	2.50/1.50	0.700	1.356	1,7	A	-4.105	-3.0507	R
ASSETS(W)	1.22	0.824	1.320	1,9	A	4.997	-2.9076	A
ΔASSETS(W)	1.83	0.763	1.332	1,8	A	0.5694	-2.9677	A
ΔΔASSETS(W)	1.49	0.700	1.356	1,7	A	-1.813	-3.0507	A
LRLOANS(NW)	1.92	0.824	1.320	1,9	A	1.892	-2.9076	A
ΔLRLOANS(NW)	1.96	0.763	1.332	1,8	A	-1.579	-2.9677	A
ΔΔLRLOANS(NW)	2.14/1.86	0.700	1.356	1,7	A	-3.89	-3.0507	R
HMVEQUITY(NW)	2.57/1.43	0.824	1.320	1,9	A	1.131	-2.9076	A
ΔHMVEQUITY(NW)	1.88	0.763	1.332	1,8	A	-2.752	-2.9677	A
ΔΔHMVEQUITY(NW)	2.61/1.39	0.700	1.356	1,7	A	-3.914	-3.0507	R
LNPLUSEQ(NW)	2.54/1.46	0.824	1.320	1,9	A	2.1	-2.9076	A
ΔLNPLUSEQ(NW)	1.76	0.763	1.332	1,8	A	-1.95	-2.9677	A
ΔΔLNPLUSEQ(NW)	2.46/1.54	0.700	1.356	1,7	A	-3.58	-3.0507	R
ASSETS(NW)	1.22	0.824	1.320	1,9	I	4.997	-2.9076	A
ΔASSETS(NW)	1.83	0.763	1.332	1,8	A	0.5694	-2.9677	A
ΔΔASSETS(NW)	1.49	0.700	1.356	1,7	A	-1.813	-3.0507	A

Table 6
The F-test for the presence of a deterministic trend within the error correction mechanism from the long-run static equation of LRLOANS upon various capital structure constituent variables

variable	country	degrees of freedom	F-statistic	accept / reject
HMVEQUITY	UK non-weighted	2,22	7.0867	accept
LNPLUSEQ	UK non-weighted	2,22	6.9024	accept
ASSETS	NL weighted	2,11	2.7533	accept
HMVEQUITY	NL non-weighted	2,11	1.3021	accept
LNPLUSEQ	NL non-weighted	2,11	1.3994	accept
LNPLUSEQ	BD weighted	2,8	6.5874	accept
ASSETS	BD weighted	2,8	2.7256	accept
HMVEQUITY	BD non-weighted	2,8	4.6396	accept
LNPLUSEQ	BD non-weighted	2,8	4.3595	accept
LNPLUSEQ	FR weighted	2,6	8.7604	accept
HMVEQUITY	FR non-weighted	2,6	1.9623	accept
LNPLUSEQ	FR non-weighted	2,6	2.0298	accept

Table 7
Cointegration tests for the UK non-weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
HMVEQUITYlag0	1.66	1.288	1.454	1,25	A	-3.861	-3.2182	R
HMVEQUITYlag1	1.59	1.188	1.546	2,24	A	-2.795	-3.2256	A
HMVEQUITYlag2	1.78	1.078	1.660	3,23	A	-3.287	-3.2339	R
HMVEQUITYlag3	1.83	0.958	1.797	4,22	A	-2.989	-3.2430	A
HMVEQUITYlag4	1.66	0.829	1.964	5,21	I	-3.203	-3.2530	A
LNPLUSEQlag0	1.64	1.288	1.454	1,25	A	-3.859	-3.2182	R
LNPLUSEQlag1	1.57	1.188	1.546	2,24	A	-2.786	-3.2256	A
LNPLUSEQlag2	1.77	1.078	1.660	3,23	A	-3.296	-3.2339	R
LNPLUSEQlag3	1.80	0.958	1.797	4,22	A	-2.96	-3.2430	A
LNPLUSEQlag4	1.63	0.829	1.964	5,21	I	-3.145	-3.2530	A

Table 8
Cointegration tests for the Netherlands weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSlag0	1.28	1.045	1.350	1,14	I	-1.651	-3.3660	A
ASSETSlag1	2.35/1.65	0.861	1.562	2,13	A	-1.868	-3.3931	A
ASSETSlag2	2.10/1.90	0.658	1.864	3,12	A	-2.191	-3.4251	A
ASSETSlag3	1.98	0.444	2.283	4,11	I	-2.067	-3.4635	A

Table 9
Cointegration tests for the Netherlands non-weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
HMVEQUITYlag0	1.59	1.045	1.350	1,14	A	-1.518	-3.3660	A
HMVEQUITYlag1	2.15/1.85	0.861	1.562	2,13	A	-1.885	-3.3931	A
HMVEQUITYlag2	2.31/1.69	0.658	1.864	3,12	I	-2.079	-3.4251	A
HMVEQUITYlag3	1.20	0.444	2.283	4,11	I	-5.662	-3.4635	R
LNPLUSEQlag0	1.65	1.045	1.350	1,14	A	-1.754	-3.3660	A
LNPLUSEQlag1	2.07/1.93	0.861	1.562	2,13	A	-1.97	-3.3931	A
LNPLUSEQlag2	2.06/1.94	0.658	1.864	3,12	A	-1.738	-3.4251	A
LNPLUSEQlag3	1.44	0.444	2.283	4,11	I	-4.817	-3.4635	R

Table 10
Cointegration tests for the German weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
ASSETSlag0	1.44	0.927	1.324	1,11	A	-2.008	-3.4635	A
ASSETSlag1	1.73	0.697	1.641	2,10	A	-2.105	-3.5104	A
ASSETSlag2	1.41	0.455	2.128	3,9	I	-1.377	-3.5690	A
LNPLUSEQlag0	2.16/1.84	0.927	1.324	1,11	A	-3.988	-3.4635	R
LNPLUSEQlag1	2.51/1.49	0.697	1.641	2,10	I	-3.743	-3.5104	R
LNPLUSEQlag2	1.92	0.455	2.128	3,9	I	-3.612	-3.5690	R

Table 11
Cointegration tests for the German non-weighted sample capital structure constituents, showing Dickey Fuller and Augmented Dickey Fuller statistics at different lag lengths (without constant or trend) and Durbin Watson statistics

variable	DW stat.	lower DW critical	upper DW critical	degrees of freedom	DW test A=accept R=reject I=inconc.	DF/ADF stat.	Mack. critical	Inference A=accept R=reject
HMVEQUITYlag0	1.51	0.927	1.324	1,11	A	-3.045	-3.4635	A
HMVEQUITYlag1	1.39	0.697	1.641	2,10	I	-1.847	-3.5104	A
HMVEQUITYlag2	1.22	0.455	2.128	3,9	I	-2.048	-3.5690	A
LNPLUSEQlag0	1.67	0.927	1.324	1,11	A	-3.267	-3.4635	A
LNPLUSEQlag1	1.38	0.697	1.641	2,10	I	-2.199	-3.5104	A
LNPLUSEQlag2	1.38	0.455	2.128	3,9	I	-1.471	-3.5690	A