THE USE OF ACCOUNTING INFORMATION IN THE VALUATION OF EQUITY SECURITIES

by

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ABSTRACT

Over the past two decades numerous studies have shown that capital market participants use accounting information to price equities.

In many situations, such as IPOs, sales of divisions, and the valuation of closely held businesses for tax purposes, the only available guide to the value of the equity is accounting data. The aim of this dissertation is to examine which accounting measures of profitability and value of assets are, comparatively, the best predictors of the market value of the firm cross-sectionally.

The dissertation starts by looking at simple rules for valuing companies (price earnings, price to book and price dividend ratios). An important contribution of the thesis, is an empirical investigation of the statistical assumptions underlying ratio based valuation models which suggests that the relationship between market capitalization and accounting data is multiplicative. Various definitions of earnings and the book value of assets are used but the price dividends ratio outperforms all of them. The best definitions of earnings and book value of assets as well as dividends are used to construct a combined forecast model which significantly outperforms the univariate rules.

Subsequently, alternative growth and risk measures and the time series properties of earnings are utilized to examine empirically the cross sectional distribution of the valuation ratios. Tests for industry effects are also performed and the conclusion is that they are of marginal economic significance.

In the second part of the dissertation, more complicated valuation models are used to examine whether all components of earnings or classes of assets in the balance sheet are 'capitalized' at the same rate. A modified version of the Litzenberger Rao model is used to correct for specification error. The conclusion is that the efficiency of the models improves using disaggregated earnings data (but not disaggregated book value data). This is consistent with the view in the literature that the classification of earnings in different classes provides information in excess of that in the aggregate earnings figure.

Finally, a theoretical model of the measurement error in accounting data is constructed to examine the biases caused by stylized depreciation schedules in estimates of value based on the book value of assets and capitalized earnings. This has important implications for the construction of optimal forecasts namely, that it allows us to examine the conditions under which the market to book (PB) ratio will outperform the price earnings (PE) ratio and the sign of the error using either of the two rules.

I thank my parents for giving me life,
and my teachers for giving me a good life.

Alexander the Great
(356 - 323 BC)
King of the Greeks

Contents

List of figures

List of tables

CHAPTER 1

INTRODUCTION

1.1 Introductory Remarks

Accounting information is part of the information set used by investors to value a company and substantial sums are spent every year by the financial industry to analyze that information. For example, in the Financial Times, in the company news section and the Lex column the PE (price-earnings) ratio is used to recommend investments in stocks. Accounting data are also used to price initial public offerings (IPOs), the valuation of companies for tax purposes and most cases where the value of a company is the basis of a contract.

While Market Based Accounting Research has unambiguously determined that the release of accounting information (mainly earnings) influences prices, there has been very little research on how investors interpret and evaluate this information. The generally accepted paradigm in finance suggests that discounted cash flows are the determinants of market value. However, for empirical research or investment management purposes even current cash flows are undefined (there are many competing definitions about how to derive cash flows numbers from the financial statements). As Lev and Thigarajan (1991) suggest:

It is highly doubtful whether real progress in financial accounting

> research, in standard-setting and in the practice of security analysis can be achieved without a thorough understanding of how financial information is used by the investors.

A logical result of such a positive research programme (which would necessarily examine the claim of accounting standard setters that earnings provide information about future cash flows and ultimately the value of the company) would be normative suggestions about how a company that is not quoted should be valued.

This thesis starts by examining simple, univariate rules using aggregate measures of earnings, book value of assets and dividends. Subsequently results from more sophisticated models which allow for extra variables (such as measures of growth and risk) and / or use account line items in the financial statements are presented. A cross-sectional approach of the relationship between the level of accounting variables and market capitalization is used. In the last chapter we examine the conditions under which market to book value ratios would be a superior tool for valuing a company rather than price earnings ratios.

1.2 Objectives of the Research

Research that examines the relationship of accounting data and security prices can be done either in (price) levels form or returns; the two approaches are economically equivalent (though price level is the 'primary' variable) but models that use returns data are generally assumed to be econometrically more tractable and therefore more frequently used. However, there are a number of reasons why investors, financial analysts, regulators and tax authorities would want to establish the value of a company in reference to the value of other companies. Usually, the only data that are available (or occasionally, are acceptable) in these cases are derived from financial statements. Our main goal in this thesis is to examine how such data can be analyzed in an optimal way defined as minimizing the root mean square error of the forecasts. This goal is a highly normative one; however, before it is achieved we have a positive research agenda as can be seen from the discussion that follows. The research objective does not negate the Efficient Market Hypothesis; rather, if prices reflect publicly available information, we want to examine how financial information maps into security prices in order to value companies for which only such data is available.

1.2.1 Pricing of Initial Public Offerings

In the case of IPOs accounting data appear to play a major role in determining the issue price. The pricing of the offer is usually the product of negotiation between the issuing company, its advisers, the underwriter and other interested parties[1]. A substantial number of studies have found that the issuing price is below the price at which the stock will eventually trade; however, it is not our aim here to resolve the paradox of why the issuing price is set at a discount but rather, to describe how the issuing price is set.

The first study which examined this decision was by Harford (1969) who argued that the pricing of an issue depends on expected profits and the choice of a PE ratio which acts as a capitalization factor. However, he also found that the market expects the issue will be priced at a discount where '... the ideal premium at which most houses aim is around 10-15 per cent ..'.

[1] The interests of the parties are often conflicting: for example, the issuing company wants the highest possible price in order to maximise the proceeds from the issue, the sub-underwriters want to be certain the issue will be sold (and therefore aim for a big discount) whereas the issue managers want to ensure both that the issue will be sold and that the issue price will be high enough that other corporate clients will use them.

De Ridder (1986) interviewed Arthur Andersen and was told that:

> The most sensitive and important information on which the price will be based is the profit forecast...

Also, one Swedish market maker told de Ridder (1986) that:

> We investigate the earning, the profit, the economic value and the sector for the company. We also try to estimate these numbers in a longer perspective. The companies' future growth potential is also investigated. The P/E ratios and the ratio economic value/P/E is examined. Also, we try to estimate what the actual share price, after the flotation, will be during a longer period of time. The discount is also examined.

This largely anecdotal evidence, suggests that there is a relationship between earnings and the market capitalization of the issue. Also, in the period leading to the big privatizations in the UK, the financial press based its comments on whether the issue price was 'fair' on the comparison of the companies' price dividends ratio with that of quoted companies. For example, on June 1, 1991 the FT commenting on the privatization of Scottish electricity companies wrote that 'the government has opted to be much more generous to the market than this [referring to the 4.7% required yield for the issue to have been fully underwritten], offering a yield of 5.1%'.

In the last chapter we will be presenting a comparison between the forecasting error in our methodology and the standard deviation of the returns of the IPOs.

1.2.2 Valuation for Tax Purposes

Accountants are frequently consulted on the valuation of companies for fiscal purposes (i.e. for capital transfer tax and capital gains tax), an obligation that in the UK dates back to the 1894 Finance Act which established the notion of the 'statutory open market valuation'. In this case, the valuer must determine the price at which the company would change hands between a (hypothetical) willing seller and a (hypothetical) buyer, both informed. Successive court decisions have defined these terms but a detailed discussion of them is beyond the scope of this thesis. It is interesting to note that the UK legislator has not given any guidelines on what should be the determining factors of the valuation but rather left the courts to rely on 'commercial practice'. The 'leading' modern case in valuation for fiscal purposes has been that of Lynall vs IRC[2] before the House of Lords in 1972 where a company was valued (for estate duty purposes) using a dividends multiplier. One of the more interesting aspects of this case was that the Lords decided that the valuation should be based only on publicly available information and not on such data as a prospective merger partner might be given. The general trend in UK litigation has been to use either a dividends or an earnings multiple (as in the case of Buckingham vs Francis (1986)) which is arbitrarily (based on the 'feelings' of the expert witnesses) adjusted for non-quoted companies from that applying for companies that are quoted.

In the USA, the Treasury in reg. 20.2031-2(f)(2) has listed the factors which are to be considered in establishing the fair market value of non-quoted shares: the company's net worth, prospective earnings, dividend paying capacity and other 'relevant factors'. However, no guidance is given on how these factors are to be discounted or how they should be weighted (or indeed how they should be measured given that at least two of the 'factors' are heavily influenced by convention). Thus, there has been litigation, in the cases that the IRS and the taxpayer could not agree on a fair valuation of the company. For most of the cases, the cited precedents are the Bader and Central Trust cases.

In the first case, which was heard before the USTC in 1959, the issue was how

[2] For a description of this case and all others discussed here see Eastaway and Booth (1985).

to value the shares of a privately held business engaged in the grain, feed and elevator business. The decision of the court was that lacking any similar traded companies, the main factors to be considered for the firm's valuation were the firm's book value of assets (discounted by 40%), prospective earnings (times an average PE ratio of comparable firms) and dividend payment capacity (which was proxied by the latest annual dividend and weighed by the average price to dividends ratio of comparable firms). The court also noted that earnings and dividends should be more heavily weighted because the book value of assets is not a reliable measure of fair market value.

Thus the formula accepted by the court was:

$$VALUE=(0.50.PROFIT.\bar{PE}+0.25.DIVID.\bar{PD}+0.25.(0.625.BOOK)) \qquad (1)$$

The weights of the three different estimates of value are those applied by the court. The estimate of value was then discounted by 10% to reflect lack of marketability.

This decision left unclear how the earnings figure was arrived at and why was the book value of assets multiplied by .625 rather than weighted by the average price to book ratio.

Three years later, the USTC in the Central Trust case resolved these issues and slightly modified the valuation formula.

In estimating the earnings figure, extraordinary items were excluded and a weighted average of the past five year earnings was taken with the latest profits being most heavily weighted. Dividend paying capacity was estimated as the past annual dividend and a third basis for estimating the firm's value was given by the firm's book value of assets. All these were capitalized using the average of the ratio of market price to the relevant variable of comparable companies.

Thus, the formula used in the Central Trust case was:

$$VALUE=(0.5.EARNINGS.\bar{PE}+0.3.DIVIDEND.\bar{PD}+0.2.BOOK.\bar{PB}) \qquad (2)$$

Again, the court discounted the estimate of value by 12.17% to reflect lack of marketability of the company.

1.2.3 Management Buy Outs

During the last decade, international stock markets experienced a proliferation in the number of corporate control related transactions (e.g. management buyouts, hostile takeovers etc). In such cases, there is demand both by shareholders and other stakeholders of the firm of an *independent* valuation of the firm's equity to establish a 'fair' value.

In mergers, acquisitions and related transactions, the price paid for a firm's equity has been observed to deviate significantly from the stock market price before the offer. Thus, it is important to address the question of how such prices are determined.

DeAngelo (1986) used '(1) a large sample of fairness opinions on management buyouts, and (2) a small sample of investment bankers' working papers' and found that 'the terms of management buyouts are evaluated by investment bankers whose valuation techniques predominantly rely on accounting data.' In fact, even 'discounted cash flow techniques employed in practice use historical accounting relations to estimate future cash flows.' DeAngelo also found that the most frequently employed valuation techniques used by investment bankers involved relationships between the stock price for comparable firms (or acquisition prices for previously consummated bids) and accounting variables, such as the price-earnings, price-to-book and price-sales ratios.

The emphasis on the use of accounting data is not surprising: since transactions that involve corporate control changes generate 'investor-manager' conflicts of interest, it is necessary for contracts to be written using data from audited financial statements and are thus considered to be 'hard'. Thus, Delaware courts when asked to appraise share value have used a weighted average of pre-offer stock prices, net assets value and capitalized historical earnings.

1.2.4 The Relationship of Accounting Numbers and Security Price Levels: A Positive Research Agenda

In their well known book on 'Positive Accounting Theory' Watts and Zimmerman argue that the role of theory is to explain and predict accounting practice. The focus of accounting research, according to them, should be the determinants of accounting reporting choices and their effects on individual welfare.

One of the areas where the relationship between financial reporting and wealth distribution is most obvious, is through the level of stock prices: positive accounting theory in this area is concerned with examining how accounting data affect the behaviour of security prices. In the previous sections we examined some situations where an independent valuation of the company's equity based on accounting data may be required. Developing models appropriate to these situations would be a highly normative research activity. However, conclusions about how financial information *should* be used can only follow from research about how and to what extent such information is used in the capital markets.

Influenced by this research paradigm, during the last two decades there has been a change of emphasis by regulators towards the information role (as opposed to the stewardship role) of accounting; i.e. financial statements that provide a 'true and fair' view of a company's activities and its value to the various claimants. Market based research in accounting has focused almost exclusively on the role of earnings, or earnings related variables, as the determinants of market value. However, this is unlikely to be the only source of information used by the market; indeed, as various reviews of the literature suggest (Lev (1989)), aggregate earnings have very little explanatory power.

If empirical research is to focus on a single variable and its relationship with the value of equity the first question that must be addressed is what functional form (linear, log-linear etc) does this relationship have. A second question is which of the many alternative definitions of accounting profitability or book value of the firm relate most to security prices. Related to this research is a paper by F. Black in 1980 suggesting that the general principle for the selection of accounting measurement rules should be that the resultant figure for earnings must be a measure of value. The criterion for choosing firm specific accounting income measurement rules, would be that a firm's market capitalization should be a multiple (constant across firms) of earnings. According to Black, 'even though accountants have not formally recognized the goal of having an earnings figure that measures value, they have done a remarkably good job of achieving this goal'. Black's argument appears to be that accountants in their pursuit of a true and fair picture of the company's activities, which leads to the smoothing of some cash flow items before they affect earnings, succeed in producing an earnings measure that approximates permanent earnings.

However, analysts when evaluating a company for investment purposes are likely to be using a number of variables (as empirical accounting research has shown there is no market fixation on current earnings). One of the most frequently discussed is the so called 'quality of earnings' or 'earnings persistence' which suggests that the effect of other variables such as growth and risk must be examined.

Another empirical question is whether the determining components of earnings or book value of assets provide additional information over that of the aggregate figure for each firm and how this can be employed for the construction of superior valuation rules.

These questions will be examined using cross-sectional accounting and market value of equity data for British quoted firms for the period 1971 - 1987.

1.3 Overview of Related Prior Research

Given the undoubted importance of valuation models it is rather surprising to find that the bibliography in this area is rather sparse. Though an extensive discussion of the literature is left for the related chapters, we provide here a short review of the valuation literature.

Formal attempts to develop pricing models closely parallel the development of analytic and econometric methodologies in economics. Most of the early models were applications of interest rate theory and the theory of investment (which still provides a good starting point for valuation models).

Among the early models, the more interesting were Tinbergen's (1938) attempt to model security prices as a function of long-term interest rates, the ratio of dividends to book equity value and share price growth and Durand's (1952) who focused on the relative prices of bank stocks as a function of book net worth, net income and dividend payments.

In 1962, Gordon published his book on 'the Investment, Financing and the Valuation of the Corporation' which still is a classic in valuation studies; there, Gordon provided theoretical justification for the use of PE ratios. Gordon begins from the fundamental proposition of neoclassical capital formation theory that the value of the firm is the PV of future payments to owners discounted at the appropriate rate. It should be emphasized however, that nowhere Gordon discusses which is the 'appropriate' rate.

Some of Gordon's theoretical results were shown to be wrong by Miller and Modigliani who, during the same period of time, published a series of papers on the irrelevance of financing decisions on the value of the firm (in a world without corporate or personal taxes). Their results were derived using arbitrage arguments and assuming perfect capital markets. Thus, their critics countered that M&M ignored market imperfections caused by institutional factors, like bankruptcy risk, in developing their model and thus their results were of limited practical importance. This sparked considerable empirical research activity using valuation models but whose results did not conclusively answer the question of whether or not there are tax advantages in the use of debt financing or why firms distribute dividends which is not tax efficient.

All the early empirical tests suffered from the failure to explicitly control for the effect of uncertainty about future cash flows. Some models made use of the 'risk class' concept introduced by Modigliani and Miller and thus limited themselves to the examination of a single industry - usually US electric utilities.

The first study which attempted to model the effects of risk was that of

Litzenberger and Rao(1971). Their model assumes perfect capital markets and mean-variance optimizing behaviour from market participants; under these assumptions the required rate of return R_i, on an asset will be:

$$R_i = I + b(r_{im}S_i) \tag{3}$$

where I is the risk free rate, b_{im} is the marginal required rate of return per unit of non-diversifiable standard deviation, S_i the standard deviation of the rate of return of the ith share and r_{im} the coefficient of correlation between the rate of return required from the ith share and the market portfolio. In a complete markets framework (i.e. where there are prices for all goods and therefore all future events can be discounted), and assuming zero future growth the value of the firm, P_i, will be equal to the PV of the firm's earnings, E_i, discounted at the required rate of return:

$$P_i = \frac{\bar{E}_i}{R_i} \tag{4}$$

The non-diversifiable risk, D_i, of the ith share can be defined as the ratio:

$$D_i = \frac{r_{im}S_{E_i}}{P_i} \tag{5}$$

where S_{Ei} is the standard deviation of the earnings to equity ratio for the ith firm. Manipulating these three relationships, Litzenberger and Rao derive the equilibrium pricing relationship:

$$P_i = E_i - br_{im}S_{E_i} \tag{6}$$

Litzenberger and Rao adjust for growth opportunities using a version of the theoretical growth model developed by Miller and Modigliani (1961) which gives an approximation G_i of the net present value of future earnings growth:

$$G_i = [\frac{\Delta B_i(\pi_i - R_i)}{R_i(1+R_i)}]T \qquad (7)$$

where T is the finite amount of years for which growth is expected to persist, π_i is the expected rate of return to equity on new investment (assumed to be constant over the T years) and B_i the expected dollar amount of equity investment for the ith firm during the current year.

Combining (4) and (5), gives the market value of the firms's equity P_i:

$$P_i^* = \frac{\bar{E}_i - br_{im}S_{E_i}}{I} + [\frac{\Delta B_i(\pi_i - R_i)}{R_i(1+R_i)}]T \qquad (8)$$

Litzenberger and Rao estimated their model for electric utility companies' shares because, as they argued, it can be safely assumed that they belong to an industry which is relatively homogeneous both in terms of risk and financial reporting methods and thus, measurement errors are likely to be firm-independent.

The estimated equation was:

$$\frac{P_i^*}{B_i} = \gamma_1\pi_i + \gamma_2 S_{\pi_i} + \gamma_3[\frac{g_{B_i}(\pi_i - R)}{R(1+r)}] + u_i \qquad (9)$$

where γ_1 = 1/I,
γ_2 = -b.r_{im}/I,
γ_3 = T,
R = an industry average required rate of return on equity,
π_i = expected return on book value for i,
$S\pi i$ = the standard deviation of π_i,
B_i = the firm's book value,
g_{Bi} = the expected rate of growth on book value, and
u_i = an error term with Var(u_i) assumed constant for all i.

Homoscedasticity of residuals was achieved by weighting all variables by the book value of assets. Expectations were modelled using the actual (occurred) values.

The main result of interest to us in Litzenberger and Rao's paper was that for all the years in the sample, π_i, which is measured as the ratio of accounting profit to book value of assets, is a statistically significant explanatory variable of prices. The significance of this model lies in that it has been extensively used by other authors in valuation research in accounting.

Most of the research that attempts to model the relationship of financial information security prices examined the effect of earnings. Examples of this strand of research include Foster (1977), Bowen (1981) etc and their aim was to examine the relationship between alternative definitions of accounting profits and the level of security prices. Also, Feldstein and Morck (1983) using a variant of Tobin's q model, Barth, Beaver and Stinson (1991) the so called 'model of differences'[3] and others examined the relationship between balance sheet items and security price levels. These papers are reviewed more extensively in later chapters.

1.4 Organization of the Thesis and Contribution to the Literature

The thesis is organized as follows. Chapter 2 examines simple univariate rules, such as market to book value, price earnings and price dividends ratios, and tests which is the best single definition of earnings and book value of assets for valuation purposes within the context of these univariate rules. An important contribution to the literature in this chapter is that it includes an empirical investigation of the statistical assumptions underlying the use of ratios as 'rule-of-thumb' valuation models. Empirical results in this chapter (which might also be

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[3] This is a term used by Barth, Beaver and Stinson (1991) and other papers by the same authors. For a discussion of these papers see the literature review section in chapter 4.

of interest to users of financial statements) are that the price-dividends ratio is the best single valuation rule and that a combined forecast methodology, which is an 'average' of the estimate of market capitalization based on each of the three ratio classes, significantly outperforms univariate rules.

Chapter 3 expands the univariate models by introducing (ad hoc) adjustments for risk, growth and the time series of earnings. The measures of growth we test, for are the change over the past year of the book value of assets, earnings and dividends whereas (book) leverage is used as a proxy for risk because we need a measure of risk that is not market determined. Furthermore, we test for industry effects; in particular, whether the characteristic ratio differs across industries and whether the performance of our models improves by using industry specific (as opposed to cross-industry) multipliers. Empirical tests have established that small market capitalization firms earn abnormal returns; therefore, we are also testing whether the industry effects are a proxy for size. Chapter 3 concludes with a synthesis of these results where we model the cross sectional distribution of the valuation ratios as a function of growth, (financial) risk and industry effects.

Chapter 4 examines whether the components of earnings or the classes of assets and liabilities in the balance sheet have differential information content to each over and incremental information content over the respective aggregate figures. We also examine whether the accrual adjustment in earnings provides any information useful to shareholders. Though similar tests have appeared in the Market Based Accounting Research literature recently, our approach is innovative because it looks at the relationship of the components of earnings (or, the balance sheet) on market capitalization rather than unexpected returns and because of the extensive work to ensure that the equation is correctly specified. Finally, in chapter 5 we develop a theoretical model to discuss the conditions under which the market to book value of the firm ratio will be a better estimator than capitalized earnings. We also use stylized depreciation models to examine the conditions under which the book value of the firm's assets under- or over-estimates their market value. Empirical tests of the validity of the model are also presented.

Chapter 6 summarizes the thesis and presents some concluding remarks. A list of references follows chapter 6.

CHAPTER 2

SIMPLE MODELS FOR THE VALUATION OF EQUITY SECURITIES

2.1 Introduction

Over the past twenty years numerous studies have shown that capital market participants use accounting information to price equities.

In textbook situations, arriving at the value of a company is simple: one takes expected future cash flows, discounts them and arrives at the company's value. In most cases however, this is simply not possible because the cash flow data are not available and users have to use accounting data.

In situations like IPOs, division sales, and valuation of companies for tax purposes when capital market data are not available the only way to obtain a 'fair value' is to use data from financial statements.

Potentially, there are many ways to analyze the accounting data in order to get an estimate of a firm's value. In this chapter we focus on simple, univariate rules; in other words, we test how well we can predict the market value of a company using information on the price earnings, market to book value and price dividend ratios which will be called, as a group, valuation ratios.

The first question we aim to answer is what is the best definition of earnings and book value of a company in this context. It is recognized that this resembles a data mining exercise but this has, hopefully, been limited by concentrating only on accounting variables that we could make a case that they refer to wealth accruing to shareholders. Furthermore, as Boatsman and Baskin (1981) suggest:

> Some might be repulsed at the prospect of drawing inferences about an unobservable (such as the value of a non-marketable asset) on the basis of a data set consisting of only observables. However, this sort of testing is routine in the empirical sciences. One theorizes about phenomena such as expected returns, equilibrium prices, demand schedules, human attitudes, mental stress, etc. None of these can be directly observed. A testing of such theories is accomplished by turning to some observable counterpart of the unobservable phenomenon of interest.

The criterion used is which accounting variable produces the market capitalization to earnings (or any other accounting variable) ratio with the minimum dispersion around its mean. Of course, a valuation model where there is a constant relationship between earnings (or the book value) of a company and its market capitalization is unsustainable but there are many plausible arguments why an earnings multiplier should show small variability around the mean. Furthermore, we will show that a ratio relationship is simply a regression equation with some assumptions about the distributional properties of the errors, a zero intercept and that the relationship is linear (or, log-linear). Thus, the choice criterion is which measure of earnings / book value of assets minimizes the root mean square error of the residuals of the regression (or, equivalently, the standard deviation of the ratio). One of the fundamental contributions of this chapter is that theoretical arguments and empirical evidence are produced about the appropriate mathematical form of the regression equation (which, as we have already said, is an alternative way of expressing a ratio model) estimated. We test our hypotheses using a sample of UK firms with December year ends for the period 1971-1987.

In addition to examining simple univariate rules we show that, because residuals from the 3 approaches are less than perfectly correlated, a combined forecasting methodology significantly reduces the average prediction error of market capitalization.

This chapter concludes by testing how the prediction error changes as we move further away from the announcement date of the financial statements.

2.2 Methodological Assumptions of Ratio Analysis

The use of ratio models to value a company has a long history in practice and most financial analysis textbooks devote a significant number of pages to ratio techniques. Elaborate models for bankruptcy prediction use ratios of financial variables and The Financial Times give on a daily basis the price-earnings ratio for every quoted company. The traditional arguments for the use of ratios are that they permit control for the effects of size on the variable under investigation or that the two variables are related at least in a statistical sense.

Boatsman and Baskin (1981) compared the predictive performance of three valuation rules: a modification of the CAPM[1], the price earnings ratio and indexing the values of the assets of the company for economy or industry wide changes in asset values. Their conclusion was that the CAPM has a slight advantage over PE ratios adjusted for growth but which is not significant for practical purposes.

LeClair (1990) examined the performance of PE ratios in the valuation of closely held companies in comparison to the Adjusted Book Value (ABV) method. His

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[1] Under this approach, Boatsman and Baskin identify a second firm with an observed market price whose expected cash flows over time are a, at least approximate, linear transformation of those of the first firm:

$$\tilde{Y}_1 = \alpha + \beta \tilde{Y}_2$$

Then, if the CAPM holds, the value of the first firm, V_1, is given by the equation:

$$V_1 = \frac{\alpha}{1+i} + \beta V_2$$

where V_2 is the observed market capitalization of the second firm and i is the risk free rate.

conclusions were that the earnings based approach outperforms the ABV one although there are industry variations and, surprisingly, that combined forecast methods (such as those used by the US courts) are unnecessary because the book value of assets and dividends have low explanatory power on the residuals of the PE method. This last conclusion is based on the small R^2 of the regressions of book value and dividends on the residuals from the PE approach but ignores the values of the coefficients (which are related to the weights that ought to be applied) which are quite high.

This extensive use of ratios assumes that there is a roughly proportional relationship between the size/dependent variable in the numerator (in this case market capitalization) and the deflatory / explanatory variable in the denominator (in our case measures of profitability or book value of assets), i.e. that the relationship is of the form:

$$\frac{MCAP_i}{EARN_i} = \beta + \epsilon_i \tag{1}$$

where MCAP refers to market capitalization, EARN is net earnings which will be used throughout this chapter as an example for all accounting variables we will be using, β is the ratio location statistic[2] whichever way it is defined and ϵ_i is an error term. If the proportionality assumption is valid the economic interpretation of the characteristic ratio is straightforward: it represents an unbiased measure of both the marginal effect and the average effect of the independent variable (earnings) on the dependent one (market capitalization). However, as Lev and Sunder (1979) and Whittington (1980) suggest, there are

[2] The desirable properties of this statistic are that it should be a the measure of the marginal effect of earnings on prices; at the simplest level, it can be estimated as the arithmetic mean of the ratios of all the companies in the sample.

a number of reasons why the proportionality assumption will not be valid[3].

The most frequently discussed statistical problems with the ratio methodology are:

a) the presence of an intercept as in the classical regression model.

b) dependence on other variables and non-linearity in the relationship.

c) violations of the assumption of normally distributed residuals.

d) whether the relationship is additive or multiplicative and whether the error is homoscedastic. This is the most important issue because it affects the choice of the characteristic ratio (e.g. the number times which earnings must be multiplied to get the value of the company) and the criterion used to evaluate alternative forecasting rules. Implicit is also the assumption that earnings and other financial variables are exogenous and not determined by the market capitalization of the firm.

In Appendix I we present an exhaustive empirical investigation of these assumptions. The conclusion that can be drawn from that discussion is that it is most appropriate to model the relationship as a multiplicative one: thus the characteristic ratio would be the exponent of the mean of the log transformed ratios. The criterion used to assess the predictive performance of ratios that use alternative accounting variables is the standard deviation of the log-transformed

[3] In this thesis we are trying to develop valuation models for situations where a firm's market value is seen as a function of (observed) accounting variables. However, if the accounting variables being used in the tests were seen as proxies for some underlying economic variables which cannot be measured directly, our results would have been suffering from an errors in the measurement of variables problem.

If this were the case our results would be biased for two reasons:

First, the estimator of ratio multiplier is likely to be downward biased and less than the true parameter. In addition, it will not be consistent even at the limit.

The second problem, is that the estimate of the variance of the error term will be biased because it will be a sum of the measurement error in the explanatory variable and 'valuation' error.

ratios; because we employ data for 17 cross sections, we will be looking at the median error over all periods and for how many periods each rule has the minimum error.

2.3 Sample Selection Criteria and Definition of Variables

The main data sample that will be used in this dissertation has been extracted from two databases maintained by the Institute of Finance and Accounting at the London Business School. Companies' accounting data were extracted from the mini version of EXSTAT and capital market data from the London Share Price Database / Source file (from now on to be called EXSTAT and LSPD respectively).

The mini EXSTAT database has accounting data for approximately 2500 UK industrial and commercial companies covering the period 1971 to present and is a limited version of the EXSTAT database. Besides the usual problems with any accounting database (change of definitions over time, data entry errors, arbitrary classifications) a specific problem for this database is that limited information documented in the financial statement footnotes is reported. From this database we extracted all companies which fulfilled the following criteria:

a) Accounting year end around the end of December since it is the period when the biggest percentage (40%) of British companies prepare their financial reports. However, acceptable accounting year end dates were between 21/12 and 10/1 to counter the problem of switching accounting year ends by British companies identified by Barron (1984). Essentially, this problem arises because many firms target a specific day (e.g. last Friday of the year) as accounting year end rather than a specific date.

b) At least four years of both accounting (of which at least two should have been profitable) and share price data in order to ensure a minimum of consistency, over time, in the sample.

c) Finally, companies with non positive book value of common equity capital (including reserves) were excluded from the analysis throughout the dissertation. Initially, companies with negative net worth were dropped because the UK company law provides that these companies could be forced into receivership. This requirement was also necessary in order to ensure that the companies included in the sample will not be dropped at a latter stage because of the log-transformation which cannot accept negative numbers.

One observation was also dropped from the sample because the sum of the assets did not match that of liabilities plus book value of equity (beyond rounding error).

The LSPD is a research database that includes capital market price data and other security-specific information about all companies quoted on the London Stock Exchange. It has been extensively used for academic research in the UK and it is generally acknowledged as a 'clean' database. From it we extracted the number of shares and price data for the end of March immediately after the accounting year end. If prices were more than seven days old at that time the company was dropped from the sample. Prices at the end of March were used because at that point it is reasonable to assume that the great majority of companies in the sample have reported their financial results[4] and therefore, this information has been impounded in prices and that the financial information is

[4] This information was given to us in discussions with financial analysts and the data collection staff at EXTEL. It is also consistent with the dividend announcement dates when those were available at LSPD.

still relevant (see also the last section in this chapter).

The collection of price data used in subsequent chapters followed similar criteria. In total the sample comprises 6402 data points distributed across 17 years but because of the various restrictions the number of data points fluctuates considerably across the years as can be seen in figure 2.1.

The variables that we will be using in this chapter were defined as follows:

a) Market Capitalization: The market capitalization of each company was calculated as the product of the number of common shares issued by the company (Item(6,1) of LSPD) times the price at the end of March (item(5,4) of LSPD). If the company has more then one type of common equity security issued (e.g. A and B shares or shares registered under different names), the market capitalization is the sum of all of them.

b) Profit and Loss Account Items:[5]

i) Operating profit (OPROF): profit before interest, tax and other income.

ii) Earnings before tax (EBT) but including net interest charges.

iii) Profits after tax or net profit (NET).

iv) Profits after adjusting for extraordinary items (EXTRA).

v) Operating cash flows (OCF) which is defined as net profit with depreciation added back.

c) Balance Sheet Variables:[6]

i) Total book value of assets (BOOK).

[5] The calculation of the profit and loss account variables, in terms of EXSTAT items is as follows: Operating PROFit = #62 , Earnings Before Tax = OPROF + #63 + #64 + #65 - #66 - #67 - #68 - #69, NET earnings = EBT - #70 -#71 -#72 - #73 - #74 -#75, earnings adjusted for EXTRAordinary items = NET - #77, and Operating Cash Flows = NET + #59.

[6] The calculation of balance sheet variables in terms of EXSTAT data items is as follows: BOOI = #6+#7+#9+#10+#11+#12+#13+#14+#15+#16+#18, BOOK= BOOI+#8, SHAR = #27+#29+#30+#31+#32 and OEP = SHAR+#28+#33.

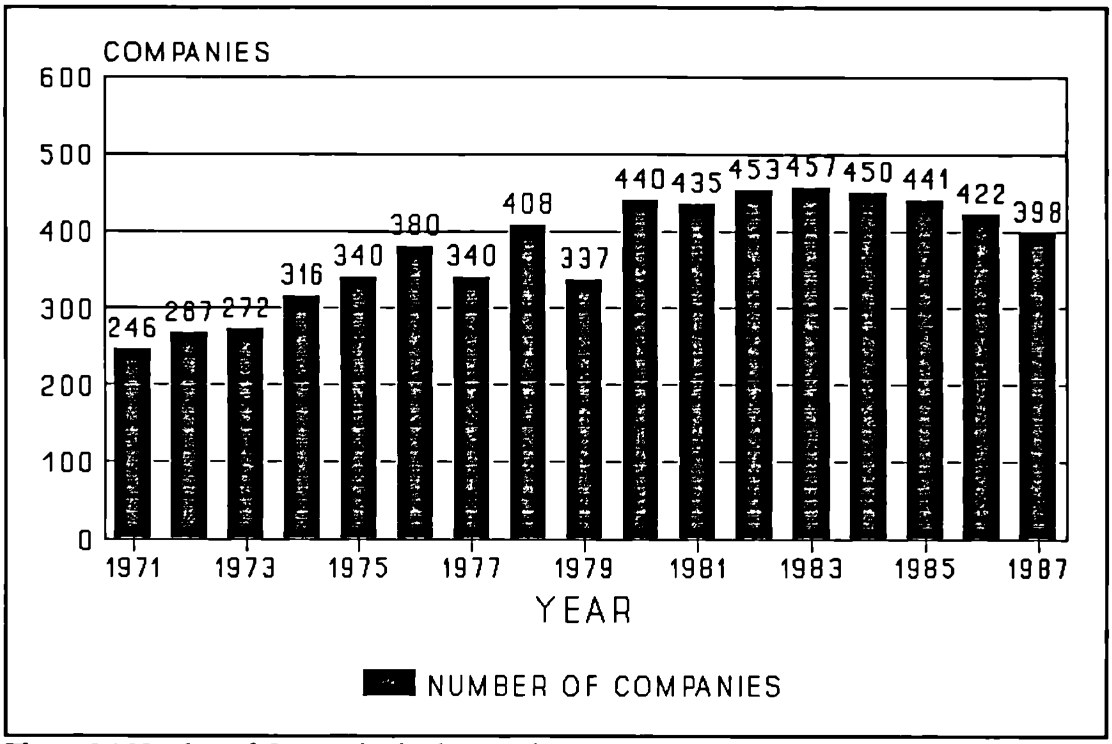

Figure 2.1 Number of Companies in the sample per year.

ii) Book value of assets minus intangible assets (BOOI).

iii) Book value of equity capital (or SHARe capital) which is defined as the total of the balance sheet values of issued equity share capital, excluding the balance sheet value of issued preference capital, but including various reserves.

iv) Corporate net worth (OEP) which is defined as the difference in the book value of assets minus the sum of the liabilities.

d)Dividends: gross of tax.

Table 2.1 in the next page reports the arithmetic mean of all the variables (except operating cash flows) used in the ratio models of this chapter. In terms of market capitalization, the average company in our sample is smaller than the companies comprising the Financial Times All Share Index.

Table 2.1 Average value of variables (in millions).

YEAR	MCAP	BOOK	BOOI	SHAR	OEP	OPROF	EBT	NET	EXTRA	DIV
1971	49.8	72.3	70.5	34.8	38.7	7.0	7.4	3.7	3.6	1.9
1972	51.4	84.4	82.1	39.7	44.1	8.2	8.5	3.9	4.1	1.9
1973	37.1	101.2	98.3	46.5	51.1	12.1	13.4	6.7	6.9	1.6
1974	28.1	107.9	105.2	45.0	49.9	15.6	16.9	7.1	6.9	1.4
1975	44.3	115.9	113.3	48.3	53.3	11.9	12.7	5.0	5.1	1.6
1976	46.4	126.0	123.5	50.5	55.9	14.2	15.5	6.5	6.4	1.7
1977	56.8	148.9	145.9	64.1	70.0	17.4	18.9	8.7	7.9	2.3
1978	64.0	148.2	146.0	62.9	69.7	16.2	16.3	8.5	8.2	2.2
1979	75.5	218.7	216.0	95.1	105.4	29.0	31.7	19.6	19.6	5.2
1980	69.9	180.1	177.9	80.8	90.3	21.8	23.0	12.2	11.5	3.2
1981	75.2	222.1	218.0	95.9	108.7	17.1	18.4	12.0	11.5	3.7
1982	96.4	243.2	238.8	102.2	117.3	16.6	18.3	10.7	9.5	3.8
1983	126.0	258.8	253.7	110.9	127.7	20.0	22.8	14.6	13.3	4.5
1984	156.7	320.0	313.6	133.6	153.3	27.7	32.4	20.3	18.8	5.7
1985	203.0	303.2	298.2	130.4	144.6	27.8	32.9	21.2	18.2	6.6
1986	295.9	346.0	338.7	148.7	164.7	23.8	29.1	20.2	18.8	8.2
1987	296.5	388.7	379.4	167.8	177.5	33.6	40.2	27.1	28.0	10.4

where,
MCAP: market capitalization,
BOOK: book value of assets,
BOOI: book value of assets excluding intangible assets,
SHAR: book value of share capital,
OEP: net worth,
OPROF: operating profit,
EBT: earnings before taxes,

2.4 Simple Models of Accounting Numbers Capitalization

Most of the voluminous literature on Market Based Accounting Research treats accounting earnings as information signals; Black (1980) suggests that it is possible to find a valuation role for them.

There are three possible categories of ratios that one can use to value a company: the price earnings ratio, which is the most frequently used one, the market to book value of the company and the price dividends ratio where dividends can also been seen as 'free' cash flow to shareholders.

In this section we first compare the predictive performance of ratios using alternative definitions of earnings in order to select the definition that is optimal for valuation models. Subsequently, the same is done for price to book ratios. Then, the two rules that use accounting variables, i.e. the price earnings ratio and the price to the book value of assets ratio are compared with the dividends capitalization model to examine whether accounting statistics of value have information in addition to that contained in current dividends. Finally, we examine the correlation of the residuals from the three approaches to predicting market capitalization in order to examine whether we can improve on the univariate prediction model. It should be emphasized that the sample changes across sections; we use the maximum number of observations for which all variables for that section are defined.

2.4.1 Price Earnings Ratios

Black in his paper calls for the selection of accounting measurement rules that will result in accounting income approximating permanent income which is usually defined as the constant sum that could be distributed to the shareholders in perpetuity. In our empirical tests we focused on alternative, traditional income measures to discover which is the best one in this respect.

The use of price-earnings ratios is quite widespread in practice. Their use in previous research (for example, Beaver and Morse (1978)) was justified, in a perfect markets framework, by a simple transformation of the Gordon valuation equation:

$$\frac{P}{E}=\frac{K}{r-g} \tag{2}$$

where K is a constant, over time, dividend payout ratio, g is growth in earnings and r is the risk free rate. However, in this case there is nothing special about earnings because the 'dividend payout' could be defined over any number. Furthermore, under uncertainty it is not clear how to measure earnings and the values of K and g are stochastic and the expected return should be risk adjusted. Another argument is the one proposed by Modigliani and Miller that the value of the firm, in the absence of growth opportunities, should equal the present value of a perpetuity of a constant stream of earnings.

Our aim is to identify an accounting earnings variable that best approximates permanent earnings as suggested by the two explanations for the usage of PE ratios. Thus we are faced by the question of which of the claims on the firm's cash flows are perceived by shareholders as representing transitory perturbations of permanent earnings.

Among the measures of profitability tested, we did not include a gross profit figure (because of data non availability). The least aggregated accounting measure used in the tests was operating profit which is the earnings number that most depends on the firm's revenue generating capacity but also, is likely to be biased because it includes the effect of accounting depreciation schedules (and other smaller items such as cost of inventories). The second profit measure used was earnings before taxes (which includes other 'profit' sources such as foreign exchange gains and losses and income from associated companies). The next profitability measure is profit after tax or net earnings. The tax payable by the company is a function of both its cash flows and the allowable offsets (e.g. accelerated depreciation, investment bonuses etc). Thus the influence of tax payments is not clear cut: they may be increasing noise because tax is assessed on a statutory measure of income which is different from economic income. Alternatively, taxes may be smoothing errors in the accounting measurement process because they smooth errors caused by the difference of accounting from economic depreciation[7].

Earnings after extraordinary items were included in order to examine whether extraordinary items are capitalized at the same rate as earnings from ordinary business activities. Extraordinary items are unlikely to be permanent and thus should simply be treated as noise (but see also the discussion in chapter 4).

Finally, we include a simple measure of the firm's operating cash flows defined as net earnings plus depreciation to examine whether the accruals adjustments give as a better measure of earnings for valuation measures (as claimed by the accounting standard setting bodies such as the FASB) or not.

The average prediction errors using each profit measure are presented in table 2.2. As it can be seen there is very little to choose between using earnings

[7] In practice, earnings of the firms being examined are normalized to exclude the effects of transactions that are not affecting earnings in a permanent way. However, working with a big database does not allow us to make such adjustments.

Table 2.2 Comparison of the forecasting error of the log-transformed market capitalization to various profitability measures ratios.

YEAR	PE1	PE2	PE3	PE4	PE5
1971	.499	.490	.498	.466	.500
1972	.556	.475	.454	.444	.476
1973	.589	.554	.547	.598	.553
1974	.570	.510	.517	.745	.527
1975	.570	.484	.490	.548	.481
1976	.574	.519	.565	.579	.517
1977	.528	.481	.493	.623	.508
1978	.565	.511	.512	.564	.508
1979	.609	.579	.615	.648	.565
1980	.738	.742	.672	.823	.626
1981	.771	.731	.755	.769	.633
1982	.794	.617	.631	.795	.608
1983	.803	.641	.594	.782	.645
1984	.787	.674	.628	.848	.668
1985	.714	.598	.517	.668	.603
1986	.710	.543	.535	.660	.593
1987	.642	.549	.507	.550	.495
MEDIAN	.609	.549	.535	.648	.553

where,
PE1: ratio of market capitalization to operating profit,
PE2: ratio of market capitalization to profit before tax,
PE3: ratio of market capitalization to net profit,
PE4: ratio of market capitalization to profit adjusted for extraordinary items,
PE5: ratio of market capitalization to operating cash flows.

before tax, net earnings and operating cash flows[8] because all ratios (in pairwise comparisons) minimize the forecasting error in, approximately, the same number of years though net earnings have a smaller median error.

Furthermore we 'pooled'[9] the prediction errors for the four alternative profit measures and ran a sign test to examine whether the superiority of net profits might be due to sampling error. The results were that the prediction error using net profits or profit before tax or operating cash flows versus those using

[8] If operating profit was adjusted for other income, then we would have had four earnings measures with roughly the same performance as predictors of market capitalization.

[9] That is we created variables of forecasting errors with the forecasting error in each of the 17 periods as an observation.

operating profits or earnings adjusted for extraordinary items was smaller at the 5% level but that it is not possible to say whether the prediction error using the ratio of price to profit before tax or the price to operating cash flows ratio versus that of the price - net profit ratio is higher in a statistically significant sense.

In subsequent tests the price to net earnings ratio will be used because of its slightly better performance and because it is more consistent with previous research and practice. However, in chapter 4 we return to the issue of whether operating cash flow is a better measure of profitability than accounting earnings for valuation purposes using more sophisticated cash flow measures and valuation models.

2.4.2 Price to Book ratios

As in the case of profitability measures we selected four measures of the book value of assets that reflect different distributions of the firm's assets to the shareholders.

The accounting valuation process cannot give a perfect measure of the value of the firm's assets. The reasons are many including conventions adopted in accounting practice such as historic cost which means that because of inflation the value of the assets in the balance sheet does not correspond to their current cost, stylized depreciation schedules. Nevertheless, if we assume that the error in the book value of assets compared to the market one is a constant μ over all assets, irrespective of vintage, and described by a relationship of the form:

$$MCAP_i = \mu . BOOK_i . e_i \qquad (3)$$

we have a ratio model.

Our aim is to identify a measure of the firm's book value of capital which is most closely related to the equity market value of the firm.

The first accounting value measure is the total book value of all the assets and the second measure is the book value of assets excluding intangible assets for which there is frequently no really clear method of valuing them and therefore are likely to be simply noise though managers sometimes argue that they help provide a fairer picture of the company's value[10]. It is recognized that these two measures of value are unlikely to be good because they do not take into account the claims of the debt holders; however, they are consistent with the valuation rules adopted in the court cases discussed in chapter 1. The other two accounting valuation measures are derived from the liabilities side of the balance sheet and are more likely to reflect the value of the firm to its owners because they exclude debt. The book value of equity capital is, in essence, the money that the shareholders put towards the cost of its assets and the firm's net worth is the book value of assets after its debts are repaid (net worth differs from share capital mainly because of the inclusion of preference shares).

Our results, presented in table 2.3, indicate that the book value of equity is the accounting valuation measure that is most closely associated with the firm's capital market value because it has the smallest deviation from the mean i.e. the smallest prediction error.

As in the case of profitability measures we carried out a sign test to examine whether this superiority of shareholders' capital variable was due to sampling

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[10] Tangential to this issue is the discussion about brand valuation in the UK. Our results indicate that intangibles are valued in a similar way to other assets by the capital market. However, since brand valuation will not be easily externally verifiable, and brands are not assets in the usual accounting sense the problem of putting a 'true and fair' price for brands in the balance sheet still remains.

Table 2.3 Comparison of the forecasting error of the log-transformed market capitalization to various historical cost valuations of assets ratios.

YEAR	PB1	PB2	PB3	PB4
1971	.671	.684	.610	.636
1972	.607	.618	.533	.558
1973	.650	.659	.559	.571
1974	.660	.671	.581	.594
1975	.668	.673	.590	.603
1976	.636	.642	.609	.614
1977	.599	.615	.564	.571
1978	.590	.595	.524	.533
1979	.705	.713	.661	.668
1980	.768	.777	.728	.726
1981	.779	.781	.691	.705
1982	.852	.861	.823	.834
1983	.850	.877	.784	.809
1984	.821	.828	.785	.822
1985	.731	.735	.713	.734
1986	.639	.643	.621	.642
1987	.560	.566	.552	.554
MEDIAN	.668	.673	.610	.636

where,
PB1: market to book value of assets,
PB2: market to book value of all assets excluding intangibles,
PB3: market to book value of equity,
PB4: market to net worth.

error; the results were that the expected prediction error using the book value of capital as the independent variable is significantly less, over time, than using each of the other variables at the 5% significance level.

2.4.3 Comparing the Predictive Power of the Three Approaches

Having determined which are the 'best' measures of accounting profitability and value, we are now ready to test the hypothesis that the price earnings ratio outperforms the market to book value ratio as a valuation statistic. In the comparison we will include the firm's current dividend payments both because theories of firm valuation assume that dividends are the valued attribute and in

Table 2.4 Comparison of the forecasting error of the three valuations ratios.

YEAR	PB	PE	PD
1971	0.604	0.479	0.483
1972	0.527	0.451	0.424
1973	0.556	0.545	0.499
1974	0.517	0.516	0.451
1975	0.522	0.492	0.422
1976	0.518	0.533	0.465
1977	0.504	0.492	0.499
1978	0.505	0.521	0.536
1979	0.582	0.694	0.534
1980	0.630	0.744	0.552
1981	0.628	0.806	0.551
1982	0.731	0.625	0.608
1983	0.708	0.566	0.648
1984	0.757	0.603	0.656
1985	0.688	0.551	0.631
1986	0.619	0.541	0.615
1987	0.532	0.516	0.547
MEDIAN	0.582	0.541	0.536

where,
PB: market to book value of equity,
PE: price earnings and,
PD: price dividends.

order to examine whether accounting variables provide any additional information, for valuing the firm, over and above that represented by current dividend payments. For some of the purposes that we outlined in the introduction dividends are the least suitable variable because they are the easiest for management to manipulate: for example, in MBOs by decreasing the payout ratio just prior to the buyout.

The results are presented in table 2.4. It can be seen that earnings and dividends have similar performance though dividends perform slightly better with a smaller prediction error in 9 years of the 17 in the sample though the difference is so small that no tests were carried out to examine whether if it is statistically significant.

Furthermore, the PE ratio has a smaller prediction error than the market to

Table 2.5 Cross correlation of the forecasting errors. All coefficients are significant at the 5% level.

YEAR	PB to PD	PB to PE	PE to PD
1971	0.538	0.479	0.616
1972	0.422	0.337	0.387
1973	0.557	0.539	0.507
1974	0.492	0.431	0.326
1975	0.398	0.345	0.233
1976	0.397	0.465	0.234
1977	0.337	0.445	0.127
1978	0.527	0.446	0.258
1979	0.599	0.326	0.406
1980	0.566	0.346	0.460
1981	0.467	0.305	0.394
1982	0.556	0.430	0.412
1983	0.514	0.468	0.529
1984	0.531	0.437	0.554
1985	0.504	0.471	0.529
1986	0.398	0.405	0.456
1987	0.252	0.185	0.425
SAMPLE	0.606	0.566	0.548

book value of equity ratio for 12 years in the sample which suggests that accountants have produced a better measure of value in the earnings figure than in the usual statement of a company's value the balance sheet. This difference is significant at the 5% level.

2.4.4 Correlation of Errors Using Alternative Variables

As we saw in the previous section, the price-dividends ratio outperforms any other univariate rule in explaining cross-sectional variation in share prices. However, we must also examine whether the other variables have incremental explanatory power by looking how the residuals from each ratio correlate with those from the others. If the value of the correlation coefficient is near 1 then the variable would offer little, if any, additional information.

In table 2.5 we report the correlations between the prediction errors of the three

Table 2.6 Pearson correlation coefficient between the prediction errors from alternative ratios. All coefficients are significant at the 1% level.

	PB1	PB2	PB3	PB4	PE1	PE2	PE3	PE4
PB2	0.995							
PB3	0.835	0.832						
PB4	0.858	0.855	0.986					
PE1	0.537	0.535	0.423	0.445				
PE2	0.367	0.368	0.324	0.345	0.710			
PE3	0.378	0.380	0.362	0.380	0.656	0.852		
PE4	0.327	0.329	0.343	0.357	0.513	0.694	0.786	
PD1	0.475	0.474	0.513	0.497	0.392	0.459	0.432	0.341

where:
PB1: market to book value of assets,
PB2: market to book value of assets excluding intangibles,
PB3: market to book value of share capital,
PB4: market to net worth,
PE1: price to operating profit,
PE2: price to earnings before tax,
PE3: price to net profit,
PE4: price to net profit adjusted for extraordinary items and
PD1: price to dividends.

'best' models. Though the correlations are uniformly positive, they are far from perfect suggesting that the accounting variables have incremental information not captured by current dividends.

Table 2.6 presents the correlation coefficients[11] for the errors across all ratios for the whole sample (excluding companies with non-positive net profits and dividends): there is a clear pattern of strong correlation of the errors from the variables from the same statement (i.e. errors from the various PE ratios are highly correlated etc) and a weak correlation with variables from other sources. Thus, it is likely that extensions to the methodology which involve either decomposition of the accounting variables to their determining parts or use of

[11] The correlation coefficients in table 2.5 are rank correlation coefficients and thus, differ slightly from those in table 2.6 which are Pearson correlations. The reason for the discrepancy is the computational resources required in order to estimate a big correlation matrix using non-parametric correlations.

variables from other financial statements can improve the prediction power of our methodology.

2.5 Combined Forecast Models: A Comparison of Ratio Based Valuation Models and USA Court Accepted Formulas

One of the most important arguments for developing valuation models is in order to value privately held companies for fiscal purposes.

As the results presented in the previous section suggest it should be possible to improve our estimates of value by employing a linear combination of the three approaches similar to those employed by the US tax courts.

The equation that we used in our tests was:

$$MCAP = \beta_0 + \beta_1.SHAR + \beta_2.NET + \beta_3.DIVIDEND \qquad (4)$$

where all variables are log-transformed and refer to the prediction based on that variable. If we exclude the intercept and assume equal weights this is equivalent to a geometric mean of the three predictions. Because the variables are log-transformed, the coefficients of the explanatory variables are actually the power to which each of them must be raised. In the forecasting literature, the inclusion of the constant and whether the weights should add to one are a topic of considerable interest: the conclusion seems to be that not constraining the coefficients results in a more efficient forecast though less robust (Bunn, 1990). However, in our tests we include the intercept in the estimated equation and do not force the coefficients to sum to 1, because otherwise the combined forecast estimator conditional on the ratio based forecasts would have been biased[12].

Two versions of equation 5 were estimated. In the first, the coefficients were fixed to those used by the USTC in the Central Trust case in 1962. These were 20% for the estimate based on the market to book value of equity, 50% for that based on the price earnings ratio and 30% for the estimate based on the price dividends ratio. In the other version, the weights were estimated using OLS as suggested in the forecasting literature[13].

Our results are presented in table 2.7. As can be clearly seen, both MCF approaches which use three variables dominate univariate prediction methods - because they have smaller prediction errors with the flexible coefficients equation being marginally superior.

In the flexible coefficients case, the sum of the weights was sufficiently close to 1 for half the years to make imposing a constraint unnecessary[14]. Furthermore, the range of the weights for the book value of equity is from a low of 8% to a high of 35%, for earnings the range is 17% to 56% and for dividends 20% to

[12] Two more points from the forecasting literature are of interest here:

a) As many forecasts as possible should be included in the combination irrespective of their predictive power. This justifies the use of the forecasts based on the market to book value of equity ratio.

b) In general, aggregating forecasts is not the same as aggregating the information sets on which these forecasts are based. However, in this case there is no difference because we employ univariate models.

[13] Two points need to be made here; one methodological and one empirical.

The first one is that the inclusion of the intercept will cause the OLS estimates of the weights to differ slightly from those obtained using the error-variance criterion. However, because our ratio based forecasts are slightly biased, this specification has better out of sample properties.

The other point is that in the cases before the US courts considerable emphasis is given to the use of 'comparable' firms. In this section the entire sample of firms was used but in the next chapter results for industry effects are reported.

[14] Imposing the constraint in general had the effect of a very small increase in the prediction error and in the weight assigned to the forecast based on the market to book value of equity ratio.

Table 2.7 Comparison of the forecasting error using court accepted formulae and univariate ratios.

YEAR	PB	PE	PD	CTRUST	FLXIBLE
1971	.604	.479	.483	.417	.417
1972	.527	.451	.424	.364	.360
1973	.556	.545	.499	.459	.451
1974	.517	.516	.451	.401	.385
1975	.522	.492	.422	.363	.338
1976	.518	.533	.465	.405	.383
1977	.504	.492	.499	.385	.380
1978	.505	.521	.536	.408	.403
1979	.582	.694	.534	.501	.470
1980	.630	.744	.552	.539	.501
1981	.628	.806	.551	.552	.487
1982	.731	.625	.608	.530	.520
1983	.708	.566	.648	.514	.504
1984	.757	.603	.656	.539	.520
1985	.688	.551	.631	.495	.492
1986	.619	.541	.615	.465	.456
1987	.532	.516	.547	.399	.377
MEDIAN	.582	.541	.536	.459	.451

where,
PB: market to nook value of equity,
PE: price earnings ratio,
PD: price dividends ratio,
CTRUST: combined forecast with weights fixed, and
FLXIBLE: combined forecast with floating weights.

54% suggesting that, on average, the courts tend to give too much weight to profits and too little to dividends[15].

2.6 Ageing of Data

One of the oldest problems in financial reporting is to ensure that the information contained in the published accounts is timely. Evidence from event studies suggests that financial statements are, at least partially, successful in this respect since on their release there is a price reaction to their publication (for a review of the Market Based Accounting Research literature see Foster(1986)).

[15] Of course, this criticism is mitigated by the fact that we are using UK data; in the USA dividend policy differs considerably.

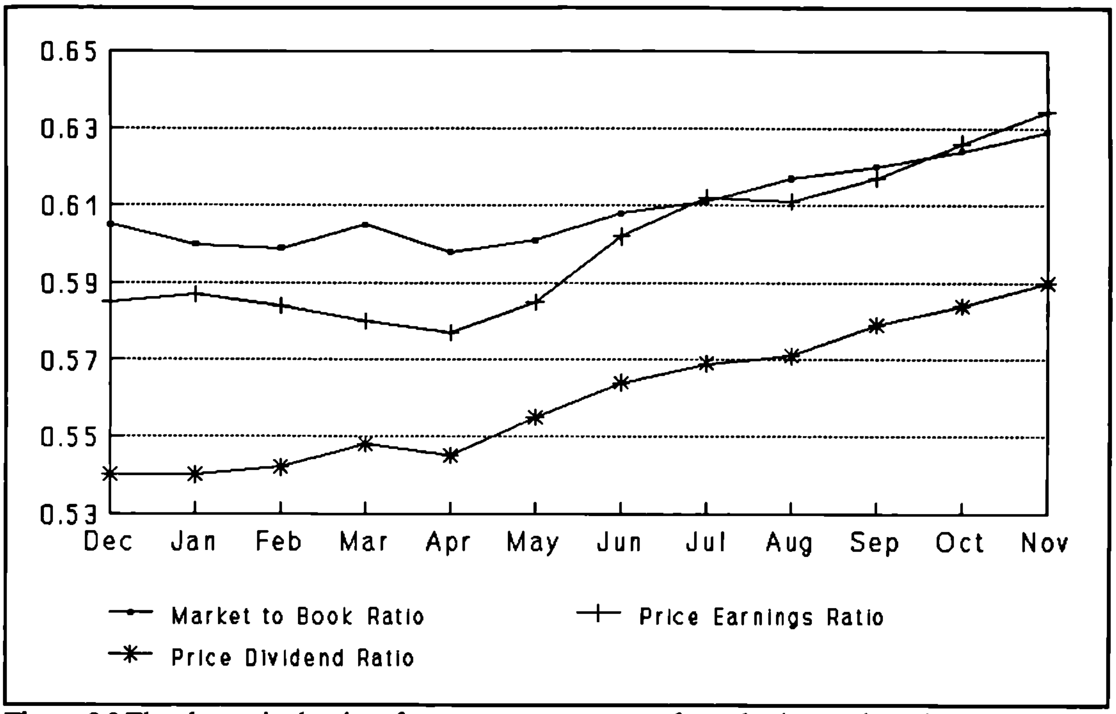

Figure 2.2 The change in the size of error as we move away from the (approximate) announcement date.

We were interested to examine using our ratio methodology whether financial information continues to be useful after a period of time has elapsed, in explaining cross sectional variations in prices. If financial statements provide information that was interpretable in the same way (or not superseded by new information) until the next annual report gets released we would expect the root mean square of the prediction errors to remain roughly steady even though we moved away from the announcement period.

We tested for this by taking the average prediction error for every month end from the accounting year end in December to the next October averaged over each of the 17 years in the sample.

Our results presented in figure 2.2 were that as we move away from March the prediction error increases steadily. This is reasonable given the new information that becomes available about the companies such as semi-annual reports, news about the economy and other companies in the same industry cannot but affect the way accounting information is interpreted. These results also suggest that the use of prices contemporaneous with the accounting year end (i.e. December prices in this case) in valuation studies is not appropriate because earnings information had not been announced and therefore not yet impounded in prices.

2.7 Summary and Conclusions

The aim of this chapter has been to examine simple valuation rules which are frequently employed in practice and the methodological problems associated with them.

In particular, the results presented here suggest that a multiplicative relationship must be assumed between market capitalization and the independent financial variables and the error term and that the characteristic ratio should be the mean of the log-transformed ratio. As a criterion to evaluate alternative valuation rules we employed variance minimization.

Employing this methodology, the best single measure of profitability for valuation purposes was (marginally) net profit and the best measure of the book value of capital the book value of equity. Nevertheless, the best univariate valuation rule is the price dividends ratio which in turn is significantly outperformed by a combined forecast methodology such as the one employed by the US tax courts. Clearly, ad hoc valuation rules based on simple aggregate measures of earnings or book value are not likely to be efficient. In the next chapter, we test for the effect of other variables (such as measures of growth and risk) on the value of the market to book value of equity, price earnings and price dividends ratios in order to derive more efficient estimators of value.

APPENDIX I

An Empirical Examination of the Statistical Validity of Ratio Based Valuation Models

As it has already been discussed in the body of the chapter, the application of the ratio methodology as an ad hoc model of the value of a firm is widespread both in practice but also in empirical research.

The tests presented here, examine the statistical validity of ratio analysis in this setting through comparison with alternative specifications in a cross-industry sample[16].

The Presence of an Intercept

In the presence of an intercept the relationship between the two variables resembles the classic regression model:

$$MCAP_i = \beta_0 + \beta . EARN_i + e_i \qquad (5)$$

The intercept term may be reflecting systematic measurement error in the independent variable (for example, a positive intercept to offset the negative price that would be the expected result of valuing a loss making firm using an earnings multiple) or the effect of variables not included in the analysis.

If we temporarily abstract from the effects of the residual term, and exclude from the estimation the intercept the PE ratio for company i would be:

[16] All the tests are on the price to net earnings, market to book value of equity, and price dividends relationships using only those observations for which all 3 financial variables are defined.

$$\frac{MCAP_i}{EARN_i} = \beta \qquad (6)$$

Then, β (the characteristic ratio) is a biased statistic of the effect of earnings on price with the bias being relatively larger for firms with small earnings and smaller for the bigger firms. This is because β will be picking up the effect of the excluded intercept β_0.

McDonald and Morris (1984) examined the statistical validity of the zero intercept assumption inherent in ratio analysis: their conclusions were that for a number of variables, the ratio methodology outperformed the OLS alternative in a single industry setting because it resulted in smaller variance of the residuals and therefore the inclusion of an intercept term was not warranted. However, they did not examine any ratios that include capital market price in the numerator or the effects of any of the usual data transformation techniques (trimming the sample or taking the log of the ratios). In addition, the results in a cross-industry sample, for the ratios examined, were not conclusive.

Using WLS, where the variance of the error term was assumed to be a multiple of the square of the independent variable in each regression[17], we estimated the regressions with market capitalization as the dependent variable and share capital, net earnings and dividends as the independent ones. If the intercept was statistically significant, then its omission will be causing bias: the results of the regression were that for 12 (out of 17) years in the case of book value of equity and dividends and for 15 in the case of net earnings the intercept is significant which suggests that exclusion of the intercept, in the price earnings relationship in particular, is likely to cause serious bias.

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[17] This is the assumption underlying the choice of the mean PE as the earnings multiplier.

Dependence on Other Variables and Non-Linearity

When market participants form an opinion about a firm's value they are most likely to use models with more variables than simply net profits or book value of assets etc or they might simply be capitalizing at a different rate each of the component parts of these variables. In this case, a simple bivariate ratio relationship has no obvious economic interpretation unless it is somehow adjusted for the effects of other variables. However, these results are deferred to the next chapter, where the models estimated include variables such as adjustments for growth and risk and tests of whether the components of earnings have information in excess of the bottom line number.

Another, related, source of bias is that we are implicitly assuming a linear (or, log-linear) transformation rule from accounting variables to market capitalization. The usual example of a non-linear relationship is the inventory turnover ratio which will be a function of the square root of sales if the firm follows the Economic Order Quantity formula for inventory management.

If we assume additive errors, then the general relationship (excluding the intercept) will be of the form:

$$MCAP_i = \beta EARN_i^{\beta_2} + e_i \qquad (7)$$

This relationship can be estimated using a non-linear least squares procedure. If β_2 is different from 1 in a statistically significant way then the relationship is non-linear. For the variables book value of share capital and dividends there was evidence of non-linearity for 11 periods and in the case of earnings for 9. In most cases, β_2 was less than 1.

If the errors are assumed to be multiplicative, the relationship can be transformed to:

$$\log(MCAP_i) = \beta + \beta_2 \log(EARN_i) + \log(u_i) \qquad (8)$$

where log is the natural logarithm, and which can be estimated using OLS. The results in this case are that deviations from linearity for the market to book value of equity relationship were trivial, but for earnings and dividends the relationship was non-linear (i.e. β_2 different from 1) for 12 and 13 years respectively. Despite these results, it can be assumed that the relationship is linear because the deviation of the coefficients from 1, in economic terms is quite small (the average of the estimated coefficients is .97 for the book value of equity, .93 for earnings and .95 for dividends).

The Nature of the Error Term and Alternative Functional Relationships

The assumed nature of the error term and its distribution is of paramount importance because on it depends the choice of what constitutes the ratio multiplier.

The assumed functional relationship (and the error term) can be either additive and/or multiplicative. We will be discussing the two simple cases in turn.

In the additive error case, which is the usual assumption in practice, the relationship is assumed to be of the form $MCAP = \beta.EARN + \epsilon$. In this case the error term can be heteroscedastic but the estimated parameters of the ratio model can be correctly specified or the inverse. This will depend on whether or not the accuracy of the predicted price (i.e. variance of the error term) is a function of the size of the independent variable. Dividing both sides by earnings shows that the deviation of the price earnings ratio for each firm in the sample from the average will depend on the size of the independent variable because

$$\frac{MCAP}{EARN}=\beta+\frac{e}{EARN} \tag{9}$$

a) If the error term e_i is homoscedastic, i.e. identically distributed across the sample, and if β is estimated as the arithmetic or value weighted mean, it will be an inefficient statistic (in a minimum variance sense) because the PE ratio of large firms will be closer to it than smaller ones. Of course, in this case the OLS estimator of β will be an efficient statistic for the purpose of predicting out of sample market values of companies.

b) If however, the error term is heteroscedastic with its variance a linear function of the independent variable, then the ratio average could be a homoscedastic estimator depending on the functional form of the variance. Specifically, if the variance of e_i is proportional to earnings, it can be proved that the GLS estimator of β is equal to the ratio of the mean market value to the mean of the accounting variable[18].

Even more interesting is the case where the variance of the error depends on the square of the accounting variable. Then, β can be estimated as the equally

[18] If $Var(e_i)=C.X_i$, where C is a non-zero constant and X_i is the independent accounting variable, we can use the WLS estimators. To do so the variables in both sides are weighted by the square root of X_i. Thus, the transformed equation is:

$$\frac{Y_i}{\sqrt{X_i}}=\beta\times\sqrt{X_i}+\frac{e}{\sqrt{X_i}}$$

Applying the usual OLS estimator for b (since the variance is now constant across the sample) we have that:

$$\beta=\frac{\sum\sqrt{X_i}\cdot\frac{Y_i}{\sqrt{X_i}}}{\sum(\sqrt{X_i})^2}=\frac{\sum Y_i}{\sum(\sqrt{X_i})^2}=\frac{\sum Y_i}{\sum X_i}=\frac{\bar{Y}}{\bar{X}}$$

weighted (arithmetic) mean of the ratio[19] and it can be interpreted as a statistic of both the marginal and the average effects of the independent variable (e.g. earnings) on market capitalization.

Using the maximum likelihood function:

$$\log L = const. - \sum \log(\gamma\, EARN_i^{\delta}) - \frac{1}{2}\sum \left(\frac{MCAP_i - \alpha - \beta\, EARN_i}{\gamma\, EARN_i^{\delta}}\right)^2 \tag{10}$$

we tested for the power δ to which earnings (or any other accounting variable) must be raised in order to resolve problems with heteroscedasticity (for justification of this approach see Maddala (1989)). The results were first that, unsurprisingly, the error is heteroscedastic and that for the book value of equity and earnings the variance of the error term is a function of the square of the dependent variable whereas for dividends the results were that for eight years δ was 1 and for nine it was 2[20]. The conclusion that can be drawn from these results is that the practice of using the average PE ratio as a multiplier is justified (within the context of the additive errors model).

Alternatively, we can assume that the function is multiplicative; then the relationship is of the form:

$$MCAP_i = \beta . EARN_i . u_i \tag{11}$$

The general specification of this case is:

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[19] If $Var(e_i) = C.X_i^2$, then weighting both sides of the equation by X_i and following the same steps as in footnote 2, the OLS estimator of b is equal to:

$$\beta = \frac{\sum \frac{Y_i}{X_i}}{N} = \frac{1}{N} \times \sum \frac{Y_i}{X_i}$$

which is the arithmetic mean of the ratio.

[20] These results are obtained by constraining δ to be 0, 1 or 2. If the constraints are not imposed, δ is in the range 1 to 2.

$$Y_i = \beta X_i^{\beta_2} u_i \tag{12}$$

but, as it has already been said, the relationship can be assumed to be linear and thus $\beta_2 = 1$. The intuition of this case is that the forecasts of market capitalization based on accounting variables differ simply by a percentage error from the actual value. In this case, the deviation of each company's ratio ($\beta.u_i$) from the estimator of the multiplier β will be independent of X and therefore β will be an efficient statistic[21] and a valid measure of the marginal effect of earnings (or any other accounting variable) on prices. The problem with this formulation is that it is inconsistent with negative earnings since the log function is defined only over the range of positive numbers (though negative PE are not well defined even in the case with additive errors). The usual way of dealing with negative PEs is to drop from the sample the companies with negative earnings. However, this omits valuable information from the sample.

Non-normally Distributed Ratios

The cross section distributional properties of financial ratios have been the subject of considerable research activity. The more interesting papers are those by Deakin (1976) and Frecka and Hopwood (1983) on the ratios of US manufacturing companies, Ricketts and Stover (1978) on the ratios of US banks and Bougen and Drury (1980) on the ratios of UK manufacturing companies. The common result is that the assumption of normality is not tenable. McLeay (1986) made an interesting theoretical contribution in this area. He started by

[21] This is simply the well known result that the mean of a random variable is the most efficient central tendency statistic of its distribution.

assuming: a) that stochastic growth processes adhering to Gibrat's law[22] generate a log-normal size distribution and b) that accounting data comprise two broad classes, those that are sums (Σ) and bounded from below at zero, like book value of assets, and those which are differences (Δ). Thus, there are three classes of ratios: (Σ/Σ) which are log-normally distributed, (Δ/Σ) which follow a t-distribution and (Δ/Δ) which follow a Cauchy distribution.

In general, we want to test whether the market to book value, price earnings and price dividends ratios are (at least approximately) normally distributed. Given the large size of the sample, with companies that may be clustered in industry specific groups, and the inevitable presence of outliers due to either different accounting measurement rules followed by these companies and/or data entry errors in EXSTAT an exact fit to the normal distribution is almost impossible. We were, however interested to examine whether the distribution was symmetric and without particularly fat tails.

For our tests we used the Shapiro-Wilk (W) test to examine whether the log-transformed ratios were a better approximation to a normally distributed variable than the raw ones and the size of the deviation. Advantages of the W test over the better known Kolmogorov-Smirnov one are that it has better properties in the tails of the distribution and it is more powerful in small samples. The W statistic is calculated as follows:

From the sample of the ranked, from smaller to larger, observations one computes the denominator D of the test statistic from the formula:

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[22] Briefly, Gibrat's law of proportionate growth states that firms' growth is an independent random variable.

$$D=\sum_{i=1}^{n}(X_i-\bar{X})^2 \qquad (13)$$

where X is the sample mean. Then W is calculated as:

$$W=\frac{1}{D}.[\sum_{i=1}^{k}\alpha_i.(X^{n-i+1}-X^i)^2] \qquad (14)$$

where X^i is the rank statistic for observation X_i and the coefficients a_1, a_2,....,a_k (k=n/2) are given in tables (see Stephens(1975))[23]. The distribution of W ranges from 0 to 1 and when W>.9 the variable was treated as being, at least approximately, normally distributed. Our results, which are reported in table 2.8, were that the price to book value of assets ratio was indeed log-normally distributed though the hypothesis of a non-log-normal distribution could not be rejected at a high level of significance. The same conclusion could not be drawn for the price earnings or price dividends ratios. However, there was a dramatic improvement in the W statistic of log-transformed PE and PD ratios, their distribution was of the right (bell) shape and they satisfied the criterion of approximate normality and therefore we decided that the log-transformation was justified in this case as well.

The log-transformation has the effect that less weight is given to equal percentage changes in a variable when the values are larger than when they are smaller; however, this effect is consistent with the assumption of a multiplicative functional specification.

[23] For a detailed analysis of the theory behind the W test one can consult the original paper by Shapiro and Wilk (1965).

Table 2.8 Wilk-Shapiro statistic for main ratios. In the first row is the W statistic for the log-transformed ratios while in the second for the raw ones.

YEAR	Price to Book Ratio	Price Earnings Ratio	Price Dividends Ratio
1971	0.983	0.869	0.959
	0.842	0.305	0.602
1972	0.983	0.954	0.955
	0.803	0.333	0.839
1973	0.966	0.921	0.974
	0.814	0.142	0.827
1974	0.984	0.977	0.972
	0.852	0.699	0.809
1975	0.986	0.972	0.986
	0.825	0.653	0.687
1976	0.975	0.946	0.946
	0.762	0.294	0.653
1977	0.987	0.964	0.930
	0.755	0.568	0.628
1978	0.974	0.967	0.957
	0.792	0.687	0.766
1979	0.979	0.887	0.934
	0.735	0.107	0.340
1980	0.970	0.960	0.944
	0.737	0.459	0.536
1981	0.979	0.885	0.946
	0.648	0.224	0.611
1982	0.958	0.954	0.931
	0.566	0.572	0.551
1983	0.961	0.954	0.900
	0.564	0.488	0.374
1984	0.950	0.925	0.887
	0.521	0.383	0.539
1985	0.972	0.941	0.939
	0.742	0.431	0.295
1986	0.981	0.849	0.891
	0.573	0.141	0.456
1987	0.974	0.858	0.901
	0.808	0.325	0.478

Testing the Linear Versus the Log-linear Specification

In the previous sections we examined the assumptions under which the ratio model is valid, and suggested the use of the log-transformation to correct for the non-normal distribution and an alternative specification of the error term (multiplicative model).

The most usual test for the optimal transformation to apply on the dependent variable of a model is the Box-Cox transformation which aims to find a scalar λ such as that the Y^{λ} given by the formula:

$$Y^{\lambda}=\begin{cases}\dfrac{(Y^{\lambda}-1)}{\lambda}, & \forall\ \lambda\neq 0\\ \log Y, & for\ \lambda=0\end{cases} \tag{15}$$

satisfy the regression assumptions.

The Box-Cox transformation though frequently used, makes a strong assumption that the errors in the model being tested are independently, normally distributed, for all values of λ. As the evidence presented in the previous section suggests, this is unlikely to be the case.

Using the statistical package GLIM, we tested for a number of λ's (from -1 to 1) for the 3 equations with MCAP as the dependent variable and the book value of equity, earnings and dividends respectively as the independent ones. In all cases, the optimal value of λ which maximizes the log-likelihood function was 0 which suggests that the log-transformation of market capitalization is the appropriate one.

Some critics of the Box-Cox transformation have argued that if the error term is heteroscedastic (as in this case) it would bias λ towards zero. Thus the same test was done on the ratios themselves a procedure that, as analyzed in the previous section, reduces heteroscedasticity. In this case, λs for the market to book value of equity and price earnings ratios were clustered around 0.2 (but were not different from 0 at the 5% level) whereas for the price dividends ratio around 0. Given that the ratios are essentially, a rule of thumb model these results can be interpreted as evidence in favour of the multiplicative functional specification.

Conclusion: Selecting a Characteristic Ratio and Comparing the Performance of Alternative Ratio Models

In the previous paragraphs, theoretical arguments were advanced and empirical evidence was produced which suggests that the error term should be modeled as multiplicative to the independent variable. It is simple to rewrite the simple bivariate relationship as:

$$\log(MCAP_i) = \beta' + \log(EARN_i) + \log(u_i) \tag{16}$$

or,

$$\log\left(\frac{MCAP_i}{EARN_i}\right) = \beta' + e_i \tag{17}$$

(where $\beta' = \log(\beta)$ and $e_i = \log(u_i)$).

Given that the residuals in this case are at least approximately normally distributed the optimum location statistic for β', which can be thought of as the number times by which we must multiply earnings to get an estimate for the value of the company, is the exponent of the arithmetic mean of the log transformed ratio because it minimizes the sum of squared errors[24]. This is also the OLS estimator for β', and it can be used for extrapolation.

Since approximate normality allows us to use parametric statistics, to evaluate the predictive performance of alternative accounting variables we will be using the Root Mean Square Error (RMSE) of the forecasts (which coincides with the standard deviation of the ratio) for each ratio as the criterion to assess the performance of ratios that use alternative definitions of the accounting variable.

[24] Implicitly a quadratic loss function is assumed which penalizes more heavily large errors.

CHAPTER 3

WHAT DETERMINES THE VALUATION RATIOS

3.1 Introduction

In the previous chapter we selected the ratios that outperform the other ratios in their class as a basis of estimating a firm's market capitalization. We now turn to the issue of what determines the value of the capitalization coefficient for individual companies aiming both to explain the observed differences in ratios and to improve the forecasting power of our rules.

Many of the results presented in this chapter are data-instigated because although theoretical constructs exist which suggest what properties we want our explanatory variables to have (even what they are supposed to be measuring), there are few guidelines about how to choose these variables.

After a short section describing the data that we will be using in this chapter we examine the effect of growth of the firm's assets, profits and dividends as well as the effects of risk as measured by beta and the leverage ratio. We also test for industry effects which might be influencing company ratios either because of macro-economic factors common to all firms in an industry or because firms in an industry follow similar accounting practices.

Finally, because there is considerable evidence that size is an important determinant of returns, we test whether there is also a size effect for the valuation ratios.

We conclude this chapter by a synthesis of the results: we attempt to model the cross sectional differences of the three valuation ratios among firms conditional on a firm's industry classification, risk and growth.

3.2 Research Design

In this chapter, we continue using data extracted from the LSPD (capital market variables) and the mini EXSTAT (accounting variables).

The market to book value of equity (PB), price-earnings (PE) and price-dividends (PD) ratios are calculated as the log-transformed ratio of total market capitalization of common stock over the accounting value of equity capital, net earnings and common dividends.

We are also using variables for the growth in book value of assets, net earnings and dividends. These were estimated as the log of the ratio of the value of the relevant financial variable for the current year over the corresponding one for the previous year. Thus companies that had losses in either year or did not pay dividends for either period had undefined growth variables. The correlation of the three growth measures over the full sample is positive but relatively low as it can be seen in table 3.1. We will also be using two measures of risk. The first, which is estimated using capital market data, is beta and was estimated using the market model on five years of monthly returns data

Table 3.1 Pearson correlation of the growth variables.

	Growth in earnings	Growth in dividends
Growth in book value	.27	.33
Growth in earnings		.45

Table 3.2 Mean value of all variables used in this chapter.

YEAR	PB	PE	PD	GBOOK	GNET	GDIV	DE	BETA
1972	1.39	10.83	27.97	19.2%	28.9%	0.9%	40.1%	0.841
1973	0.71	5.56	18.45	24.2%	17.8%	-7.0%	57.1%	0.823
1974	0.62	5.29	16.57	16.1%	-1.2%	5.4%	61.8%	0.833
1975	0.82	7.58	21.22	9.1%	5.0%	15.9%	53.1%	0.796
1976	0.80	6.19	20.45	18.4%	33.0%	18.7%	55.1%	0.767
1977	0.87	6.43	23.56	12.0%	27.1%	20.0%	52.6%	0.772
1978	0.94	7.14	26.79	17.3%	23.6%	19.7%	49.4%	0.761
1979	0.72	6.00	18.43	18.1%	4.7%	25.1%	55.5%	0.796
1980	0.77	7.28	22.78	6.2%	-9.5%	-3.9%	50.0%	0.726
1981	0.82	9.28	24.34	13.0%	-13.9%	10.0%	49.0%	0.741
1982	1.04	10.98	28.27	10.0%	7.3%	13.3%	43.1%	0.777
1983	1.27	11.26	33.15	14.6%	31.4%	25.6%	40.5%	0.758
1984	1.37	11.65	34.14	22.8%	21.6%	25.6%	41.0%	0.878
1985	1.64	12.93	36.78	12.2%	17.1%	23.0%	36.9%	0.891
1986	2.11	14.95	45.77	20.9%	30.8%	30.2%	32.2%	0.930
1987	1.95	12.66	37.88	22.1%	30.6%	33.0%	33.5%	0.928
SAMPLE	1.06	8.83	26.76	15.9%	16.1%	16.8%	46.4%	0.814

where,
PB: market to book ratio,
PE: price earnings ratio,
PD: price dividends ratio,
GBOOK: growth in the book value of assets,
GNET: growth in earnings,
GDIV: growth in dividends,
DE: leverage,
BETA: beta.

(24 observations before, and up to, the 'announcement' date and 36 afterwards)[1]. Our estimate of beta was not Bayes adjusted and was treated as missing if there were less than 36 months of data available. The second, which is an accounting proxy for risk, is the (log-transformed) leverage ratio which was calculated as the ratio of TOTAL financial liabilities[2] (debt obligations plus preferred equity) over the total value of the firm, i.e. financial liabilities plus market capitalization[3].

We test for industry effects using the Institute of Actuaries industrial classification scheme except that we aggregated industries in 19 groups (details of the aggregation scheme can be found in appendix I).

Finally, we measure size as the log-transformed book value of assets which was defined in the previous chapter.

In table 3.2 on the previous page we present the mean, for every year, for each of the variables that we will be using in this chapter as well as the sample mean over all years. In this and the next chapter we follow the rule, established in the previous chapter, of using the maximum number of observations for which all variables in a section are defined. However, because for 1971 none of the growth variables is defined from now on the reported results are limited to the

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[1] This was forced on us by problems of data availability: if the entry of a number of companies in LSPD was concurrent to that of their entry in EXSTAT (as is the case for a large number of companies) we would lose five initial years of data.

[2] There are many ways to define leverage. However, all are highly correlated and therefore, it is unlikely that there is any point in mining the data.

[3] Leverage was defined as the log of DEBT/(MCAP+DEBT) where debt in terms of EXSTAT variables is defined as: #28+#36+#37+#38+#39+#40+#42+#43+#44+#45+#46 +#46+#49+#50. This definition of leverage is obviously inappropriate for firms that do not already have a market value such as the ones we aim to value. Thus in the forecasting performance tests market capitalization is replaced by a book measure of leverage, defined as the log of (BOOK-SHAR)/BOOK, which has a rank correlation coefficient of .64 with the original variable over the sample.

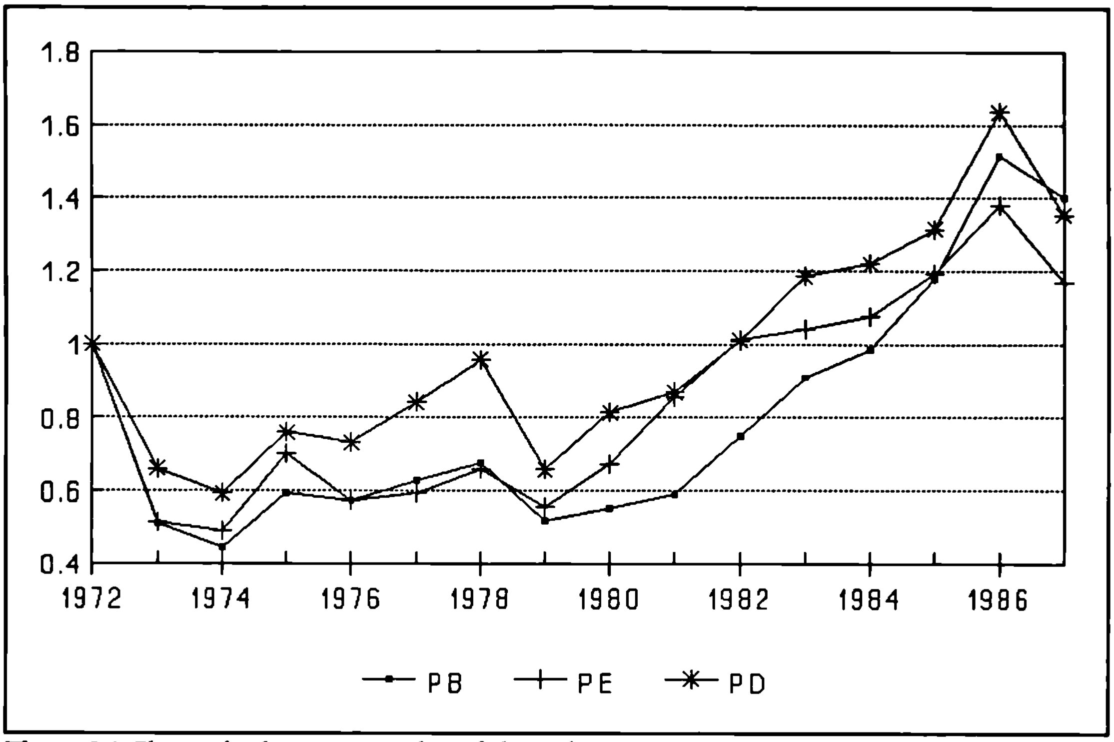

Figure 3.1 Change in the average value of the ratios.

period 1972-1987. In figure 3.1 we plot the time series of the average capitalization coefficients (standardized by the value for 1972). It is interesting to note that over time the mean capitalization coefficient of the book value of share capital, profits and dividends fluctuates considerably but in addition that there is significant co-movement between the three ratios.

3.3 Growth and The Time Series Properties of Accounting Numbers

Most of the published valuation models, either theoretical or empirical, emphasize the effects of growth in the capitalization coefficient[4]. In Gordon's model, (constant) expected future growth (g) is one of the determining factors of the rate at which dividends are capitalized (1/(r-g)). In this model, we expect positive correlation between the price earnings and price dividends ratios and

[4] Throughout this section, for reasons of parsimony of the discussion, when we are discussing the effects of growth we implicitly assume positive growth.

growth variables that are a good proxy of expected future growth opportunities. In past empirical research, the most frequently used definition of growth has been a function of the average past growth in the book value of assets[5]. Underlying this practice is the assumption that this growth rate will persist in the future. A better justification for modelling of expected growth as growth in the book value of assets, is that since book value is a stock variable, whereas earnings (and dividends) are a flow one, an increase in the book value of assets should in the long run lead to higher earnings and dividends. This will be true if the new assets have not yet fully reached their income generating potential which would be the case for any assets acquired at any time after the start of the period. Thus, we expect positive correlation between growth in the book value of assets and the price earnings and price dividends ratios.

An alternative purpose for the inclusion of a 'growth' variable is to exploit the time series properties of accounting numbers (lets say, the observation that earnings exhibit mean reversion over time). This is presumably the reason underlying the decision by the US Tax Court in the Central Trust case to take the weighted average of the past five years of earnings. There is a considerable volume of published research about the time series properties of accounting numbers and therefore we want to examine here the possibility of improving our forecasts using those properties.

Most of the published models have focused on the time series properties of earnings[6]. Two general conclusions can be drawn: there is negative serial

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[5] This refers to the papers which use the Modigliani and Miller adjustment for growth such as Litzenberger and Rao (1971), Foster (1977) etc.

[6] For a review of the literature see Foster (1986).

correlation (in the change in earnings series) and that, on average, ARIMA models cannot forecast future earnings any better than a random walk model. These two conclusions may appear to contradict each other. However, they do not because the correlation is weak, there are frequent structural changes in the time series of earnings because of changes in the reporting environment and of course, there are usually too few observations to estimate the usual Box Jenkins function.

These results are consistent with a model of earnings where they are composed of two stochastic processes. The first one is a permanent component, which follows a random walk with a drift (usually positive) process, and a zero expected value transitory component which is serially uncorrelated. It is easy to prove that in such a model the earnings series will be non-stationary and exhibit negative serial correlation[7]. Investors cannot distinguish between the transitory

[7] This model has been previously used in the literature, including Beaver, Landsman and Morse (1980) and Lieber, Melnick and Ronen (1983). In mathematical notation:

$$\tilde{E}_t = \tilde{\mu}_t + \tilde{u}_t$$
$$\tilde{\mu}_t = \tilde{\mu}_{t-1} + \tilde{w}_t$$

where:

$\tilde{E}_t$=*net earnings for t,*
$\tilde{\mu}_t$=*permanent earnings for t,*
$\tilde{u}_t$=*transitory component of earnings for which* $E(\tilde{u}_t)=0$,
$Cov(\tilde{\mu}_t, \tilde{\mu}_{t+\tau})=0,\ \forall\tau\neq 0$,
$\tilde{w}_t$= *persistent noise (growth),* $E(\tilde{w}_t)=\alpha$

Important assumptions are:

$$Cov(\tilde{w}_t, \tilde{w}_{t+\tau}=0, \forall\tau\neq 0$$
$$Cov(\tilde{u}_t, \tilde{w})=0, \forall\tau$$

Under these assumptions, the change in earnings ΔE_t equals:

$$\Delta\tilde{E}_t = \tilde{u}_t + \tilde{u}_{t-1} + \tilde{w}_t$$

If $\alpha=0$ (i.e. zero growth case) the expected value of the firm is the present value of the perpetuity of permanent earnings. In any other case, the value of the firm is the sum of current permanent earnings plus the PV of the growth opportunities.

component and the drift in the permanent earnings. However, the time series of past earnings can be used to obtain a stationary series.

Under these assumptions, there should be negative correlation between the price earnings ratio and growth in profits over the past year: firms with high increase in reported earnings over a period will be perceived as also having a high transitory component and the expectations will be for a reduction in reported earnings over the next period. Investors will price earnings at a lower multiple. The converse will be true for companies that experienced a big decrease in profits[8].

It is generally accepted that current earnings (and change in earnings) are one of the determining factors of dividend payments. One of the best known descriptive models of dividend policy is Linter's equation: $D_t=a+bP_t+dD_{t-1}+u$ where D is dividends and P profits. Dividend disbursements are controlled by two parameters: the target payout ratio, r, and a speed-of-adjustment factor, c, which determines the speed at which current dividends are to be adjusted, when there is a change in earnings towards the new target payout. Their relationship to the coefficients of the estimated equation is b=cr and d=1-c. If in this equation we substitute for previous periods' dividends, it is easy to see that

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The process we have defined is, in Box-Jenkins terminology, an IMA(1,1). It is easy to prove analytically that serial correlation, R, in the first differences will be negative:

$$R=\frac{Cov(\Delta E_t,\Delta E_{t+1})}{Var(\Delta E_t)}=\frac{-\sigma^2_u}{2\sigma^2_u+\sigma^2_w}<0$$

If the variance of the transitory earnings, u, is zero then the process is a pure random walk whereas if the variance of the drift component is zero we have a mean reverting process.

[8] It would be interesting to examine the empirical regularity that Beaver and Morse (1978) reported that high PEs (ie small earnings relative to market capitalization) tend to move faster towards the mean than low ones. If accountants are aiming to measure 'permanent' earnings, which are capitalized as a perpetuity, losses mean an error in the accounting measurement process since a firm cannot have a negative market capitalization because of limited liability.

current earnings are a function of current earnings and a series of past earnings with declining weights. Thus an increase in profits will lead to an increase in dividend payments and therefore, we expect positive correlation of the growth over the past year in profits and the cross sectional distribution of price dividends ratios. This is also consistent with the empirical results of Fama and Babiak (1968) which suggest that conditional on past year's dividends, positive growth in profits will result in a dividend increase.

Finally, the theoretical results which suggest that dividends are used by management as a signalling device to shareholders about the firm's prospects and the empirical evidence that dividends are 'sticky' suggest that growth in dividends should be perceived by investors as good news. Therefore, we expect positive correlation between dividends growth and the cross sectional distribution of the price dividends ratio.

To summarize, our hypotheses about the expected relationships between the growth variables and the price earnings and price dividends ratios are:

H_{01}: Positive correlation between growth in book value of assets and the price earnings ratio.

H_{02}: Negative correlation between earnings growth and the price earnings ratio.

H_{03}: Positive correlation between growth in book value of assets and the price dividends ratio.

H_{04}: Positive correlation between earnings growth and the price dividends ratio.

H_{05}: Positive correlation between dividends growth and the price dividends ratio.

In table 3.3 we present the Spearman rank correlation coefficient for growth in the book value of assets and earnings growth and the price dividends ratio as

Table 3.3 Rank correlation coefficients between price earnings and price dividends ratios and growth variables.

YEAR	GBOOK with PE	GNET with PE	GBOOK with PD	GNET with PD	GDIV with PD
1972	.028	-.369	.284	.175	-.108
1973	-.052	-.253	.154	.069	-.044
1974	-.182	-.417	.153	.194	.096
1975	-.127	-.442	.295	.191	.076
1976	-.153	-.348	.182	.170	.046
1977	-.082	-.364	.198	.204	-.009
1978	-.077	-.389	.247	.157	.127
1979	-.160	-.337	.151	.142	.205
1980	.061	-.419	.333	.107	.252
1981	-.126	-.318	.151	.107	.171
1982	-.026	-.087	.299	.232	.334
1983	.095	-.011	.258	.262	.329
1984	.136	-.145	.293	.258	.299
1985	.191	-.152	.273	.210	.339
1986	.114	-.045	.358	.237	.254
1987	.110	-.109	.280	.265	.271
SAMPLE	-.065	-.153	.165	.219	.246

where,
GBOOK: growth in the book value of assets,
GNET: earnings growth,
GDIV: dividends growth,
PE: price earnings ratio and,
PD: price dividends ratio.

well as for dividends growth and the price dividends ratio. In the last line sample refers to the correlation over the total sample (over all years) and not to an average of the correlation coefficients in the 16 cross sections.

Generally, results are consistent with our hypotheses. The price earnings ratio exhibits strong negative correlation with profits growth, a result consistent with those of Beaver and Morse (1978) for US stocks. The effects of growth in the book value of assets are generally weak and not consistent over time since for some years there is positive correlation and for some others negative. The price dividends ratio is uniformly positively correlated with growth in the book value of assets and profits but the effects of growth in dividends are not consistent over time and, for some years, weak.

For each of the relationships tested in table 3.3 we had fairly strong priors on the nature of the relationship. However, for completeness we report in appendix II the correlation coefficients of all combinations of all ratios with all growth variables. Some of the results depend mainly on the nature of accounting numbers and the way they are prepared.

Contrary to expectations, the strongest and most persistent relationship appears to be between the market to book value of equity ratio and growth variables. It is difficult to attribute this to differences between accounting and economic depreciation. For example, if accounting depreciation is faster than economic, then the book value of assets will be lower than their market value and therefore, a high market to book ratio will be associated with low growth in the book value of assets.

However, we will be using some of these results to examine the cross sectional variability of the ratios. As it can be observed from examining the tables, the growth variables which have the strongest influence, for most of the years in the sample, on the valuation ratios are assets growth for the market to book value of equity ratio and the price to dividends ratio and earnings growth for the price earnings ratio.

3.4 Adjusting for Risk

The models we have been using up to now, implicitly assume that all firms belong to the same risk class. Besides growth another potential source of variation of the capitalization coefficients between companies is risk: we aim to use information from usual risk measures to increase the forecasting performance of our model.

The correlation between measures of risk and the price-earnings and price dividends ratios should be negative because risk increases the required rate of return.

3.4.1 Capital Market Measures of Risk

The first risk measure that we tested for was the firm's beta. Beta is widely accepted in the theoretical literature at least as an adequate measure of risk and it has been extensively used in empirical studies.

Our results are presented in table 3.4. The effects of beta on the cross sectional distribution of the valuation ratios are generally weak and not consistent over time (except for the price-dividends ratio) which is in agreement with the results of previous valuation studies such as Beaver, Eger, Ryan and Wolfson (1989).

Various explanations of the results can be constructed. For example, the generally positive correlation between beta and the market to book value of equity ratio can be explained if we see the firm's growth opportunities as an option. Then if these prospects are risky (thus increasing the firm's beta) the value of the option increases with market capitalization. However, because these options are not recorded in the balance sheet, high beta firms will have higher market to book value of equity ratios.

The results for the price earnings ratio were that the correlation coefficient is positive for half the years and negative in the rest though the effects are generally weak either way. A plausible explanation for this is given by Beaver and Morse (1978):

> Stock's earnings move together because of economy wide factors. In years

Table 3.4 Rank correlation coefficient between beta and the valuation ratios.

YEAR	PB	PE	PD
1972	.131	.011	.153
1973	-.082	-.121	-.091
1974	-.000	.141	.014
1975	.130	.083	.159
1976	.059	.079	.165
1977	-.067	-.072	.100
1978	.018	-.081	.031
1979	.018	-.049	.008
1980	.129	.084	.083
1981	.141	.115	.083
1982	.138	.149	.083
1983	.230	.072	.158
1984	.160	-.063	.114
1985	.296	.039	.206
1986	.276	.100	.255
1987	.156	-.083	.072
SAMPLE	.175	.079	.138

> of transitorily low earnings, the market-wide P/E will tend to be high, but stocks with high betas will have even higher P/E ratios because their earnings are most sensitive to economy-wide events. Conversely, in years of transitorily high earnings, high beta stocks will have even lower P/E ratios than most. Therefore, we expect a positive correlation in "high" P/E years and a negative correlation in "low" years.

Finally, the results for the price dividend ratio are that this ratio is weakly positively correlated with beta. We can not think of any satisfactory explanation for this result.

In conclusion, beta doesn't seem a very satisfactory risk measure for valuation purposes using accounting variables because it doesn't behave according to expectations and the explanations for the results obtained could not have been specified without the benefit of hindsight and it has small explanatory power.

3.4.2 Accounting Measures of Risk

There is a considerable body of Market Based Accounting Research that

Table 3.5 Rank correlation coefficient between leverage and the market to book value of equity, price earnings and price dividends ratios.

YEAR	PB	PE	PD
1972	-.567	-.338	-.161
1973	-.611	-.459	-.315
1974	-.599	-.393	-.256
1975	-.622	-.287	-.251
1976	-.572	-.336	-.222
1977	-.558	-.347	-.217
1978	-.573	-.333	-.393
1979	-.682	-.328	-.484
1980	-.587	-.187	-.304
1981	-.603	-.285	-.265
1982	-.585	-.304	-.405
1983	-.536	-.380	-.329
1984	-.546	-.316	-.389
1985	-.489	-.358	-.387
1986	-.373	-.312	-.251
1987	-.277	-.271	-.186
SAMPLE	-.639	-.458	-.445

attempts to estimate 'accounting' betas; i.e. a company's beta from its annual accounts. Indeed research by Hochman (1983) and others suggests that betas estimated this way are a better forecast of a firm's future beta than the more usual ones based on capital market data. One of the most influential variables in these models is the firm's leverage ratio which mainly measures financial risk rather than operational.

As in the case of beta, we expect negative correlation between leverage and the price earnings and price dividends ratios. As Modigliani and Miller (1958) have shown, leverage is inversely related to the price earnings ratio because it increases the riskiness of the returns of common stock relative to expected value. If the Modigliani and Miller argument about the tax advantages of debt is correct then we expect positive correlation between the market to book value of equity ratio and leverage because market capitalization includes the value of the tax shield to the shareholders which is not included in the firm's book value of assets. However, if the balance sheet records only tangible assets and, as the empirical evidence suggests, firms which hold largely intangible assets borrow less there will be negative correlation between leverage and the market to book ratio. Our results are presented in table 3.5. The correlation coefficients between the leverage ratio and the valuation ratios are negative which confirms our hypotheses. Furthermore, since the correlation is very strong suggesting that the risk variable we want to use to explain cross sectional variation in the capitalization coefficients is leverage. It should be noted however, that in subsequent sections we are using an accounting data based leverage ratio to examine the performance of the valuation rules. The rank correlation coefficient between this book measure of leverage and the valuation ratios is very low (and frequently not significant) especially with the price dividends ratio.

3.5 Industry Effects

In practice, it is very common to examine the financial ratios of a company in comparison with those in the same or similar industries; evidence by Lev (1969) suggests that companies' accounting ratios tend to cluster around an industry standard. Furthermore, most previous studies of the valuation of companies concentrated on an industry (usually US electric utility companies or banks) using Modigliani and Miller's argument of a risk class. In this section we aim to examine whether this practice is justified by looking if we can improve the explanatory power of our models using industry specific multipliers.

The first test was the Kruskal-Wallis non-parametric test of randomness in the differences of the value of the ratio between classes from the sample mean.

The results confirm that at least one of the industries (excluding the 'other' category) has a different multiplier from the sample mean at the 5% significance level: for the market to book value of equity this was true for 15 out of the 16 years in the sample, for the price earnings ratio for 14 and for the price dividends ratio for 13 years.

However, the more interesting question is whether we can improve the predictive power of our methodology by using a different ratio benchmark for each industry. Using a finer set to compute our capitalization coefficients decreases the error in the estimation of the capitalization coefficients which is due to using a largely heterogeneous set of firms with different production functions. On the other hand it increases that part of the error which is due to random disturbances and decrease the efficiency of our estimates because we will have fewer degrees of freedom. The rule of thumb that can be made, is that the forecasting error decreases if the RMSE within industry groups is smaller than over the total sample.

To test, we regressed[9] each ratio on a complete set of industry dummies and found an average reduction (throughout the 16 years in our sample) in the forecasting error for the market to book value of equity ratio of 6.9%, for the price earnings ratio of 4.4% and for the price dividends ratio of 4.8%. This gain is small, in an economic sense, in comparison with an average reduction of 27%, 22.1% and 16.5% correspondingly using the combined forecast methodology[10].

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[9] As it has already been mentioned, for the total sample of firms, linearity in the relationship between market capitalization and share capital, earnings and dividends is a good working assumption. This is not necessarily the case within industry groups but no formal testing was carried out.

[10] Use of industry specific characteristic ratios reduces the prediction error in the combined forecast case by 6.1%.

Thus, the question arises whether there are specific industries that have ratios standing out from the sample average. A stepwise regression procedure was used to identify the industries that were statistically significant in explaining the cross sectional variation in the ratios. If a dummy variable entered the equation, and had a coefficient statistically significant from 0, then an industry specific multiplier is warranted.

The results were that for the market to book value of equity ratio there were always a bigger number of industry dummies which were significant explanatory variables with four industries (electricals, motors, textiles and business services) being significant for more than half the years in the sample. For the PE ratio, three industries (electricals, leisure and financial) were consistently significant whereas for the PD ratio only two (electricals and leisure). As it can be seen, there is a very limited number of industry groups for which the use of an industry specific multiplier is necessary (because they have a different capitalization coefficient from the sample mean), consistently over time.

These results in combination with those presented earlier, would seem to indicate that company grouping should most likely be on the basis of financial characteristics (such as growth, risk etc) rather than on the basis of industrial classification schemes.

3.6 Size Effects

Past empirical research has established that small firms earn abnormal returns and in general, there is an inverse relationship between the size of the firm and its rate of return. Therefore, we examined whether size, as proxied by the firm's book value of assets is related to the firm's valuation ratios. In particular, if the price-earnings ratio is viewed as a measure of the inverse of a firm's nominal cost of capital, we would expect positive correlation between the PE ratio and size.

The results presented in table 3.5 are, generally, not consistent with our expectations. The correlation coefficient in each case is low and its sign is not consistent over time. In consequence we did not include size as an independent variable in any of our subsequent analyses.

3.7 The Performance of Ratio Models After Adjusting for Growth and Risk

In the previous sections we examined several variables that are used both by theoretical valuation models and in investment banking practice. We examined whether these variables can explain the cross-sectional variation of the valuation ratios. In this section we aim to combine these results to examine how far we can improve the forecasting performance of our simple capitalization models of accounting variables (and dividends).

Thus, we regressed each ratio on the relevant growth variable, the accounting leverage ratio and dummy variables for all industries. The standard error of the regressions that we run is presented in table 3.6 (the coefficients of the variables, their t-statistics and the adjusted R^2 for all regressions are given in appendix III). Coefficients for the growth variables have the expected sign, but the coefficients of leverage in the estimated regressions on the market to book and price dividends ratios were frequently positive and in all three equations of low explanatory power. This contrasts with the correlation results presented in table 3.5 and can be explained by the use of the book value of equity (rather than the market one) in the definition of leverage when estimating these regressions.

Table 3.6 Rank correlation coefficients between size and the valuation ratios.

YEAR	PB	PE	PD
1972	-.183*	.073	.057
1973	-.123*	-.057	.093
1974	-.001	.049	.277*
1975	.049	.183*	.308*
1976	.085	.095	.295*
1977	-.036	-.011	.051
1978	-.027	-.006	-.048
1979	-.033	-.061	-.094
1980	.138*	.125*	.068
1981	.044	.011	.045
1982	-.052	-.054	-.109*
1983	-.095	-.144*	-.091
1984	-.043	-.220*	-.088
1985	.068	-.041	.007
1986	.064	.029	-.044
1987	.078	-.122*	-.110*
SAMPLE	.069*	.055*	.082*

where (*) significant at the 5% level.

Furthermore, industry effects are more pronounced for the PB ratio.

It can be seen from the table that after adjusting for growth, leverage/risk and industry effects the price earnings ratio marginally outperforms the price dividends ratio as a method to predict the market value of companies. The performance differential between the three approaches has decreased considerably although the market to book value of equity ratio continues to underperform the others.

Since our aim is to develop more efficient rules for the valuation of companies, we looked at a linear combination of the three approaches as we did in chapter 2. The results which are presented in the last column of table 3.7, show a dramatic reduction in the root MSE of the forecast. The weights assigned on the three approaches exhibited small variability over the 16 cross-sectional samples and, on average, were 23% on the PB, 41% on the PE and 36% on the PD

Table 3.7 Standard error of the regression of the valuation ratios on growth, leverage and industry dummies.

YEAR	PB	PE	PD	CF
1972	.496	.398	.403	.320
1973	.512	.465	.464	.388
1974	.492	.430	.420	.349
1975	.469	.410	.389	.315
1976	.448	.430	.409	.319
1977	.454	.440	.456	.340
1978	.451	.411	.494	.340
1979	.527	.477	.485	.399
1980	.563	.574	.495	.434
1981	.567	.585	.518	.421
1982	.607	.529	.506	.414
1983	.599	.513	.525	.430
1984	.626	.536	.563	.451
1985	.590	.481	.555	.422
1986	.538	.475	.540	.395
1987	.476	.446	.514	.350
MEDIAN	.519	.470	.494	.391

where,
PB: error using the forecast based on the market to book value of equity ratio,
PE: error using the forecast based on the price earnings ratio,
PD: error using the forecast based on the price dividends ratio,
CF: error using the combined forecast.

based forecast. Furthermore, it was encouraging to note that in each of the 16 periods the sum of the weights was not different from 1 in a statistically significant way.

However, as can be seen from appendix III the variables that we used explain, on average, only 18% (mean adjusted R^2 over the period covered by our sample) of the cross sectional variability of the market to book value of equity ratio, 27% of the variability of the price earnings ratio and 14% of the variability of the price dividends ratio. Finally, the strong correlation in the residuals from one period with those in subsequent years for the market to book value of equity ratio (and the other ratios in a lesser degree) presented in appendix IV leads us to believe that additional variables are needed. In the next chapter we will be using models that examine the information in the components of earnings and the book value of assets. In chapter 6, we present the performance of a combined forecast rule using the conclusions of this and the next chapter.

3.8 Conclusion: What Percentage of Market Capitalization Do These Models Explain

Up to this point we have been concerned with which estimator is the one which minimizes the forecasting error. However, this gives no indication about the size of the error in monetary terms; i.e. how far out are our forecasted market capitalizations differ from the true values.

The statistic used is the Mean Absolute Percentage Error which is defined as:

$$MAPE = ABS\left(\frac{MCAP - M\hat{C}AP}{MCAP}\right)$$

where MCAP is actual market capitalization and MCAP is the forecasted one.

Table 3.8 Absolute Percentage Error for the capitalization ratios and the combined forecast.

	PB	PE	PD	CF
Mean	46.2%	41.2%	41.2%	32.9%
Median	35.9%	29.7%	33.0%	25.1%
1%	0.5%	0.6%	0.7%	0.4%
99%	170.6%	200.5%	185.3%	139.9%

where,
PB: Market to Book Value of Equity Ratio,
PE: Price Earnings Ratio,
PD: Price Dividends Ratio,
CF: Combined Forecast with flexible coefficients.

In tables 3.8 and 3.9 we present the MAPE of alternative valuation rules averaged over the period 1972-1987.

The tests show that the ordering of the alternative forecasting rules given by the

Table 3.9 Absolute Percentage Error for the capitalization ratios and the combined forecast after adjusting for industry effects.

	PB	PE	PD	CF
Mean	42.0%	38.3%	37.8%	29.8%
Median	33.4%	28.0%	29.6%	22.8%
1%	0.6%	0.5%	0.5%	0.4%
99%	154.8%	190.6%	161.8%	123.3%

where,
PB: Market to Book Value of Equity Ratio,
PE: Price Earnings Ratio,
PD: Price Dividends Ratio,
CF: Combined Forecast with flexible coefficients.

Root Mean Square Error is preserved[11]. The industry effects are clearly seen to be of marginal economic significance and comparison of the mean and the median Absolute Percentage Error, which is significantly smaller, suggests the presence of skewness in the forecast errors.

Table 3.10 Absolute Percentage Error of the forecasts from the ratios and the combined forecast after adjusting for growth, leverage and industry effects.

	PB	PE	PD	CF
Mean	39.7%	34.3%	35.5%	28.3%
Median	31.9%	26.2%	27.8%	21.2%
1%	0.6%	0.5%	0.7%	0.4%
99%	149.7%	150.3%	151.3%	118.3%

where,
PB: Market to Book Value of Equity Ratio,
PE: Price Earnings Ratio,
PD: Price Dividends Ratio,
CF: Combined Forecast with FLEXIBLE coefficients.

Furthermore, as it can be seen in table 3.10, the MAPE of the regressions of growth, leverage and industry dummies on the ratios (but not that of the combined forecast based on these regressions) we are using in section 3.7, is marginally worse than that of the combined forecast based on the simple ratios.

[11] This is easily explained by the fact that our variables are approximately log-normally distributed and therefore the mean of the log-transformed ratio is the median of the raw ratio which is the absolute error minimizing statistic.

APPENDIX I

INDUSTRIAL CLASSIFICATION

1)BUILDING MATERIALS

12. Bricks and Roofing Tiles
13. Builders Merchants
14. Building Materials/Quarry Products/Asbestos
15. Cement and Concrete
16. Paint
17. Timber

2)CONTRACTING & CONSTRUCTION

18. Constructing and Construction
30. Heating and Ventilation

3)ELECTRICALS & ELECTRONICS

19. Electricals (excluding Radio and TV)
35. Electronics

4)ENGINEERING, MECHANICAL

20. Cold Formed Fastings and Turned Parts
22. Industrial Plant, Engines & Compressors
23. Mechanical Handling
24. Pumps and Valves
25. Steel and Chemical Plant
26. Wires and Ropes
27. Miscellaneous Engineering Contractors
28. Machine and Other Tools
29. Miscellaneous Engineering Contractors

5)METALS, METAL FORMING

21. Founders and Stampers
32. Metallurgy
33. Special Steels
34. Miscellaneous Metal Forming

6)MOTORS

41. Motor Components
42. Motor Distributors
43. Motor Vehicles

7)FOOD, DRINK AND TOBACCO MANUFACTURING INDUSTRIES

45. Breweries
46. Wines and Spirits
49. General Food Manufacturing

50. Milling and Flour
63. Tobacco

8)LEISURE AND RECREATION SERVICES
36. Radio and TV
47. Hotels and Caterers
48. Leisure

9)RETAIL DISTRIBUTION
51. Food retailing
55. Departmental Stores
56. Furnishing Stores
57. Stores, Mail order
58. Stores, Multiple

10)PAPER MANUFACTURING & PUBLISHING
52. Newspapers and Periodicals
53. Publishing and Printing
54. Packaging and Paper

11)TEXTILES
37. Floor Covering
59. Clothing
60. Cotton and Synthetic
61. Wool
62. Miscellaneous Textiles

12)CHEMICAL MANUFACTURING
66. Plastic and Rubber Fabricators
67. Health and Household Goods
68. General Chemicals

13)OIL & GAS
70. Oil & Gas

14)SHIPPING & TRANSPORT
71. Shipping
72. Transport and Freight

15)HOLDING COMPANIES
73. Holding Companies

16)BUSINESS SERVICES
75. Agencies
76. Miscellaneous Business Services

17)BANKING, FINANCE, INSURANCE, AND LEASING
77. Banks
78. Foreign Banks

79. Discount
80. Hire Purchase
81. Insurance (Life)
82. Insurance (Composite)
83. Insurance (Brokers)
84. Investment Trusts
85. Merchant Banks and Issuing Houses
86. Property
87. Financial (Miscellaneous Financial Trusts)

18)COMMODITY GROUPS

89. Rubbers
90. Teas
91. Copper
92. Mining Finance
93. Tin
94. Diamonds
95. Gold
96. Miscellaneous Mines and Collieries
97. Overseas Trade

19)OTHER

38. Furniture and Bedding
39. Household Appliances
40. Kitchen and Tableware
44. Security and Alarm Services
64. Footwear
65. Toys and Games
74. Laundries and Cleaners
88. Telecommunications

APPENDIX II

CORRELATION BETWEEN VALUATION RATIOS AND MEASURES OF GROWTH

Table 3.11 Rank correlation coefficient between the ratios and growth over the past year in the book value of assets, profits and dividends.

	Market to Book Equity Ratio			Price Earnings Ratio			Price Dividends Ratio		
YEAR	Gbook	Gnet	Gdiv	Gbook	Gnet	Gdiv	Gbook	Gnet	Gdiv
1972	.325	.070	.079	.028	-.369	-.023	.284	.175	-.108
1973	.152	-.010	-.075	-.052	-.253	.002	.154	.069	-.044
1974	.162	.134	.207	-.182	-.417	-.117	.153	.194	.096
1975	.269	.182	.259	-.127	-.442	-.102	.295	.191	.076
1976	.256	-.083	.105	-.153	-.348	-.013	.182	.170	.046
1977	.280	.045	.101	-.082	-.364	-.103	.198	.204	-.009
1978	.284	.133	.190	-.077	-.389	-.204	.247	.157	.127
1979	.209	.275	.385	-.160	-.337	-.139	.151	.142	.205
1980	.332	.280	.534	.061	-.419	.011	.333	.107	.252
1981	.286	.188	.351	-.126	-.318	-.164	.151	.107	.171
1982	.326	.220	.345	-.026	-.087	-.082	.299	.232	.334
1983	.387	.218	.295	.095	-.011	.072	.258	.262	.329
1984	.388	.296	.340	.136	-.145	.019	.293	.258	.299
1985	.267	.199	.441	.191	-.152	.064	.273	.210	.339
1986	.260	.294	.274	.114	-.045	.006	.358	.237	.254
1987	.161	.150	.247	.110	-.109	-.064	.280	.265	.271
SAMPLE	.198	.220	.321	-.065	-.153	.060	.165	.219	.246

APPENDIX III

REGRESSION RESULTS:
VALUATION RATIOS ON GROWTH, RISK AND INDUSTRY DUMMIES

In tables 3.12 - 3.14 in the next three pages we present regression coefficients for the 3 valuation ratios (PB, PE and PD) on growth, risk as measured by book leverage and industry dummies. The growth variable in the case of the market to book value of equity and price dividends ratio is growth in the book value of assets and for the price-earnings ratio growth in earnings. Also reported, is the number of industry dummies that were significant at the 5% level. Heteroscedasticity-consistent t-statistics are reported in parentheses.

Table 3.12 Dependent Variable: Market to Book Value of Equity Ratio

YEAR	Constant	Leverage	Growth in book assets	Number of Industries	Adjusted R^2
1972	0.520	.054	.351	6	.07
	(3.86)	(0.58)	(2.17)		
1973	-0.073	.076	.033	6	.14
	(-0.52)	(0.86)	(0.22)		
1974	-0.378	.150	.474	2	.10
	(-3.10)	(1.55)	(2.27)		
1975	-0.095	.106	.896	5	.13
	(-0.92)	(1.12)	(4.72)		
1976	-0.243	.059	1.046	7	.17
	(-2.58)	(0.80)	(4.73)		
1977	-0.076	.158	1.012	6	.18
	(-0.76)	(2.01)	(5.31)		
1978	-0.086	.084	.691	7	.19
	(-0.91)	(1.21)	(4.69)		
1979	-0.448	-.010	.892	4	.15
	(-3.06)	(-0.10)	(4.12)		
1980	0.006	.215	.963	6	.20
	(0.05)	(2.82)	(4.24)		
1981	-0.045	.083	.441	4	.08
	(-0.36)	(1.09)	(1.89)		
1982	0.181	.216	.789	5	.21
	(1.25)	(2.36)	(4.04)		
1983	0.372	.237	.640	8	.24
	(3.22)	(2.71)	(4.53)		
1984	0.639	.432	.420	10	.28
	(4.99)	(4.17)	(2.63)		
1985	0.921	.477	.319	8	.26
	(6.93)	(4.21)	(1.85)		
1986	1.067	.404	.187	5	.23
	(8.97)	(5.31)	(1.38)		
1987	1.093	.472	.091	4	.18
	(9.92)	(6.41)	(1.05)		

Table 3.13 Dependent Variable: Price Earnings Ratio

Year	Constant	Leverage	Growth in Earnings	Number of Industries	Adjusted R^2
1972	2.480	-.127	-0.271	4	.16
	(17.43)	(-1.51)	(-2.18)		
1973	1.890	-.085	-.514	6	.29
	(14.36)	(-0.72)	(-3.82)		
1974	1.631	-.142	-.565	3	.30
	(16.12)	(-1.20)	(-9.29)		
1975	1.951	-.182	-.415	0	.30
	(21.18)	(-1.96)	(-8.70)		
1976	1.918	-.023	-.465	4	.28
	(18.02)	(-0.16)	(-5.21)		
1977	1.918	-.032	-.347	2	.21
	(17.90)	(-0.28)	(-4.52)		
1978	1.972	-.160	-.397	6	.36
	(22.92)	(-1.97)	(-8.18)		
1979	1.568	-.341	-.760	4	.51
	(12.66)	(-2.97)	(-9.96)		
1980	1.856	-.050	-.514	5	.40
	(14.91)	(-0.57)	(-6.60)		
1981	2.115	-.153	-.531	4	.42
	(18.19)	(-1.68)	(-8.51)		
1982	2.349	-.078	-.210	7	.20
	(19.54)	(-.99)	(-2.96)		
1983	2.355	-.011	-.164	3	.13
	(23.65)	(-.16)	(-2.09)		
1984	2.620	.044	-.294	4	.20
	(21.99)	(0.60)	(-3.76)		
1985	2.617	-.069	-.294	4	.23
	(31.56)	(0.93)	(-4.19)		
1986	2.769	-.0.38	-.303	2	.20
	(23.95)	(-0.53)	(-2.25)		
1987	2.472	-.152	-.205	1	.12
	(24.68)	(-2.05)	(-2.35)		

Table 3.14 Dependent Variable: Price Dividends Ratio

Year	Constant	Leverage	Growth in book assets	Number of Industries	Adjusted R^2
1972	3.346	.051	.405	3	.06
	(33.01)	(0.61)	(2.87)		
1973	2.930	.029	.070	4	.14
	(26.35)	(0.30)	(.43)		
1974	2.794	.106	.329	5	.13
	(28.93)	(1.11)	(1.78)		
1975	2.851	-.130	.762	5	.12
	(37.04)	(-1.83)	(4.81)		
1976	2.812	-.113	.750	4	.16
	(26.29)	(-1.83)	(3.51)		
1977	3.042	-.090	.679	3	.11
	(28.11)	(0.77)	(2.66)		
1978	3.101	-.151	.626	2	.14
	(30.58)	(-1.79)	(3.41)		
1979	2.693	-.181	.603	1	.06
	(19.50)	(-1.38)	(3.16)		
1980	3.125	.121	.772	2	.14
	(31.39)	(1.75)	(4.27)		
1981	3.204	.058	.290	2	.05
	(24.72)	(0.75)	(2.02)		
1982	3.126	-.084	.739	5	.22
	(29.67)	(-1.11)	(3.17)		
1983	3.195	-.039	.554	3	.21
	(29.48)	(-0.54)	(3.50)		
1984	3.321	-.077	.660	5	.26
	(26.76)	(-1.05)	(4.25)		
1985	3.410	-.143	.326	4	.12
	(32.97)	(-2.01)	(2.05)		
1986	3.386	-.126	.759	4	.20
	(31.79)	(-1.77)	(5.61)		
1987	3.353	-.148	.414	0	.06
	(35.81)	(-1.84)	(4.16)		

APPENDIX IV

CORRELATION OF FORECASTING ERRORS WITH ERRORS IN SUBSEQUENT YEARS

Table 3.15 Correlations of forecasting errors using PB ratio with errors in subsequent years.

Base Year	Years after base year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1972	.83	.65	.57	.57	.47	.43	.35	.32	.30	.32	.30	.19	.16	.09	.35
1973	.68	.56	.45	.43	.39	.29	.26	.25	.29	.21	.27	.24	.10	.30	
1974	.73	.56	.48	.45	.35	.34	.32	.30	.26	.25	.20	.17	.33		
1975	.74	.63	.56	.41	.42	.38	.34	.30	.37	.31	.21	.26			
1976	.78	.69	.52	.52	.47	.46	.36	.40	.30	.19	.25				
1977	.80	.64	.57	.45	.45	.36	.38	.33	.21	.30					
1978	.76	.64	.51	.55	.45	.42	.35	.21	.34						
1979	.82	.71	.64	.51	.41	.34	.21	.35							
1980	.82	.66	.58	.49	.43	.31	.40								
1981	.74	.65	.51	.41	.31	.35									
1982	.72	.66	.51	.40	.47										
1983	.74	.65	.54	.64											
1984	.78	.68	.75												
1985	.75	.79													
1986	.93														
AVG	.77	.65	.55	.48	.42	.37	.33	.31	.29	.26	.25	.22	.19	.19	.35

Table 3.16 Correlations of forecasting errors using PE ratios with errors in subsequent years.

Base Year	Years after base year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1972	.76	.46	.36	.39	.33	.27	.23	.25	.17	.11	.18	.14	.14	.10	.15
1973	.61	.41	.35	.34	.32	.20	.29	.24	.19	.18	.24	.22	.13	.31	
1974	.63	.42	.42	.39	.27	.40	.28	.26	.22	.28	.29	.24	.42		
1975	.63	.51	.40	.26	.35	.27	.24	.15	.26	.24	.08	.24			
1976	.73	.43	.37	.29	.17	.25	.19	.15	.17	.18	.29				
1977	.68	.40	.43	.30	.34	.11	.21	.32	.19	.23					
1978	.60	.45	.33	.27	.12	.19	.20	.07	.20						
1979	.52	.36	.38	.37	.21	.17	.11	.08							
1980	.64	.39	.35	.33	.28	.17	.21								
1981	.60	.26	.36	.31	.24	.25									
1982	.52	.45	.43	.20	.20										
1983	.61	.43	.36	.26											
1984	.59	.39	.38												
1985	.68	.39													
1986	.61														
AVG	.64	.41	.38	.31	.26	.23	.22	.19	.20	.20	.22	.21	.23	.21	.15

Table 3.17 Correlations of forecasting errors using PD ratios with errors in subsequent years.

Base Year	Years after base year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1972	.78	.56	.52	.43	.37	.33	.29	.28	.26	.28	.25	.23	.06	-.11	.11
1973	.62	.53	.42	.41	.35	.28	.26	.23	.28	.15	.28	.11	-.11	.20	
1974	.63	.49	.41	.36	.30	.28	.21	.17	.15	.23	.17	-.04	.11		
1975	.72	.58	.51	.32	.36	.26	.28	.30	.32	.23	.05	.03			
1976	.78	.66	.52	.38	.43	.42	.46	.45	.29	.12	.16				
1977	.77	.56	.45	.37	.42	.38	.39	.21	.18	.11					
1978	.70	.52	.45	.51	.41	.41	.15	.13	.13						
1979	.68	.59	.57	.47	.45	.13	.20	.31							
1980	.66	.54	.48	.50	.21	.26	.20								
1981	.66	.52	.46	.24	.26	.14									
1982	.67	.68	.38	.36	.35										
1983	.70	.51	.50	.55											
1984	.64	.57	.58												
1985	.65	.64													
1986	.64														
AVG	.69	.57	.48	.41	.36	.29	.27	.26	.23	.19	.18	.08	.02	.04	.11

APPENDIX V

POOLED REGRESSION RESULTS

For the past two chapters we have implicitly assumed that our results for a period are independent of those before or after it. As it can been seen from the tables presented in appendix IV this is unlikely to be true; serial correlation of the residuals (from each company over time) will normally be high reducing the efficiency of our tests.

Thus, the regressions of the capitalization ratios were pooled over time as suggested by the econometrics literature. The estimated equations were of the form:

$$RATIO_j = CONSTANT + \sum_{i=1}^{18} INDUSTRY_{ij} + \sum_{y=1}^{15} YEAR_{yj} + GROWTH_j + DE_j + u_j$$

where INDUSTRY and YEAR are dummy variables for industry and year each observation j belongs to, and GROWTH and DE (leverage) are as previously defined.

The estimation procedure used was a variation of LSDV (least squares - dummy variables). In the general case, the errors in the pooled regression are assumed to be composed of a (constant) part due to cross-sectional effects (frequently referred to as unit effects), one due to time effects and a random (noise) component. The constant effects are captured by dummy variables (i.e. differing intercepts for each cross-section and time unit) but the slope coefficients of the variables for risk and growth are assumed to be constant over time and across industries. The dummy variables represent what Maddala (1977) calls 'specific ignorance,' in contrast to the general ignorance which is the random error. The difference is that industry dummies are used to capture cross sectional effects rather the more usual firm specific dummies. This was necessary in the context of our research whose aim is to value out of sample companies which would have been impossible if company specific dummies were used and in order not to reduce degrees of freedom.

The estimated equations were:

a)For the ratio of the market to book value of equity ratio:

$$\underset{(1.00)}{PB_t = 0.047} \; - \; \underset{(-19.27)}{0.256 * DE_t} \; + \; \underset{(10.86)}{0.542 * GBOOK_t} \; + \; e_t$$

Eleven industry dummies and fourteen period ones were significant at the 5% level and the adjusted R^2 was 0.51.

b)For the price earnings ratio:

$$PE_t - 2.306 \; - \; 0.223 * DE_t \; - \; 0.393 * GNET_t \; + \; e_t$$
$$\quad (59.29) \;\; (-13.87) \qquad (12.07)$$

Twelve industry and eleven period dummies were significant at the 5% level and the adjusted R^2 was 0.48.

c)For the price dividends ratio:

$$PD_t - 3.081 \; - \; 0.256 * DE_t + 0.542 * GBOOK_t \; + \; e_t$$
$$\quad (76.42) \;\; (-15.49) \quad (12.18)$$

Eleven industry dummies and thirteen period ones were significant at the 5% level and the adjusted R^2 was 0.38.

On the basis of the standard error of the regression it is impossible to judge whether the price earnings or the price dividends model performs best: the difference among them is less than 1%. Furthermore, if we assume company specific effects and use company specific dummies, than the RMSE reduces to a trivial number in all three cases (and the PB ratio has the smallest one) which confirms the existence of company effects.

CHAPTER 4

THE INFORMATION IN THE COMPONENTS OF EARNINGS

4.1 Introduction

The aim of this dissertation is to examine the usefulness of accounting data for the valuation of equity securities in a number of situations such as IPOs, MBOs and valuation of a company for tax purposes where the accounting data may be the only ones available (or on which a contract can be based). Previous chapters concentrated on univariate models of accounting variables and market capitalization. It was implicitly assumed that all components of the balance sheet or the profit and loss account were 'priced' at the same rate.

Under the assumption that accounting numbers are a proxy for the latent economic ones it is highly unlikely that all components of earnings will be capitalized at the same rate.

The first part of this chapter is devoted to reviewing the literature with specific emphasis on those models that attempt to find a relationship between accounting numbers and the capital market value of the firm. A discussion of the statistical problems that such studies face follows including empirical evidence which suggests that the Litzenberger Rao model that is widely used in empirical research, is likely to be misspecified.

In the second part a cross sectional regression methodology is used to examine the relative 'prices' of the components of net earnings after tax, whether accrual adjustments have an incremental information content in excess of operating cash flow data and the role of extraordinary items. The same methodology is also used to test the potential differential content of the balance sheet items.

It should be emphasized that these models attempt to identify which parts of the financial statements are used by investors to value companies so that one could value out of sample companies relative to the quoted ones. Implicit is the assumption that this relationship is constant across firms.

4.2 Literature Review

Given the undoubted importance of valuation models it is rather surprising to find that the bibliography in this area is rather sparse.

The most frequently used model is that of Litzenberger and Rao which in turn depends on the empirical model of Modigliani and Miller. Both were extensively described in the introductory chapter. Most of the papers in this area use different definitions of accounting earnings (e.g. operating profit, earnings before interest and taxes etc) and the researcher attempts to identify which is the one most 'related' to security prices. They differ from the tests we carried out in the previous two chapters because they use a more general valuation model than the simple ratio models that we used earlier.

Foster (1977) evaluated the relationship between three definitions of income for property liability companies (underwriting earnings (U), underwriting earnings plus investment earnings (i.e. realized capital gains / losses on equity stock these companies own) (U+I), and the sum of underwriting earnings plus investment earnings plus unrealized capital gains (U+I+C)) and their share prices. The Litzenberger-Rao valuation model was used for a sample of 22 firms for the period 1968-1972. In examining the degree of association of the three earnings measures with security prices, Foster employed economic criteria (i.e., which measure gives parameter values closest to their theoretical levels) and statistical ones (i.e., which measure results in the highest R^2). On both criteria U was the least informative measure of earnings, while the most comprehensive one (U+I+C) had the highest explanatory power.

Bowen (1981) used a sample of 107 US electric utilities, for the period 1962 to 1975, to determine whether income from operations and income from the allowance for funds used during construction (AFC) (i.e. including imputed interest on capital employed for the building of power stations) have the same per dollar value for investors. Bowen used the Litzenberger-Rao model modified to include separate earnings terms for operating income and AFC. A major advantage of Bowen's paper is the attention paid to testing the correct specification of the model. Using similar criteria to Foster (1977), Bowen concluded that although the AFC earnings coefficient was of the right sign and statistically significant, the AFC component of earnings is generally less valuable per dollar than earnings from operations.

Olsen (1985) used the Litzenberger Rao model to examine the information content of financial statements prepared using SFAS 33 (accounting for changing price levels) relative to those prepared using the historic cost convention i.e. whether they could explain a higher proportion of cross sectional price differences. He focused on electric utilities because of their homogeneity as an industry (similar production technology) and because of the common regulatory environment. It was argued that if current cost disclosures convey information about production costs that is not recognised when regulators set rates, then an association might be observed between share prices and current cost disclosures. Olsen paid particular attention to the issue of the variable used as a deflator to remove heteroscedasticity - an issue discussed in the next section. His result was that current cost disclosures did not have a significant incremental information content.

Similar to the Foster and Bowen papers is a paper by Barth, Beaver and Wolfson (1990) on the relationship between two components of earnings (profit from operations and securities gains and losses) and bank share prices. Earnings from operations arise from the bank's normal deposit and lending activities and as such are highly dependent on the level of interest rates (though they do not include unrealized gains or losses). Securities gains and losses arise from changes in the value of securities that the bank is trading on its own account; unless the bank's portfolio managers have superior portfolio management skills, this component of income can be viewed as non-recurring and therefore, its capitalization coefficient should be zero. A multiple regression model of market capitalization on earnings and securities gains and losses (with the book value of the bank's common equity used as weights) was run for 20 successive years. Their results were that the coefficient on earnings was positive and significant for all the years in the sample whereas that of the securities gains or losses variable changed sign and was not significant for any of the years.

Other studies that examined the effect of the components of earnings on security prices, albeit using a price reaction (returns) methodology, include Beaver and Dukes (1972) who examined the differential information content of historic cost profit and accrual adjustments and found that historic cost income was the 'most consistent with the information set used in setting security prices' and that earnings plus accrual adjustments are the 'least consistent'. Similar results are reported by Beaver, Griffin and Landsman (1982) and Beaver and

Landsman(1983). Jennings (1986), who performed the most comprehensive study, examined the relative and differential information content of seven components of ordinary earnings (revenue, cost of good sold, interest expense, current tax expense, deferred tax, depreciation and other expenses) and found that there is evidence that all components of earnings except current tax contribute to the information content of earnings. Furthermore, over the sample period, all components reject the hypothesis of being capitalized at the same rate as (aggregate) earnings.

Finally, Lipe (1986) used time series data to test indirectly for relative and differential information of six components of accounting income (gross profit, general and administrative expense, depreciation, interest expense, tax payments and other items). Lipe estimated a time-series regression for eighty-one firms over thirty-four years. His dependent variable was abnormal returns estimates as the residuals from an annual market model regression. As independent variables he used the 'surprise' in each of the six components of earnings which is measured as the residual from a Vector Auto-Regression (AR1) model. His tests rejected both the hypothesis of no relative information content (regression coefficients equal to 0) and the hypothesis of no differential information (all coefficients equal). Underlying Lipe's work is the assumption that the relationship between returns and components of income is constant over a long period of time.

Implicitly, or explicitly, all these studies assume that the accounting measurement process gives a forecast of future cash-flows which are the determinant of security prices. All studies assume a linear pricing relationship.

A number of recent studies have also looked to valuation issues using information from the balance sheet.

Feldstein and Morck (1983) examined whether share prices fully reflect unfunded pension obligations (which affect the real net value of a company's assets). They attempted to specify the firm's ratio of market capitalization to book value of assets as a function of the ratio of earnings to book value of assets, earnings growth, beta, book leverage (but excluding unfunded pension liabilities from the definition of debt), R&D expenditure and unfunded pension liabilities both as a percentage of book value of assets. They concluded that market capitalization correlates more closely with pension obligations when those obligations are valued at an average rate rather than the rate used by the firms themselves. Furthermore, this rate was significantly below the long term money market rate which, according to Feldstein and Morck, suggests that firms overestimate pension liabilities.

Beaver, Eger, Ryan and Wolfson (1989) and Barth, Beaver and Stinson (1991) examined the effect of supplemental disclosures (ones which are voluntarily made or required by regulators but not by financial reporting standards) on bank and thrift[1] share prices respectively. These disclosures referred to non-performing assets (i.e. bad debts). Both papers employed the model of differences where the market value of a firm's equity is modelled as a function of the book value of equity plus the difference between the market and book value of loan assets; in the estimated equation separate terms are included for loan losses, non-performing loans and fixed-interest-rate loans maturing in more than one year. Both studies conclude that non-performing loans exhibit an

[1] Thrifts are US financial institutions which differ from banks in that a larger portion of their assets is in mortgages and are supervised by the US Federal Home Loan Bank Board.

expected significant negative relationship with market capitalization. Beaver et al also found that conditional on the reported level of non-performing loans, allowances for bad debts have positive association with market capitalization.

4.3 Econometric Problems in Cross Sectional Valuation Research

The rather thin valuation literature can perhaps be explained by the serious statistical problems facing the researcher in this field. Recently, there has been considerable discussion on the econometric problems faced by capital markets research in accounting. Christie (1987) discusses the economic models underlying cross sectional research in accounting where the dependent variable is either the level of security prices or returns. He argues that the two models are equivalent and therefore choosing between them is only a matter of which approach is 'better' on econometric grounds. However, this argument ignores those cases, such as IPOs and valuation for tax purposes, that we discussed in chapter 1 where the actual value of the company is what is required. In these cases it is an issue for empirical investigation how serious these statistical problems are.

The possible econometric problems facing levels research are:

a) Heteroscedasticity and the problem of choosing an appropriate deflator,

b) Multicollinearity,

c) Measurement error, and,

e) The correct functional specification.

These will now be examined in turn. There are also a number of other small problems such as cross sectional dependencies in market capitalization (for which we have tried to correct using industry dummies where possible) and the fact that, when estimated over consecutive periods, the coefficients vary a lot in comparison to the estimated standard errors[2]. These are unlikely to be affecting the tenor of the results presented here because we are conducting a cross sectional study but would matter if we wanted to predict future prices using current accounting data.

4.3.1 Heteroscedasticity

Using OLS to estimate equations where financial variables enter in levels terms (i.e. measured in pounds) is inefficient because the variance of errors is not constant over the sample (i.e. errors are heteroscedastic). The estimates of the variances are also biased, thus invalidating tests of significance.

The usual correction in these cases is to assume a functional form for the variance of the error term and then deflate (weight) both the dependent and the independent variables with a size variable. However, as Christie points out, there is no natural deflator in valuation models and deflation by any variable which is not a function of the independent variables can generate specification errors. This is a well known criticism and was first articulated by Kuh and Meyer (1955). From this Christie appears to conclude that market reaction type of studies are methodologically superior because they have a natural deflator (the market price in the previous period). This argument however, is refuted by Landsman and Magliolo (1988) who argue that:

> the issue of appropriateness of econometric specification (levels versus changes) is unresolvable given the current state of capital market research, suggesting that biases for or against either methodology are

[2] This problem is important when one attempts to forecast future prices conditional on accounting data whereas we are conducting a cross-sectional study. Furthermore, there is no reason why the 'capitalization' coefficients of earnings, dividends etc should be constant over time.

unwarranted.

Most of the valuation studies described in the previous section use the book value of assets or equity as a deflator. However, there is no reason to assume that the variance of the error term will be a multiple of the square of book value; unless this is the case, weighting will introduce spurious correlation which might have the effect of less efficient estimates than using simple OLS (Kuh and Welsh, 1955). One alternative is to use the dependent variable (earnings, dividends etc) as the deflator which is what the ratio models used in the previous two chapters do.

Another approach is to use White's consistent covariance matrix which is the approach adopted in this dissertation[3]. This results in consistent t-statistics (as well as any other statistics derived from the covariance matrix) which means that the tests for differential information content are valid. However, the usual measures of fit (R^2 and RMSE) are misleading because OLS (and NLS) parameters are estimated in such a way as to minimize the sum of squares (or, alternatively, maximize the R^2). Therefore, comparisons of the forecasting power

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[3] White's consistent covariance estimator may be briefly summarized as follows. For the linear model:

$$Y_i - x_i \times \beta + e_i$$

where (x ,e) is a sequence of independent but not (necessarily) identically distributed vectors which satisfy E(x . e)=0 and β is the coefficient vector which we want to estimate. Assuming that the (X'X/n) matrix (where X is the observation matrix) is non-singular and finite, White has proved that the variance estimator:

$$Var(\beta)-(X'.X/n)^{-}1.\sum[e_i^2.(x_i'.x]/n.(X'.X/n)^{-1}$$

is consistent.

It should be emphasized, that in the presence of heteroscedasticity, the estimators of the coefficients are still unbiased and consistent but inefficient.

Furthermore, the estimates of the variances are also biased, thus invalidating the tests of significance and it is for this effect that White's estimator compensates for.

of these models with that for the univariate ones are merely indicative.

4.3.2 Multicollinearity

Some of the components of earnings are likely to be a function of other components; for example, taxes are, in general, a function of operating profit (minus interest expenses).

This is a potential cause of multicollinearity whose effect is that the estimated coefficients are unbiased but inefficient[4]. The usual effect of multicollinearity is that it is difficult to disentangle the influence of individual independent variables. If the coefficients are inefficient, the power of the differential information tests is low. Also, if there is a very serious multicollinearity problem with the data used, the estimated coefficients may have unexpected signs and their magnitude will be unstable. This problem arises because no explicit specification can be made of the relationship between the explanatory variables. The Belsley, Kuh and Welsch (1980) criterion was used in testing the specification of every equation estimated to identify which variables have the biggest problem with collinearity. Tests for differential information content are qualified where appropriate. Nevertheless, the problem of multicollinearity doesn't alter the power of the conclusion that disaggregating earnings increases the efficiency of the forecasting rules. However, there is no easy way around this problem it can only be noted as a potential problem.

[4] It should be emphasized that unless we have perfect multicollinearity, this is a computational problem only.

4.3.3 Measurement Error

As it has already been said in previous chapters, our aim is to value companies using accounting data. Measurement error is thus unlikely to be a problem (excluding data-entry errors in the databases we are using) except in the case of non-systematic application of the accounting measurement rules.

If accounting earnings and measures of asset and liability value were used because they represent latent economic variables, these would have been measured with error (assuming that they can be measured at all). Measurement error in the independent variables can be a problem if the error component is correlated with the other independent variables or the dependent one. The result in this case is that the estimators of the coefficients will be biased. However, because usually there is no information on the size of the error in each observation nothing can be done to correct for its effects except by making strong assumptions.

4.3.4 Functional Specification

A fundamental problem for all valuation studies is that there is no theory explaining the relationship of accounting earnings with the stream of future cash flows to investors. Thus, in practice, a linear model between a firm's value and earnings, risk and growth prospects is estimated. Usually, this is the Litzenberger and Rao[5] model which is derived as a theoretical relationship between a firm's market capitalization and its earnings and risk[6].

Results presented in chapter 2, on the form of the functional relationship

[5] For an extensive discussion of this model see section 1.3, chapter 1.

[6] Though there is also an adjustment for growth, it is largely ad hoc.

between market capitalization and earnings, book value of equity etc suggest that the linear relationship is unlikely to be correct. We decided therefore, to test the linearity assumption of the model that is most frequently used in valuation studies (Litzenberger and Rao (1971)). In order to examine the linearity or not of the model we applied the Box-Cox transformation test on the structural equation (i.e., the theoretical relationship between earnings and market value) of the model:

$$P_i^* = \gamma_1 \bar{E}_i + \gamma_2 S_{E_i} + \gamma_3 \Delta B_i \frac{(\pi_i - R)}{R(1+R)} + U_i$$

In brief the variables used are: E_i which is a weighted average of earnings for periods t-1, t and t+1, π_i the firm's expected rate of return on book value, S_{Ei} which is the standard deviation of earnings to equity, R which is the industry average required rate of return on equity, B_i is the firm's book value and U_i a random disturbance term. In our tests, there was only one difference from the Litzenberger-Rao tests: A four year horizon was used to estimate change in the book value of assets and the standard deviation in the firm's rate of return but this is highly unlikely to be biasing the results. Also, we left R as a parameter to be estimated rather than an exogenous variable. The results were that for all the fourteen years tested the log-transformation of value was necessary (for British data).

A potential criticism of the above results is that the structural equation is likely to be heteroscedastic and therefore, the estimation procedure will favour the log-transformation. The test was therefore recast in terms of the equation used in the empirical tests in Litzenberger and Rao's and Foster's papers:

$$\frac{P_i^*}{B_i} = \gamma_1 \pi_i + \gamma_2 S_{B_i} + \gamma_3 g_{\pi_i} \frac{(\pi_i - R)}{R(1+R)} + u_i$$

The basic difference of the two equations is that all variables have been weighted by the book value of assets to achieve homoscedasticity; thus, most of the variables are as defined for the structural equation above except g_{Bi} which measures the rate of growth of book value. For this equation the value of λ (i.e., the power transformation that must be applied on the dependent variable) that maximized the log likelihood function was in the range -0.2 to 0.4.

These results seem to suggest that Christie's criticism of the imposed linearity in the relationship is likely to be correct and cast doubt on the validity of the results of the papers discussed in the literature review section. Strictly speaking, this results suggest that the relationship is trans-log. Nevertheless, we will be using a simple cross sectional non-linear (logarithmic) regression model is used which satisfies the statistical tests outlined above: when applying the Box-Cox test on our model, we found an average λ of .08 (over the 16 years in the sample) and an average μ (power transformation of the earnings terms) of slightly less than .08 which suggest that deviations of our model from the log-linear case are trivial.

In addition to the question of the mathematical form of the equation to be estimated should have, another issue is whether all relevant variables are included in the model. In the results presented in the following sections, we include variables to control for risk (as proxied by leverage) and growth (proxied by the growth in the firm's profits over the year in accordance with the arguments advanced in the previous chapter). Industry dummies are not included initially because previous results have shown that they are of small economic significance[7]. Other variables that have been used in previous valuation studies include dividend payout policy, and the vintage of the firm's assets etc but it is unclear, a priori, what their effects are likely to be and their use is highly ad hoc.

4.4 Decomposing Ordinary Earnings

FASB has argued that '.. the individual items, subtotals, or other parts of a financial statement may often be more useful than the aggregate to those who make investment, credit, and similar decisions'. Ross (1988) argued that ' .. we know from the no arbitrage analysis that the value of the firm's income is a function not only of the total cash flow but also of the form in which it comes packaged, including depreciation offsets, capital gains, and so on ..'. Ross further argues that this is motivated by firms rational decisions aiming to minimize their tax burden.

It is therefore interesting to examine whether additional information, increasing the efficiency of the valuation rules, can be gained by decomposing net profit to its determining parts. This process can go on to assign a per unit 'price' to every component of earnings down to the level of individual transactions. As an empirical matter such a disaggregation is impossible because of the dis-economies of scale involved in analyzing such a huge volume of information and therefore it is highly unlikely that any improvement in the efficiency of the estimates of value will result. But if, as the FASB claims, the marginal user of accounting data has different aggregation rules of the subtotals which compose profits from those adopted by the accountants (i.e. all parts equally weighted),

[7] Furthermore, they do complicate the estimation process considerably.

using different weights or 'prices' for the components of earnings will reduce the forecasting error.

From the start it should be acknowledged that the decision on how many and which different components of earnings to use will affect the results. The criteria used here are mainly data availability, grouping of the available items to subtotals of similar risk and capital cost characteristics (or temporary versus transitory components), acceptability by the investment community and parsimony of the estimation process. Thus, we split net earnings to gross profit including exceptional charges[8], depreciation, other income, net interest expense, and tax expense including prior year tax adjustments[9].

Since the Litzenberger Rao model suffers from the specification problems analyzed in the previous section, an empirical model derived from the results presented in the previous chapter was used.

The equation estimated was:

$$\begin{aligned} MCAP_i = \log(\beta_1 * GROSS_i + \beta_2 * DEPR_i + \beta_3 * OTHINC_i + \beta_4 * NINT_i + \beta_5 * TAX_i) \\ + \beta_6 * DE_i + \beta_7 * GNET_1 + e_i \end{aligned} \tag{3}$$

where MCAP is market capitalization, GROSS is gross profit, DEPR is depreciation, OTHINC is other income, NINT net interest, and TAX is all tax

[8] Ideally, one would want to decompose gross profit, as defined, to sales minus cost of goods sold, and other expenses. However, very few firms prior to the Companies Act 1985 used to report cost of goods sold data.

[9] Initially, we also included in the tests the item 'other claims' which was defined as the sum of minority shares and preference dividends both of which are small items compared to profit from ordinary activities. However, its inclusion had trivial effects on the explanatory power of the model and the coefficient did not always have the expected sign and therefore this variable was dropped.

expenses including prior year adjustments[10]. The sign convention for the earnings components variables is that an increase in any of them implies an increase in ordinary profits (taxes enter the equation as a negative amount) and therefore the estimated coefficients should be positive.

As suggested by the results in the previous chapter the log-transformed leverage ratio, DE, is used as a proxy for (financial) risk differentials. It is unlikely that there is high correlation between net interest payments which enter the equation as a component of earnings and are flow variable and leverage which reflects the stock of debt and includes such as zero coupon debt and preferred stock and therefore is likely to give a different view of future debt repayment costs. Growth in earnings, GNET, is measured as growth in earnings over the past year which affects the results because of the time series properties of earnings. There is no constant term in the regression because it was found that it makes the estimation procedure converge to economically implausible solutions. An intuitive description of the specification we employ here, is that it is a simple transformation of the PE ratio, like the one used in the previous chapter's tests, but with the subtotals of earnings weighted at market determined rates instead of equal weights.

It is difficult to make any hypotheses about the relative size of the coefficients without a theoretical model. The size of the coefficients will depend on both the perceived permanence of the components and the rate ('cost of capital') at which each is capitalized. Thus, gross profit should have a higher coefficient than interest charges or tax payments because it is a component of high permanence.

[10] In terms of micro EXSTAT variables these are defined as: GROSS = #62+#59, DEPR = -#59, OTHINC = #64+#65, INT = #63 - #66 -#67 - #68 - #69, TAX=- (#70 + #71 + #72 + #73 + #74 + #75).

However, this approach is largely arbitrary because various such scenarios can be constructed with no ex ante arguments to distinguish among them. The other approach is to assume that the components of earnings represent cash flows accruing to various providers of capital and thus the respective capitalization coefficients will depend on the relative cost of capital. Under this argument, gross profit should be capitalized at some function of the weighted average cost of capital and net interest payments at a function of the cost of debt which would normally be lower and therefore, the coefficient on interest payments should be higher than on gross profit. Even under this argument, it is not clear what will be the size of the coefficient on tax payments for which it can be argued that they either are a cost borne by the equity holders (which implies a small coefficient) or that their level is determined by a mixture of effects because of items such as depreciation and debt tax shields (which would imply a coefficient near that of GROSS earnings)[11]. Under both arguments about the expected size of the coefficients, other items should have a capitalization coefficient which is not significantly different from 0 because they are composed of highly transitory items such as exchange gains / losses.

The coefficient on leverage, which is a proxy for the firm's risk, will have a negative relationship with market capitalization as will growth in earnings over the past year due to the negative serial correlation of earnings[12].

To examine whether FASB's argument that the components of earnings have incremental information content over the aggregate income figure is right we test

[11] This can be tested if we estimate equation 3, after apportioning the tax to the components and leaving a residual tax. However, this was found to affect neither the size of the forecasting error nor the relative size of the coefficients.

[12] For an extensive discussion of these issues see chapter 3.

two hypotheses.

The first one is the 'no relative information' hypothesis that the components of earnings have no information content individually and can be specified as:

$$H_0: \beta_i = 0 \quad \forall i$$

i.e. that the estimated coefficients on the disaggregated components will not be different from 0. Of course, it is unlikely that every component will have a coefficient which is not statistically significant given the well documented information content of earnings but the tests will show whether some components might be redundant information.

The other hypothesis of no differential information suggests that all components will have the same coefficient and is equivalent to the accountant's income measurement rule under which all components of earnings receive equal weight. In mathematical notation it is:

$$H_0: \beta_i = \beta_j \quad \forall i,j, i \neq j$$

As we have already said, with the exception of leverage and earnings growth, all other coefficients should be positive.

Results of the estimation procedure are presented in table 4.1 where the reported t-statistics were obtained using White's consistent covariance matrix estimator. Multicollinearity diagnostics suggested that the estimated equation may be collinear (ie. the Belshley, Kuh and Meyer 'condition' number was higher than 30) only for two periods (1972 and 1974). Initially we thought this result counter-intuitive given the supposedly well known relationship between earnings before tax and tax payments; however, the ratio of tax payable to earnings before tax exhibits very high standard deviation and its mean is not particularly close to

YEAR	GROSS	DEPR	OTHINC	NINT	TAX	DE	GNET	R^2
1972	8.261	7.200	10.600	8.178	7.348	-.191	-.175	.92
	(7.92)	(4.08)	(5.70)	(7.90)	(5.13)	(-2.29)	(-1.94)	
1973	4.774	5.137	5.920	3.983	4.754	-.257	-.367	.90
	(5.40)	(4.32)	(5.10)	(3.97)	(3.41)	(-1.72)	(-3.83)	
1974	3.630	3.560	4.001	3.624	2.797	-.199	-.489	.92
	(6.47)	(5.60)	(5.63)	(6.46)	(3.13)	(-1.36)	(-7.37)	
1975	3.499	2.469	3.578	2.915	2.058	-.387	-.277	.94
	(4.83)	(2.90)	(4.00)	(3.62)	(1.77)	(-2.77)	(-5.93)	
1976	2.903	2.063	2.973	2.259	1.199	-.370	-.227	.93
	(4.09)	(2.42)	(3.53)	(2.74)	(1.08)	(-2.70)	(-4.05)	
1977	3.606	3.354	3.601	2.439	1.619	-.288	-.198	.93
	(6.88)	(6.18)	(4.47)	(3.20)	(2.11)	(-2.52)	(-3.61)	
1978	3.829	3.176	4.822	2.675	2.053	-.385	-.213	.94
	(8.38)	(4.34)	(5.63)	(3.88)	(3.19)	(-3.85)	(-5.23)	
1979	2.767	2.131	3.401	2.337	1.430	-.514	-.248	.93
	(7.73)	(3.48)	(5.69)	(4.63)	(3.13)	(-4.07)	(-4.00)	
1980	4.052	2.947	6.392	3.334	3.468	-.256	-.204	.90
	(7.06)	(3.13)	(6.90)	(4.94)	(5.10)	(-2.17)	(-2.84)	
1981	4.437	3.391	6.232	3.964	4.026	-.421	-.188	.92
	(7.52)	(4.21)	(7.41)	(5.57)	(5.36)	(-3.22)	(-3.90)	
1982	6.191	4.740	5.487	5.484	3.910	-.233	-.064	.92
	(8.18)	(4.60)	(5.79)	(6.33)	(3.31)	(-2.38)	(-1.04)	
1983	7.946	6.517	8.515	7.736	6.579	-.140	-.040	.92
	(8.83)	(4.90)	(6.01)	(5.85)	(4.12)	(-1.61)	(-.72)	
1984	8.688	7.255	9.880	8.626	7.697	-.128	-.127	.89
	(8.75)	(5.73)	(6.86)	(7.26)	(5.13)	(-1.19)	(-2.13)	
1985	10.445	9.873	11.763	9.181	9.188	-.121	-.143	.92
	(10.07)	(7.87)	(7.31)	(6.33)	(4.37)	(-1.41)	(-2.83)	
1986	12.014	11.317	13.198	9.396	9.405	-.147	-.254	.92
	(8.02)	(6.01)	(6.01)	(3.98)	(2.03)	(-2.08)	(-2.53)	
1987	8.514	5.307	10.947	9.466	8.494	-.275	-.102	.94
	(8.14)	(4.42)	(7.65)	(4.34)	(3.22)	(-3.51)	(-1.27)	
AVG	5.972	5.027	6.957	5.350	4.752	-.270	-.207	
	(7.39)	(4.64)	(5.86)	(5.06)	(3.48)	(-2.43)	(-3.33)	

the corporate tax rate. This can be explained by the different practices used by the Inland Revenue and accountants to estimate earnings (depreciation in particular).

Disaggregating earnings leads to an average decrease in the root mean square error compared with a simple regression of market capitalization on earnings, leverage and earnings growth of more than 5% on average though for one period the root mean square error was actually slightly smaller using the aggregate figure. This result suggests that the components of earnings are likely to have incremental information content.

In addition, all coefficients have the expected sign and the coefficients of the components of earnings are different from 0 in a statistically significant way[13]. This leads us to reject the hypothesis of no relative information content.

Furthermore, the coefficients on the main earnings components (gross profit, interest payments, tax expenses) move in the same direction over time and their relative size is consistent over time. Using Kendall's coefficient of concordance test we found that the hypothesis that the ranking of all the coefficients on the components of earnings by size is the same over time cannot be rejected at the 1% level. It is interesting to note though, that the coefficient of OTHINC is consistently higher than the other ones, contrary to our expectations, and consistent with the results of Livnat and Zarowin (1990). Nevertheless, the forecasting performance of this model slightly underperforms that of a simple regression (a much less expensive exercise in terms of computing resources) of

[13] At the bottom line of table 4.1, and all subsequent tables in this chapter, we present the average of the coefficients over the years in the sample. These averages have no statistical or economic interpretation (especially given the big variation of the coefficients over time) but are presented in order to give the reader an idea about the relative size of these coefficients.

market capitalization on earnings, leverage and earnings growth which includes adjustments for industry effects. This led us to re-estimate equation 3 but we allowed industry specific capitalization coefficients for GROSS which is, at least in numerical terms, the most important determinant of accounting earnings. Furthermore, OTHINC was added to GROSS and INT to TAX (for a justification of this, see discussion on differential information content below where it is argued that the coefficients of these components are not different in a statistically significant sense[14]). This was found to decrease on average the RMSE by more than 10% when compared to a simple regression using aggregate earnings or more than 5% when the regression includes industry dummies. The estimated coefficients on the other variables were of the expected sign and magnitude.

The second hypothesis we wanted to test was whether the components of earnings have differential information content. To test, we employed a two step procedure: First, we tested whether all coefficients of the components are equal to each other and to that of aggregate earnings in a multiple regression of earnings, growth in earnings and leverage on market capitalization. In this case, as in the pairwise comparisons subsequently, we used the Wald test which is chi square distributed. In comparison to the likelihood test it is less likely to reject the null. However, the null hypothesis of no differential information was not rejected at the 1% level for all the years in the sample.

The second test involved setting up pairwise comparisons between the coefficients of various components. Though some of the results vary considerably

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[14] The reason for this operation was that we wanted to preserve as many degrees of freedom as possible.

over time, we found that the coefficients on the pairs interest and tax and operating profit and other income were not different in a statistically significant way for most of the years. Furthermore, the size of the coefficient on depreciation was between the groups though more frequently, not different from the coefficient of net interest. These results seem to suggest that, for valuation purposes the most parsimonious description of accounting earnings is that they are composed from four components: income from operations (GROSS plus OTHINC), financial costs (INT plus TAX) and depreciation which may also be included with the financial costs.

Financial analysts, when computing earning per share are concerned to include only profits arising from 'ordinary activities of the business'. For this reason, exceptional and extraordinary items pose particular problems.

Exceptional items, according to the Accounting Standards Committee, are 'material items which derive from events or transactions that fall within the ordinary activities of the company, and which need to be disclosed separately by virtue of their size or incidence if the financial statements are to give a true and fair view' (ASC, 1986). Exceptional items should be taken into account when computing net profit (though many analysts and EXTEL do not) and therefore, their coefficient should be significant. However, by definition, exceptional items should have a smaller coefficient than operating profit because they are non-recurring. Using data for the period 1980-1987 for which we can separate the exceptional items from the other components we re-estimated equation 3 adding a term for exceptional items. The estimated equation therefore was:

$$MCAP_i = \log(\beta_1 * GROSS_i + \beta_2 * DEPR_i + \beta_3 * OTHINC_i + \beta_4 * NINT_i + \beta_5 * TAX_i + \beta_6 * EXCEP_i) + \beta_7 * DE_i + \beta_8 * GNET_i + e_i \qquad (6)$$

where MCAP is market capitalization, GROSS is gross profit adjusted for exceptional items, DEPR is depreciation, OTHINC is other income, NINT net interest, TAX is all tax expenses excluding prior year adjustments[15] and EXCEP is exceptional charges plus 'exceptional' tax.

The results which are presented in table 4.2, confirm that exceptional items are a significant explanatory variable but the relationship between the coefficients on exceptional items and operating profit is not constant over time. Nevertheless, separating exceptional items reduces the root mean square error by 3%.

In contrast to exceptional items, are extraordinary items which according to accounting rules are the product of economic events that are both non-recurring and outside the firm's normal activities[16] and are not taken into account when computing net earnings. Interestingly, extraordinary items have to be immediately (in the year incurred) written off through the profit and loss account.

The recognition and recording of extraordinary items in the financial statements and especially what distinguishes them from exceptional items is governed by relatively 'soft' rules. It has therefore been suggested in the literature that managers, as insiders in the firm, use these items to signal to investors their beliefs about the firm's value. The managers may be employing classification

[15] In terms of micro EXSTAT variables these are defined as: GROSS = #62+#59+#60+#61, DEPRECIATION = -#59, OTHINC = #64+#65, INT = #63-#66-#67-#68-#69, TAX=-(#71+#72+#73+#74) and EXCEPTIONAL= -(#60+#61+#70+#75). Note that the definitions of GROSS and TAX have changed from the tests of the component of earnings.

[16] The definition of extraordinary items changed twice in recent years: in 1973 with the publication of SSAP6 and in 1986 with an amended version of the standard. The changes were prompted by the ASC's unhappiness with managers' discretion on the definition of extraordinary items. Under SSAP6 examples of extraordinary items include such events as the sale or abandonment of a significant part of the business, write downs of receivables and inventories etc.

Table 4.2 Estimation results for the period 1980 to 1987 for the effects of the components of earnings on market capitalization after adjusting for exceptional items (t-statistics in parenthesis).

YEAR	GROSS	DEPR	EXCEP	OTHINC	NINT	TAX	DE	GNET	R^2
1980	4.261	3.212	5.974	3.570	2.656	0.394	-.256	-.075	.92
	(7.37)	(4.12)	(6.69)	(5.30)	(3.15)	(1.15)	(-2.31)	(-1.43)	
1981	4.213	3.292	5.984	3.530	3.267	4.872	-.397	-.196	.92
	(6.75)	(3.37)	(7.17)	(5.11)	(4.26)	(5.24)	(-3.17)	(-4.29)	
1982	6.487	5.101	6.689	6.274	4.541	3.184	-.210	-.042	.92
	(7.78)	(4.65)	(6.39)	(6.53)	(3.44)	(1.98)	(-2.07)	(-.64)	
1983	7.610	6.197	7.941	7.390	6.001	9.091	-.157	-.038	.92
	(9.01)	(4.90)	(6.62)	(5.79)	(4.18)	(3.62)	(-1.82)	(-.70)	
1984	8.759	7.716	9.139	8.286	8.048	9.160	-.153	-.083	.89
	(8.54)	(5.58)	(6.58)	(6.76)	(4.88)	(3.01)	(-1.38)	(-1.43)	
1985	11.281	10.891	11.467	9.641	10.699	7.498	-.108	-.152	.92
	(10.80)	(8.59)	(8.43)	(6.73)	(5.13)	(2.89)	(-1.31)	(-3.01)	
1986	12.954	11.443	14.863	11.366	14.396	12.883	-.152	-.153	.93
	(9.38)	(6.70)	(8.07)	(5.02)	(4.42)	(2.76)	(-2.12)	(-2.07)	
1987	8.234	5.403	10.740	9.082	7.316	7.383	-.268	-.080	.94
	(6.91)	(4.16)	(6.93)	(3.94)	(2.49)	(3.78)	(-3.36)	(-.97)	
AVG	7.975	6.657	9.100	7.392	7.116	6.808	-.213	-.102	
	(8.32)	(5.26)	(7.11)	(5.65)	(3.99)	(3.06)	(-2.19)	(-1.817)	

smoothing as the most cost effective means to signal their view as insiders of the true value of the firm[17].

Thus it is interesting to examine whether changes in profits are correlated with changes in extraordinary items. If income smoothing is taking place, it is expected that decreases in earnings result in increased extraordinary items. To test this the rank correlation between changes in net profits and extraordinary items (both weighted by the previous period's ordinary profits) was examined. Our results suggest that there is weak evidence that profits behave as if income smoothing is taking place. To be more precise, for the 16 years in the sample the correlation coefficient was statistically significant at the 10% level for 8 years but it also it was positive (contrary to the hypothesized relationship) for 4 out of the 16 years of which 2 were significant.

The positive correlations observed are consistent with the argument that the events that determine extraordinary items also affect ordinary income; e.g. a fire that destroys the inventory (which is an event that has to be reported as an extraordinary item) reduces profits because orders cannot be filled. Thus, extraordinary items are important because they provide information about the transitory component in the firm's earnings though it is unclear at what rate they should be capitalized (a non zero rate nevertheless). An alternative view is that of the ASC in SSAP6 which implies that extraordinary items have no explanatory power because they have no relevance to future cash flows and therefore they should be capitalized at a zero rate.

To test whether extraordinary items are priced and if so, whether at the same

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[17] Management can smooth profits in many ways including the timing of an event's occurrence and/or the timing of its recognition, by changing the allocation rules and finally through the classification of items in different parts of the income statement.

rate as components of net profits the equation:

$$MCAP_i = \log(\beta_1 * GROSS_i + \beta_2 * DEPR + \beta_3 * FIN_i + \beta_4 * EXTRA_i) + \beta_5 * DE_i + \beta_6 * GNET_i + e_i \qquad (7)$$

was estimated. MCAP is market capitalization, GROSS is operating profits plus depreciation plus other income, DEPR is depreciation, FIN is the sum of net interest payments and tax and EXTRA is extraordinary items for firm i. The sign convention is that increases in any of the components mean increased profits and therefore all component coefficients are expected to be positive. A log-linear specification was used in accordance with the results previously presented. The non-linear estimation results which are presented in table 4.3 show that extraordinary items have no explanatory power on the cross sectional variation in the market value of firm's since they are a significant variable for only one period. This is consistent with extraordinary items having no relationship with the future cash flows of the firm.

4.5 The Accrual Adjustment in Accounting Earnings

The generally accepted paradigm of finance is that the value of the firm equals the PV of expected future cash flows. As we saw in chapter 2, within the context of accrual accounting we can define various measures of profitability which are competing proxies for this latent fundamental variable. The justification of using accruals data is given by FASB which argues:

> Information about enterprise earnings based on accrual accounting generally provides a better indication of an enterprise's present and continuing ability to generate cash flows than information limited to the financial aspects of cash receipts and payments.

However, if investors are looking at statistics of expected future cash flows, it is

Table 4.3 Estimation results for the effects of extraordinary items on market capitalization (t-statistics in parenthesis).

YEAR	GROSS	DEPR	FIN	EXTRA	DE	GNET	R^2
1972	8.990	7.827	8.889	1.515	-.197	-.194	.92
	(9.93)	(4.68)	(9.80)	(0.95)	(-2.65)	(-2.17)	
1973	4.155	4.259	3.510	0.268	-.299	-.342	.90
	(5.60)	(3.95)	(3.49)	(1.59)	(-2.15)	(-3.60)	
1974	4.343	4.249	4.222	-0.027	-.208	-.489	.92
	(8.72)	(7.68)	(7.62)	(-0.08)	(-1.31)	(-7.32)	
1975	4.125	3.054	3.354	0.221	-.387	-.298	.94
	(6.44)	(4.10)	(4.40)	(0.66)	(-2.51)	(-6.84)	
1976	3.811	3.039	2.937	0.169	-.348	-.258	.93
	(6.09)	(4.03)	(3.75)	(0.81)	(-2.37)	(-4.94)	
1977	3.897	3.686	2.361	-0.307	-.286	-.223	.93
	(7.21)	(6.62)	(3.21)	(-0.88)	(-2.33)	(-4.31)	
1978	3.861	3.136	2.310	0.234	-.421	-.230	.94
	(8.63)	(4.60)	(3.73)	(0.49)	(-4.36)	(-5.70)	
1979	2.873	2.310	2.089	-0.100	-.572	-.231	.92
	(7.22)	(3.74)	(4.10)	(-0.22)	(-4.48)	(-3.49)	
1980	3.576	2.634	2.043	0.490	-.347	-.117	.91
	(7.84)	(3.20)	(4.16)	(2.88)	(-3.26)	(-2.32)	
1981	4.289	3.313	3.386	0.365	-.468	-.166	.92
	(8.11)	(4.61)	(5.85)	(1.66)	(-3.87)	(-4.00)	
1982	6.805	5.666	5.727	-0.035	-.234	-.078	.92
	(8.63)	(5.45)	(6.07)	(-0.10)	(-2.21)	(-1.23)	
1983	8.141	7.590	7.021	-0.839	-.193	-.060	.92
	(9.22)	(6.22)	(5.83)	(-1.54)	(-2.20)	(-1.13)	
1984	8.527	7.781	7.620	-0.617	-.206	-.102	.90
	(9.00)	(6.76)	(6.67)	(-0.91)	(-1.85)	(-1.80)	
1985	10.301	9.729	8.879	0.034	-.163	-.147	.92
	(10.72)	(8.47)	(6.07)	(0.21)	(-1.70)	(-2.99)	
1986	11.858	10.826	9.116	0.713	-.166	-.267	.92
	(10.38)	(5.77)	(4.31)	(0.88)	(-2.21)	(-2.41)	
1987	8.714	5.596	8.976	0.049	-.325	-.112	.94
	(8.59)	(5.01)	(3.87)	(0.08)	(-4.30)	(-1.44)	
AVG	6.142	5.293	5.153	0.133	-.301	-.207	
	(8.27)	(5.30)	(5.18)	(0.40)	(-2.73)	(-3.48)	

possible that a cash-flows based measure of profitability will be more useful for valuation purposes because, as it is argued, the accounting process is likely to be introducing a number of biases in the estimates of the firm's profitability particularly depreciation, but also the exclusion of non-realized gains etc. Nevertheless, previous research suggests that operating cash flows have no incremental information content above earnings.

The usual method in the accounting literature to extract a firm's operating cash flow from its annual report is to use the equation:

CASH FLOW FROM OPERATIONS = ORDINARY PROFITS +
DEPRECIATION, DEPLETION etc +
CHANGE IN DEFERRED TAXES +
CHANGE IN WORKING CAPITAL[18]

This measure of cash flow is generally acknowledged to be a 'hard' number because there is a limited number of items which are affected by alternative accounting treatment of transactions. However, this indirect method of estimating a firm's operating cash flow is still liable to suffer from a number of potential biases:

Ambiguity in the definition of 'operations'.
Diversity in reporting practices.
Impact of changes in the reporting entity on the non-cash current accounts.
Use of absorption costing in accounting for manufactured inventory.
Measurement of current portion of long-term leases.
Reclassifications between current and non-current accounts. (Drtina and Largay (1985)).

The previous section examined whether there is incremental information, for the purposes of valuation, in the components of accrual earnings. In this section we are examining whether operating cash flow adjustments have any incremental information content over earnings computed using historic cost and accruals conventions.

The equation that was used in the tests is:

$$MCAP_i = \log(\beta_1 * GROSS_i + \beta_2 * FIN_i + \beta_3 * DEPR_i + \beta_4 * \Delta DTAX + \beta_5 * \Delta WC) + \beta_6 * DE_i + \beta_7 * GNET_i + e_i \quad (8)$$

where GROSS (which does not include depreciation), FIN, DEPR, DE and GNET are as previously defined (see equation 7), ΔDTAX is change in deferred

[18] For a more detailed description of this equation see Drtina and Largay (1985).

tax over the past year and ΔWC is change in working capital[19]. The equation differs from the usual measures of operating cash flows because it explicitly includes a term for depreciation whereas operating cash flows do not include depreciation. If operating cash flows are the best proxy variable, then the coefficient of depreciation will not be statistically significant. The sign convention for all the operating cash flow variables is that an increase in any of them implies higher operating cash flows.

Results of previous studies which used a price reaction methodology suggest that the coefficients of the add back components will be of small statistical significance.

The results of the non-linear estimation of equation 8 are reported in table 4.4 in the next page. First, depreciation is a statistically significant explanatory variable for all the years in the sample. Furthermore, the other two accruals adjustments components usually have a different sign (negative) than expected and the coefficients of ΔDTAX is significant for only 1 year whereas that of ΔWC is significant for 2. Also, on average the RMSE is higher by approximately 3% in comparison to that of disaggregated earnings. These results suggest that, unexpectedly, operating cash flows have no incremental information content over disaggregated accounting earnings and support FASB's view.

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[19] In terms of EXSTAT variables DTAX is computed as the sum of #34+#35, working capital (difference of current assets minus current liabilities) as (#13+#14+ #15+#16+#17+#18)-(#43+#44+#45+#46+#47+ #48+#49+#50). Change is measured as the change of these items between current and previous balance sheet.

on market capitalization (t-statistics in parenthesis).

YEAR	GROSS	FIN	DEPR	ΔDTAX	ΔDWC	DE	GNET	R^2
1972	14.098	13.992	13.230	-0.517	-.968	-.154	-.097	.93
	(9.79)	(9.74)	(7.35)	(-0.27)	(-3.58)	(-2.36)	(-1.45)	
1973	8.598	7.090	8.599	-0.407	-0.019	-.338	-.279	.89
	(4.54)	(4.06)	(3.69)	(-0.50)	(-0.06)	(-2.32)	(-3.57)	
1974	6.715	6.467	6.529	-0.243	-0.034	-.193	-.454	.91
	(4.33)	(4.47)	(4.33)	(-0.57)	(-0.26)	(-1.34)	(-7.08)	
1975	9.646	8.101	7.878	-0.171	0.101	-.335	-.296	.93
	(4.79)	(4.90)	(4.25)	(-0.35)	(0.44)	(-2.40)	(-6.65)	
1976	8.330	6.818	6.614	-1.009	0.502	-.305	-.276	.93
	(5.11)	(4.87)	(4.50)	(-1.69)	(1.94)	(-2.30)	(-5.16)	
1977	8.171	5.227	7.868	0.055	-0.321	-.300	-.194	.93
	(5.05)	(3.82)	(5.15)	(0.15)	(-1.09)	(-2.42)	(-3.76)	
1978	10.697	6.314	9.459	0.352	-0.840	-.418	-.208	.94
	(7.29)	(4.57)	(5.16)	(0.93)	(-6.65)	(-4.60)	(-5.10)	
1979	9.516	6.788	7.974	0.253	-0.515	-.483	-.226	.92
	(5.59)	(4.49)	(4.07)	(0.60)	(-1.48)	(-4.19)	(-3.39)	
1980	7.760	5.824	5.276	-0.266	-0.319	-.302	-.109	.89
	(5.94)	(5.32)	(3.22)	(-0.56)	(-0.97)	(-2.76)	(-1.77)	
1981	13.640	11.312	11.064	-2.309	0.051	-.491	-.189	.92
	(5.25)	(5.34)	(4.19)	(-1.26)	(0.02)	(-3.86)	(-4.15)	
1982	11.955	9.927	10.363	0.186	-0.486	-.234	-.066	.92
	(6.41)	(6.08)	(5.61)	(0.26)	(-1.67)	(-2.23)	(-1.15)	
1983	12.107	10.576	10.304	2.228	-0.703	-.165	-.076	.92
	(7.66)	(5.82)	(5.90)	(2.03)	(-1.89)	(-1.93)	(-1.43)	
1984	13.279	12.630	10.816	1.304	0.291	-.190	-.096	.90
	(5.89)	(5.46)	(4.99)	(1.06)	(0.081)	(-1.71)	(-1.61)	
1985	15.603	13.713	14.659	1.493	0.192	-.178	-.164	.92
	(6.10)	(5.24)	(5.70)	(1.28)	(0.40)	(-1.78)	(-3.30)	
1986	17.612	14.666	15.907	1.003	-0.499	-.153	-.212	.93
	(8.37)	(5.20)	(6.77)	(0.58)	(-1.10)	(-2.14)	(-.308)	
1987	18.161	19.177	11.702	-0.229	-0.104	-.299	-.132	.93
	(7.76)	(6.30)	(5.41)	(-0.08)	(-0.21)	(-3.84)	(-1.47)	
AVG	11.618	9.914	9.890	0.108	-0.229	-.284	-.192	
	(6.24)	(5.36)	(5.02)	(.10)	(-1.01)	(-2.64)	(-3.21)	

4.6 The Information in the Components of the Balance Sheet

In chapter 2 we justified the use of the market to the book value ratios with the argument that book values differ from market ones by a constant percentage. However, this assumption is clearly not realistic because the book value of different classes of assets and liabilities will differ from the corresponding market values by a different percentage the determining factor being, most probably, their vintage. As we have already said, this assumption has been frequently used in the literature.

The question of how to decompose the book value of equity is not as clear cut as in the case of earnings where the subtotals are clearly defined and their relationship to net earnings well articulated. The book value of equity can be defined as the sum of issued ordinary capital and reserves or as the difference of the book value of assets minus the book value of all liabilities. If we assume the former, it is unlikely that there will be any advantage in decomposition. In the latter case, however, we can disaggregate the book value of assets in current assets and fixed assets and the book value of liabilities in current and long term liabilities or to even smaller groups. However, it is not clear which components should be included in the tests. One approach is to decompose assets and liabilities to the highest number of groups possible and then have a simplification process which will leave only the components with significant differential information content. However, this process poses a particular problem: firms may operate a 'maturity' matching so that they have enough, say, current assets to cover their current liabilities. Thus, there are severe problems with multicollinearity. In fact, in preliminary tests of such a model the condition number was approximately 30 times over the cutoff level. Furthermore, fixed assets were found to be highly correlated with long term liabilities which suggests that it is easier to borrow money when there is a strong asset base.

The equation was therefore recast in terms of the difference between assets and liabilities of corresponding maturity. Specifically, dividend and tax payable were subtracted from cash and equivalent items and the rest of the current liabilities from current assets. The leverage variable which was used in previous tests as a proxy for risk was dropped from this estimation because the level of debt and book value of assets enters the equation directly. Thus, the estimated equation was:

$$MCAP_i = \log(\beta_1 * CASH_i + \beta_2 * CA_i + \beta_3 * FIXASS_i + \beta_4 * INTA_i + \beta_5 * LTL_i + \beta_6 * OL_i) + \beta_7 * GBOOK_i + e_i \quad (9)$$

where MCAP is the log of the firm's market capitalization, CASH and CA are as previously defined, FIXASS includes fixed and non-current assets, INTA refers to intangible assets, LTL are the long term liabilities and OL is deferred tax[20]. Because LTL and OL are expressed as negative sums all coefficients are expected to be positive. Two of the components are of particular interest to accounting regulators: intangible assets and deferred taxes.

Assets are usually defined as probable future economic benefits, controlled by the firm and should be the result of a past transaction or event. However, intangible assets have no physical existence and their value depends upon the rights they confer to the controlling entity. Examples of intangible assets are patents, copyrights, franchise rights and, normally the biggest component in the UK, goodwill. There are two fundamental characteristics of intangible assets: the

[20] In terms of EXSTAT variables, our variables are defined as follows: CASH=#16-#47-#48, CA=#13+#14+#15+#17+#18-#42-#43-#44-#45-#46-#49-#50, FIXASS=#6+#7+#9+#10+#11+#12, INTA=#8, LTL=#28+#33+#36+#37+#38+#39+#40+#41 and OL=#34+#35.

YEAR	CASH	CA	FIXASS	INTA	LTL	OL	GBOOK	R^2
1972	0.040	1.080	0.911	1.299	1.191	-1.869	0.366	.89
	(0.13)	(11.67)	(9.58)	(3.96)	(7.12)	(-2.80)	(2.53)	
1973	0.387	0.665	0.611	0.802	0.795	-0.058	0.082	.87
	(2.12)	(11.68)	(11.52)	(3.94)	(8.51)	(-0.21)	(0.44)	
1974	0.332	0.496	0.444	0.665	0.555	-0.128	0.355	.87
	(1.81)	(11.65)	(10.21)	(4.32)	(7.09)	(-0.75)	(2.14)	
1975	0.571	0.680	0.482	0.798	0.599	-0.181	0.902	.90
	(3.61)	(13.82)	(11.85)	(4.91)	(6.43)	(-1.06)	(4.93)	
1976	0.537	0.584	0.504	0.699	0.586	0.027	1.021	.92
	(4.12)	(12.54)	(14.48)	(6.67)	(10.08)	(0.19)	(4.90)	
1977	0.850	0.703	0.683	1.152	0.708	0.144	0.627	.91
	(3.49)	(11.37)	(13.76)	(5.96)	(5.31)	(0.91)	(2.35)	
1978	0.962	0.752	0.846	0.979	0.911	0.463	0.715	.91
	(3.84)	(13.15)	(16.47)	(5.11)	(7.63)	(2.71)	(5.42)	
1979	0.722	0.479	0.599	1.191	0.601	-0.088	0.761	.87
	(2.21)	(6.97)	(7.50)	(4.12)	(3.35)	(-0.31)	(3.05)	
1980	0.414	0.517	0.669	1.502	0.757	-0.751	1.257	.88
	(3.00)	(6.02)	(10.62)	(5.08)	(10.80)	(-2.02)	(5.24)	
1981	0.805	0.605	0.610	1.145	0.635	-1.052	0.417	.88
	(5.40)	(17.43)	(16.87)	(2.58)	(5.98)	(-2.77)	(2.20)	
1982	0.793	0.616	0.727	1.828	0.656	-1.893	0.757	.85
	(3.64)	(11.10)	(13.75)	(3.65)	(5.54)	(-3.14)	(3.78)	
1983	1.027	0.799	0.974	1.691	0.894	-1.203	0.691	.85
	(3.73)	(8.82)	(13.30)	(3.31)	(5.38)	(-1.92)	(4.60)	
1984	1.115	0.935	0.997	1.426	1.014	-1.272	0.574	.85
	(5.00)	(12.28)	(13.53)	(4.53)	(8.39)	(-1.81)	(4.11)	
1985	1.548	1.353	1.291	1.908	1.155	-0.319	0.510	.87
	(6.63)	(15.27)	(14.22)	(3.95)	(9.05)	(-0.41)	(2.92)	
1986	2.159	1.828	1.793	1.566	1.746	0.295	0.350	.89
	(8.58)	(15.87)	(14.56)	(2.35)	(9.52)	(0.32)	(2.64)	
1987	2.189	1.709	1.694	2.127	1.617	-1.370	0.015	.91
	(8.93)	(13.51)	(14.75)	(3.94)	(9.45)	(-1.35)	(0.24)	
AVG	0.903	0.862	0.865	1.299	0.901	-0.578	0.588	
	(4.14)	(12.07)	(12.94)	(4.27)	(7.47)	(-0.90)	(3.22)	

high degree of uncertainty regarding the value of future benefits and that they cannot usually be separated from the firm or its real assets. If the book value of the assets (excluding intangibles and after subtracting the book value of debt) is a good approximation for their market value (in the market for real assets) then intangibles would represent the premium (not necessarily positive) of the real assets being in a corporation. For these reasons the valuation and depreciation of intangibles pose a special problem for accountants.

The other item which has been the focus of considerable debate in the UK accounting profession is deferred taxes which are the difference arising from the timing differences on tax payable between profits and losses as computed for tax purposes and results presented in financial statements. As we saw in the section on accruals accounting versus operating cash flows, an increase in deferred taxes over the period should be treated as part of operating cash flows and therefore should be considered of positive value to equity holders. Normally however, deferred taxes are classified as a liability. The important difference is that they will never be settled (have to be repaid). If the capital market recognizes them as a liability they will have a positive coefficient; otherwise a negative one. Estimation results are reported in table 4.5 in the previous page. Deferred taxes for most of the years in the sample are perceived as part of the equity rather than a liability. The coefficients of current assets, fixed assets and long term liabilities are not different from each other in a statistical sense. Cash and equivalent assets are priced by the capital market at a higher rate than other assets in apparent contradiction to theories such as Jensen's free cash flow. Finally, intangible assets have the highest coefficient, perhaps to compensate for the undervaluation of intangibles in the financial statements.

However, the RMSE of this estimate of market capitalization compared to a regression of market capitalization on the book value of equity, accounting leverage, growth in the book value of assets and industry dummies is higher by 3%. Thus we re-estimated equation 8, aggregating current assets (adjusted for current liabilities), fixed assets and long term liabilities into one component and allowed its coefficient to vary by industry. This led to a small reduction of 1% to the RMSE compared to the simple regression. This suggests that extra computational complexity is not generally justified. Potentially, a different breakdown of assets and liabilities would lead to better performance but it is unclear how it would be defined.

4.7 Conclusions

The results presented in this section confirm previous results that earnings are a good summary of the firm's future cash flows as perceived by the capital market. Nevertheless, the components of earnings have incremental information content because they appear to be capitalized at a different rate. However, there is no evidence to support the use of operating cash flow adjustments or extraordinary items in valuation models.

Disaggregating the book value of equity as the difference of the book value of assets and liabilities also leads to improved forecasting performance though at a very small scale. Nevertheless, it was interesting to find that deferred tax is treated as part of equity by the capital markets and that intangible assets have the highest coefficient.

In the next chapter, we return to the simple price earnings and market to book ratio models to examine under what conditions would either of them yield a better estimate of value and we leave for the final chapter, the comparison of the performance of the best models developed so far with the 'mis-pricing' observed in initial public offers of unseasoned stock.

CHAPTER 5

A THEORETICAL COMPARISON OF THE MEASUREMENT ERROR IN THE PRICE EARNINGS AND MARKET TO BOOK RATIOS

5.1 Introduction

In chapter 2 we examined the relative performance of PE and PB ratios. In this chapter we examine under what conditions PB ratios will exhibit smaller forecasting errors than PEs and derive formulae which will give an approximation of the error in relatively simple settings.

We start this chapter with a discussion of the literature of attempts to reconcile the accounting rate of return with the internal one since we will be drawing heavily on some of its conclusions.

Subsequently, we present our model and use simulated data as examples to our results. Throughout the chapter we assume that the firm is in a steady state of growth and a no-tax world but the analysis can easily be extended if the tax system is neutral with respect to both source of funds (i.e. equity or debt) and investment projects undertaken (no investment subsidies) and depreciation for tax purposes equal to that for reporting to shareholders.

This chapter concludes by an empirical investigation of the conclusions of our model.

5.2 ARR versus IRR: a Literature Review[1]

It is generally accepted in the accounting literature, that accountants should not

[1] This section is not intended as a full review of the ARR versus IRR literature; rather, we review the papers whose results are useful to the development of our model.

try to estimate economic profit or the PV of future cash flows (i.e. the value of the company) but rather supply relevant information to the users of financial statements (such as investors, creditors, regulators etc) to form their own estimates of these items.

Nevertheless, accounting data are frequently used in empirical research as a proxy[2] for underlying economic variables and in particular the Accounting Rate of Return (ARR) as an accurate estimator of the Internal Rate of Return (IRR). In general, the rate of return metrics are used as a summary measure of actual (past) or prospective performance and as a measure of required performance. The uses of such studies are many and varied and include the estimates of company profitability produced by the Bank of England, tests of hypotheses concerning industry concentration and in competition policy[3]. This last use, with important real economy effects, has attracted most attention and has been the cause of a number of papers which attempt to reconcile the ARR with a Discounted Cash Flows (DCF) based rate of return.

The ARR is normally defined as the ratio of (accounting) income during a period of time to net book value of capital at the beginning of the period. By contrast, the IRR is the discount rate that makes the NPV of a project equal to 0. Though both numbers involve the comparison of a stock variable (capital) and a flow one (income or cash flows), as it can be seen from the respective definitions, these two measures have important conceptual differences:

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[2] This differs from our empirical work where we use accounting data as the variable on which valuation contracts are written which means that they are the fundamental variable.

[3] In the UK, the Mergers and Monopolies Commission uses the ARR to examine whether the market power of a firm is against the public interest and in the USA, it is used to regulate private sector utilities for which a minimum rate of return is set.

a) In the measurement of ARR, income is defined as cash flow minus depreciation and the expensed (immediately written of) portion of current period investments[4]. In the case of the IRR, the flow variable is cash flow *before* such adjustments.

b) The stock variable in the case of ARR is the net book value of capital measured in accordance with the GAAP and for IRR the total initial outlay of funds.

Given these conceptual differences it is clear that the ARR will be equal to the IRR only by coincidence.

However, there has been considerable research activity that examines the conditions under which the ARR will be equal to the IRR, focusing mainly on the difference between the accounting and economic depreciation.

The first papers in this area date back to the late 60s. Solomon (1970) examined the difference between ARR and IRR assuming a project that earns constant cash flows (rectangular profile) over its lifetime. His conclusion was that it is impossible to reconcile the two measures except in the case where the growth rate in investments is constant and equal to the IRR.

Stauffer (1971) used a more realistic model of the firm by examining the effect of alternative cash flow profiles, working capital and corporate taxes. His most important conclusion was that for every cash flow profile there will be a unique depreciation schedule for which ARR will equal IRR. In the case of rectangular cash flow, the presence of working capital reduces the error between ARR and IRR. Finally, Stauffer proved that if the tax treatment of depreciation differs

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[4] An economist would classify in this area the accounting treatment of R&D and advertisement expenses which should normally have long term benefits for the company.

from the accounting one, there are no conditions under which the ARR will equal the IRR.

In 1974, Gordon demonstrated that depending on the time pattern of cash flows, the pattern of economic depreciation will also vary:

a) When cash flows are constant or increasing, depreciation will increase over time.

b) When cash flows are decreasing, depreciation may decrease, increase or remain constant depending on the slope of the cash flows pattern and the discount rate.

Kay (1976) approached the problem using continuous time as a tool of analysis and examined the difference of an ARR 'averaged' over a number of periods (since the DCF based rate of return is a multiperiod metric) and the IRR. He concluded that, under fairly general conditions, it is possible to reconcile the two return statistics. Kay found a number of interesting relationships:

a) If the ARR on a project is constant over its lifetime, the ARR will always equal the IRR.

b) Every sequence of ARRs defines a valuation function under which the NPV of the cash flows of the project is zero. According to Kay, 'this result suggests a rather natural sense in which one might consider the IRR to be the average ARP (ARR) of the project. Sequences of accounting rates of return all generate functions which discount the present value of the project to zero. The IRR is merely the rate of return corresponding to that particular sequence in which the rate is constant.'

c) If the accounting valuation of the initial and terminal capital stock is equal to the economic one, then the IRR (r) will be equal to[5]:

$$r=\sum_{t=1}^{n}.w_t\alpha_t \tag{1}$$

where α=ARR and w is the weighting factor, defined as:

$$w_t=\frac{\upsilon^{t-1}A_{t-1}}{\sum_{j=0}^{n-1}\upsilon^j A_t} \tag{2}$$

where A=book value of assets and υ^j is the PV factor $(1+r)^{-j}$. The sum of weights will equal 1.

Kay also showed that if a firm grows at a steady rate ρ, its ARR will be constant and the book value of the firm will also grow at rate ρ and the relationship: $(\rho-\alpha)/(\rho-r)=W/V$ (where W and V are the economist's and the accountant's valuations of the firm respectively) which implies that the error in the ARR (in comparison to the IRR) will be a function of the difference between the two valuation rules.

The literature on the ARR versus the IRR focuses on using accounting variables to infer a firm's rate of return. In the next section, we address the issue of how far the accounting valuation rules differ from economic values.

5.3 Simple Valuation Models: A Theoretical Examination

In chapters 2 and 3, we examined the forecasting performance of two simple valuation rules: the price-earnings (PE) and the market to book value of equity (PB) ratio as well as the effects of growth and risk variables. It was observed

[5] This is actually the relationship as modelled by Peasnell (1982) and it refers to ex-ante data for which the IRR is readily available. Kay suggests as a starting value in the computation of the IRR, to use an average of the series of ARRs. The difference between the 'true' IRR and the estimated one, will be largely an empirical issue.

that the PE significantly outperformed the PB ratio; using simple models of the difference of accounting and economic depreciation we attempt to explain this effect and look at the conditions under which the market to book value of assets ratio will be a better estimator of market value than the price-earnings ratio.

The discussion in this section could have been derived from the fundamental valuation equation; instead, we start from a concept well established in the accounting literature. Following Hicks' (1946) analysis it is widely accepted that the income of a firm (or individual) is the maximum sum that the firm can distribute and still be as well off (i.e. own assets of same value) at the end of the period as it was at the beginning.

Turning this definition on its head, the value of company V_T at time T will be equal to:

$$V_T = R.V_{T+1} + R.C_{T+1} \qquad (3)$$

where $R = 1/(1+r)$ is the discount rate which is known with certainty, C_{T+1} is the amount which is expected to be distributed at the end of the period, and V_{T+1} the expected value of the company at the end of the period.

Re-arranging the expression:

$$V_T = \frac{V_{T+1} - V_T + C_{T+1}}{r} \qquad (4)$$

where $(V_T - V_{T+1})$ is the economic depreciation of the firm's assets i.e. the change in the PV of future cash flows.

Given our assumptions about the economic environment, r is a deterministic variable, exogenously determined and it will vary among firms conditional on their risk. If we also assume no monopoly rents, the value of the firm will equal the cost of the assets in place at the beginning of the period less the accumulated economic depreciation:

$$V_T = \sum_{t=0}^{T} I_t^* - \sum_{t=0}^{T-1} (V_t - V_{t+1}) \tag{5}$$

where I^* is the (purchase) cost of the investments. This valuation approach is equivalent to (but not the same) as the balance sheet.

However, an investor who wants to form an estimate of the firm's value has no recourse to (current or future) cash flow data but only the accountant's estimates of profitability and book value of assets. Thus, he is able to make estimates of the firm's value in two ways.

The first is to capitalize operating cash flows less accounting depreciation (i.e. accounting profits in this simplified world) which is the PE ratio approach to valuation. The relationship will be:

$$\hat{V}_{1T} = \frac{BV_{T+1} - BV_T + C_T}{r} \tag{6}$$

where BV_t denotes the book value of assets. In this valuation approach the only source of error is the difference between accounting depreciation and the economic one. In practice however (as we did in chapter 2), the discount factor will be estimated as the average PE ratio from a sample of companies. This may be different from the cost of capital (which we have no data to estimate) and will affect the direction and size of the error[6]. Thus in practice, this estimate of value will equal the 'true' value if and only if these two sources of error cancel each other out.

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[6] This is also a justification of industry specific PE ratios: though risk and growth in earnings vary considerably within an industry the production technology and therefore, the depreciation patterns should be similar.

The second estimate, is to rely on the (net) book value of the firm's assets (since the firm is all equity financed, the book value of assets equals the book value of equity):

$$\hat{V}_{2T} = \sum_{t=0}^{T} I_t^* - \sum_{t=0}^{T-1} (BV_t - BV_{t+1}) \tag{7}$$

where I^* is the historic cost (assumed to be the same with economic cost) of the firm's investments. V_{2T} will differ from V_T if either the initial investments were to have a non-zero NPV or the accumulated accounting depreciation differs from the economic one.

In order to compare the error in the two valuation models, we assume a company that invests in a zero-NPV, K-period project of cost I^* at the beginning of period 0 and $(1+g)I^*$ in identical projects[7] at the beginning of each subsequent period. After K periods, the firm will be in a steady state because its value will be increasing by g every period.

In this case, the general expression for economic depreciation at the start of period N (N>K) will be:

$$ED_N = PV_N - PV_{N+1} = PV_N - GPV_N = -gPV_N \tag{8}$$

where G=1+g.

Using Kay's result that if a firm grows at a steady rate, the book value of assets also grows at the same rate, we have that book depreciation for the current period equals:

$$AD_N = BV_N - BV_{N+1} = BV_N - G.BV_N = -gBV_N \tag{9}$$

The error, E_1, in the valuation of the company based on capitalized accounting

[7] Projects are assumed to be infinitely divisible.

earnings will be equal to:

$$E_1 = V_N - \hat{V}_{1N} = (\frac{V_{N+1} - V_N + C_N}{r}) - (\frac{BV_{N+1} - BV_N + C_N}{r}) = \frac{(V_{N+1} - V_N) - (BV_{N+1} - BV_N)}{r} = \frac{g(PV_N - BV_N)}{r} \qquad (10)$$

As can be seen from equation (10), V_{1N} will be an exact estimator of V_N in the trivial case of zero growth, in the case that the project has a 1 year life (because book value will be equal to the market value), or if the book value of the assets is equal to their market value.

The second valuation rule, V_{2N}, that a user of financial statements can employ is simply to take from the balance sheet the net (of depreciation) book value of assets. In this case, the valuation error will be the difference between accumulated accounting depreciation and the accumulated economic one:

$$E_2 = V_N - \hat{V}_{2N} = \sum_{t=0}^{N-1} (BV_{t+1} - BV_t) - \sum_{t=0}^{N-1} (V_{t+1} - V_t) = PV_N - BV_N \qquad (11)$$

This equation does not give us any guidance on the relationship between book value and market value, the discussion of this issue is deferred for latter. Equation 10 suggests that the pricing error using capitalized earnings will be a function of the growth rate, the required rate of return and the difference between the market value and the book value of the firm which, as it can be seen from equation 11, is the error for the second approach. Thus, comparisons of the performance of the two rules depend on the relative size of the growth rate, g, and the required rate of return, r:

$$E_1 = \frac{gE_2}{r} \qquad (12)$$

Conditional on the rate of growth our choice of estimator of the value of the company will be:

- if the absolute value of g is greater than r, then the book value of the firm's assets will be a better guide to the firm's value than capitalized earnings.

- if the absolute value of g is less than r then capitalized earnings will be a better guide to the firm's value. In the special case of zero growth, capitalized earnings will estimate market value with zero error.

- If g=-r both approaches will have the same error but with opposite sign and therefore, their average will be a perfect estimate.

A summary of these results is also given in table 5.1. Except in fairly unusual circumstances about the relative size of growth and the required rate of return, capitalized earnings will exhibit smaller valuation error than the book value of the firm (which, incidentally, will never be equal to the market value except by coincidence).

In earlier chapters we introduced the concept of a combined forecast which significantly outperforms any of the forecasts based on one variable. Given our two estimates of the firm's, its state steady of growth rate and its cost of capital, there is a set of weights which will give a combined forecast with zero error. Under our earlier results about the comparative performance of the two rules these weights will equal -g/(r-g) for the book value and r/(r-g) for capitalized earnings. In practice, we select those weights based on the error for other firms.

To summarize, we have assumed that:

a) a firm is in a steady state of growth g, and

b) a no tax economy (though the analysis is readily extendable for an economy where accounting depreciation is the same for taxation and financial reporting purposes),

Table 5.1 Relative size of growth rate and required rate of return and its effect on the choice of valuation model.

Relationship between g and r	Choice of estimator
g>r	book value
g=r	indifference
0<g<r	capitalized earnings
g=0	capitalized earnings perfect forecast
-r<g<0	capitalized earnings
g=-r	average of the two approaches
g<-r	book value

and found that the error in valuing a company using capitalized earnings is a function of the growth rate (g) relative to its cost of capital (r) and the difference between the (current) market and book value.

The sign of the valuation error for the capitalized earnings approach depends both on the growth rate on whether the book value of assets is an under- or over-estimate of the market value. Thus, we now turn to examining the relationship of market and book value but before we do so, we introduce a taxonomy of accounting depreciation schedules conditional on their relationship to economic depreciation.

Suppose that for a simple project the difference between economic and accounting depreciation decreased monotonically over time (which means that it starts from being positive, goes to zero and then becomes negative). This can be expressed as:

$$(V_t - V_{t+1}) - d_t I^* < (V_{t-1} - V_t) - d_{t-1} I^* \tag{13}$$

In this case economic depreciation is more accelerated than accounting depreciation and therefore, we will be referring to this case as <u>accelerated depreciation</u>. Alternatively, we define as decelerated depreciation the case where the difference between economic and accounting depreciation is a monotonically increasing function of time which can be expressed as:

$$(V_t - V_{t+1}) - d_t I^* < (V_{t-1} - V_t) - d_{t-1} I^* \tag{14}$$

or, for practical use:

$$(V_t - V_{t+1}) - (V_{t-1} - V_t) > I^*(d_t - d_{t-1}) \tag{15}$$

Since the two most frequently used accounting depreciation methods, straight line and declining balance, are monotonic functions of time, for the above definitions to apply to an accounting depreciation schedule over the life of the asset, requires that economic depreciation (i.e. the discounted cash flows time pattern) is also a monotonic function of time. The classification of an accounting depreciation method as accelerated or decelerated depends both on the depreciation method and the cash flows profile.

For the discussion that follows we will assume a firm that uses straight line depreciation, investing in projects whose cash flows pattern is an annuity (or increasing) and which have no scrap value. Then it can be proved[8] that economic depreciation is a (strictly) monotonically increasing function of time which implies that the left hand side of equation (15) is always positive.

For straight line depreciation, accounting depreciation d_t is constant over time and therefore, the right hand side of (15) will be equal to zero. Thus, if the cash flow from the project is an annuity or increasing straight line accounting depreciation can be classified as decelerated.

In the case of declining balance depreciation (assuming a trivial scrap value for computational convenience), the same depreciation rate is applied to the net of

[8] Proof for this argument can be found in the appendix of Gordon (1974).

depreciation value of the asset up to time t. Thus, the depreciation charges are a decreasing function of time which suggests that the right hand side of (15) is negative and therefore an annuity (or, increasing) cash flow profile with declining balance accounting depreciation also implies decelerated depreciation.

The general conclusion that can be drawn from this discussion is that, conditional on our assumption of a level (or, increasing) cash flow profile of the project, accounting depreciation charges are too high early in the life of the asset and too low towards the end. These results should not be interpreted as evidence that accounting depreciation will under no circumstances be the same as (or less than) economic depreciation but rather, they suggest that they are suitable only for projects with declining cash flows and a particular required rate of return. However, what we are really interested in is the behaviour of accumulated depreciation in order to examine the difference between the current market value of the asset and the net book value.

Since both accounting (straight line and declining balance) and economic depreciation are a monotonic function of time and positive numbers, both accounting and economic accumulated depreciation will be monotonically increasing functions of time. Total accounting depreciation over the life of the asset is equal to total economic depreciation and to the cost of the asset. Furthermore, accounting depreciation in period 1 is higher than economic depreciation. Therefore, at any point in time accumulated accounting depreciation is higher than the accumulated economic one which implies that the book value of the asset will always be an underestimate of its market value. It also follows that the book value of the firm will also be an underestimate of its market value or that E_2 (as defined in equation 11) is positive. This is consistent

Table 5.2 Relationship of growth and valuation error conditional on the relationship between accounting and economic depreciation.

	Decelerated Depreciation	Accelerated Depreciation
Capitalized Earnings		
Correlation with g	Positive	Negative
Sign of error*		
g>0	Positive	Negative
g<0	Negative	Positive
Book value of assets		
Correlation with g	Positive	Negative
Sign of error*	Positive (irrespective of g)	Negative (irrespective of g)

*Sign of error depends on the difference of actual - forecast.

with the empirical results in chapters 2 and 3 where we saw that book value of equity is, on average, less than market capitalization.

From these assumptions it also follows that if plotted against time, accumulated economic depreciation is a convex function, declining balance a concave one and straight line depreciation a straight line. Thus, in our specific example the book value of firms that use straight line depreciation is closer to market value than those that use declining balance.

Up to now, we have assumed a cash flow profile which results in decelerated depreciation. However, it is possible to construct examples of cash flow patterns for which depreciation will be accelerated and for which the book value of assets will overestimate their market value. In table 5.2 we present the effect on our valuation rules of the two depreciation patterns.

To illustrate these results we will be using the example first used by Solomon (1970) and then by most other papers in the ARR versus IRR literature: assume a firm which invests in a £1000 (C_0) in a project with a six year life which pays £229.61 every year. The firm's required rate of return is 10%.

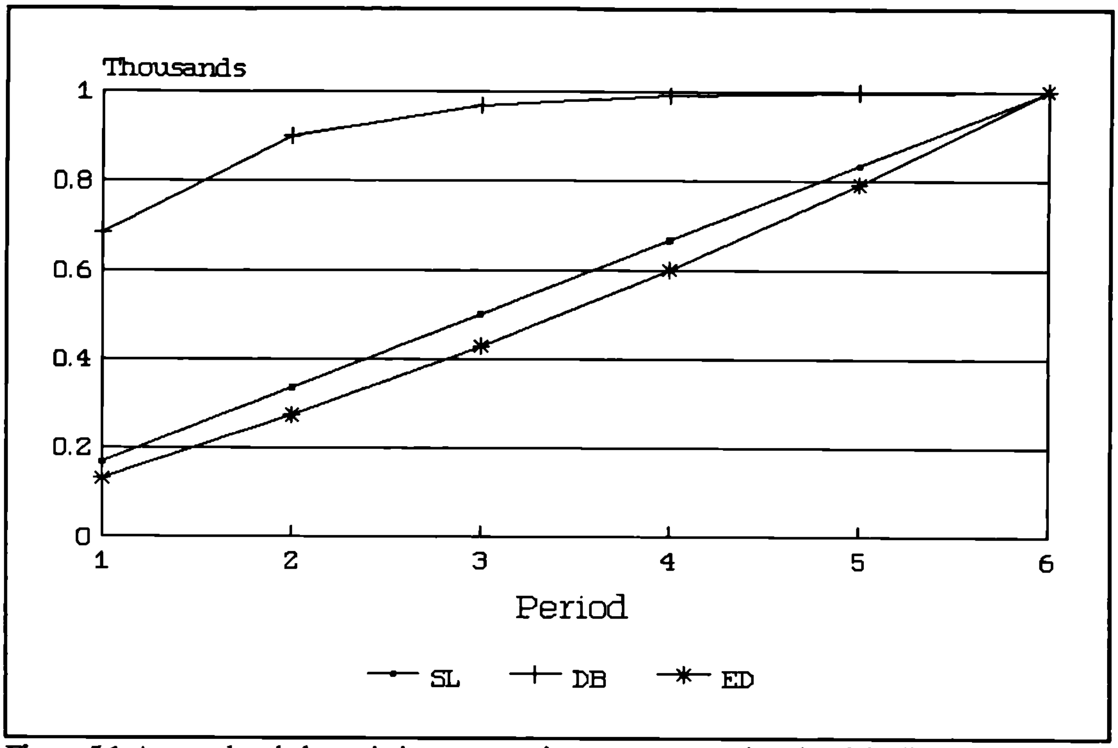

Figure 5.1 Accumulated depreciation: economic versus accounting (straight line and declining balance) - decelerated depreciation case.

In figure 5.1 we plot the accumulated depreciation on this asset using straight line and declining balance versus accumulated economic depreciation. From this graph we can see that,given our assumptions about the cash flow profile and scrap value, the error is much greater using declining balance as suggested earlier.

In figures 5.2 and 5.3 we plot the valuation error using the two approaches (in 5.2 the firm uses straight line depreciation and in 5.3 declining balance but the error is scaled down by a factor of 100) as the rate of the firm's growth changes in comparison to its required rate of return. It should be emphasized that the error in these figures refers to the difference of actual value of the firm minus

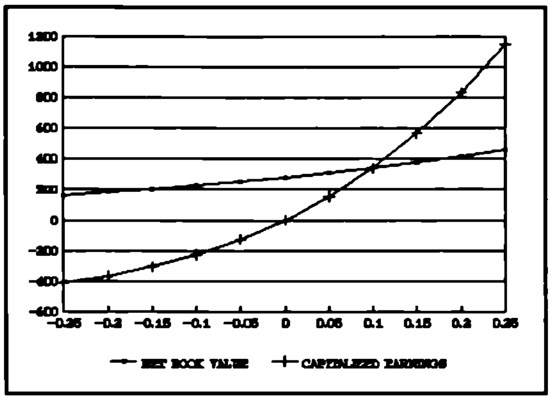

Figure 5.2 Difference between market value of firm and estimated value where firm uses straight line depreciation as the growth rate increases.

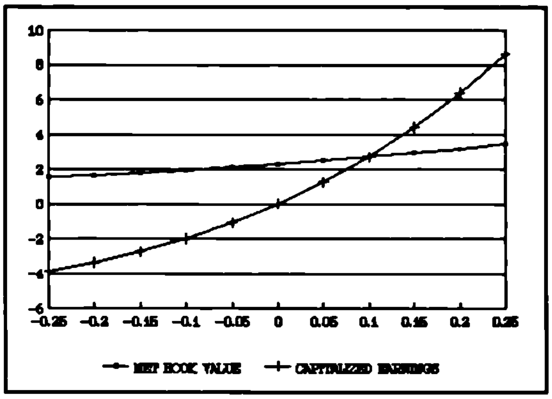

Figure 5.3 Difference between market value of firm and estimated value where firm uses declining balance depreciation as the growth rate increases.

the forecasted value.

As can be seen from the figures the error curve follows the results presented in table 5.1. Also, if we take into account the different scaling in the two figures the much bigger error that results from using declining balance is apparent. Figures 5.2 and 5.3 refer to the monetary value of the valuation error; to be consistent with results in previous chapters in figure 5.4 we present the ratio of actual to forecasted value for a firm that uses straight line depreciation. If accounting depreciation is accelerated, in figure 5.4 the market to book based forecast ratio would have been approaching 1 asymptotically from below.

5.4 Empirical Results

The theoretical results of the previous section suggest a number of hypotheses that are open to empirical investigation. The aim of our tests is not to confirm or reject these hypotheses; it is easy to reject the model given our strong assumptions about steady state growth. Rather we aim to examine whether those results can give as any information about the size and sign of the error when valuing a company using book value or capitalized earnings and whether our

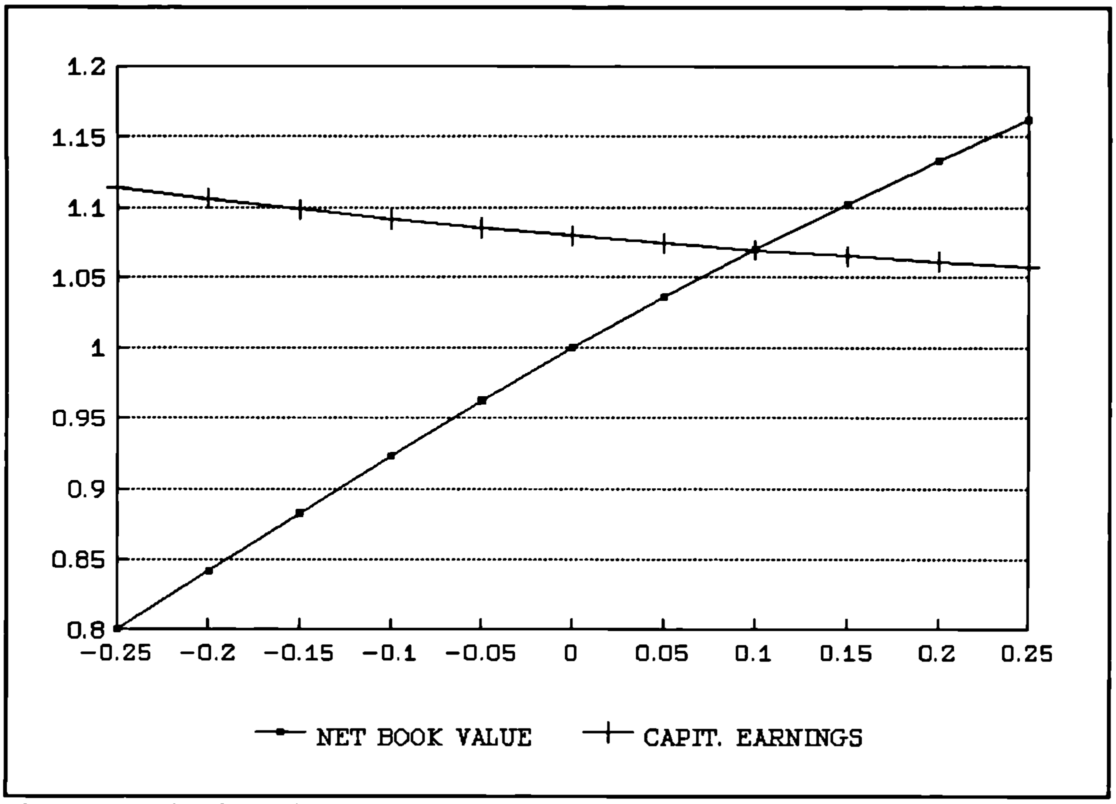

Figure 5.4 Ratio of actual to forecasted value of the firm as a function of growth.

knowledge of the firm's past growth rate can help us improve the combined forecast models used previously. Our tests can be classified in three broad groups:

a) Tests of the relationship between growth and the size and / or sign of the error when valuing a company using either capitalized earnings or the book value of assets.

b) Tests of the relationship between growth and the comparative forecasting performance of valuation rules base on either capitalized earnings or the book value of assets.

c) Tests of the relationship between growth and the size of error using either of the two approaches and the weights applied on them to obtain a perfect forecast. For these tests we will be using the data employed in the previous three chapters for the book value of equity[9], earnings, market capitalization and growth in the (net of depreciation) book value of assets. Growth in the book value of assets is measured as the log of growth over the past year; it is unlikely to be a good measure of steady state growth but it has been used for consistency with previous chapter results.

In addition, it would have been interesting to examine the valuation error using either of the two approaches for a company that uses straight line depreciation versus that of a company that uses the declining balance method. However, the necessary data are not usually available in computerized databases and companies use different depreciation methods depending on the nature of the asset.

One problem that we have in empirical tests of the model, is the choice of a number for cost of capital (earnings multiplier). In previous chapters, when our aim was to minimize the forecasting error, we used the average price-earnings ratio but this is not appropriate here because it involves circular reasoning. We want to test whether capitalized earnings over- or under- estimate the value of the firm; if the average PE was used, capitalized earnings, on average, will be equal to market capitalization. Therefore, we used the 3 months Treasury bill rate (for the month corresponding to the prices in our sample) plus 900 b.p.

Equation (12) suggests that the valuation error using capitalized earnings will be an increasing function of growth (if the book value of assets underestimates their market value). However, here we are concerned with a test of a joint hypothesis: that the error is an increasing function of growth and that the book value of the

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[9] Our definition of the book value of equity (SHAR) has changed to reflect the conclusions of chapter 4 that deferred taxes are treated by the capital market as part of the equity. Thus, in terms of EXSTAT variables SHAR = #27+#29+#30+#31+#32+#34+#35.

equity is an underestimate of the market value (i.e. that depreciation is decelerated). If depreciation is accelerated, we expect negative correlation between growth and the valuation error using capitalized earnings. Therefore, we split the sample into firms for which the book value of equity is less than their market value and therefore, increasing growth will mean higher error and those firms whose book value of equity is an over-estimate of the market value and for which increased growth will mean lower error. Results are presented in table 5.3. In the case that the book value of equity is higher than market capitalization, as expected, there is strong negative correlation over 13 out of the 16 years in the sample. In the other case, the rank correlation coefficient was positive for half (8) of the years in the sample. Thus, empirical evidence does provide some support, although weak, on the validity of our model on the relationship of growth and the size of the valuation error using capitalized earnings.

Table 5.3 Rank correlation coefficients between growth and the valuation error using capitalized earnings

YEAR	M<S	M>S
1972	-.022	-.036
1973	-.064	-.243
1974	-.255	.022
1975	-.196	-.231
1976	-.192	-.329
1977	-.161	-.203
1978	-.168	-.248
1979	-.233	-.377
1980	-.094	.253
1981	-.247	-.146
1982	-.139	.049
1983	-.219	.158
1984	-.200	.257
1985	.044	.228
1986	.051	.131
1987	.195	.102

where,
M: market capitalization,
S: book value of equity

Equation 12 also predicts that the sign of the error using capitalized earnings will depend on the sign of the growth variable and the sign of the difference between market and book value of equity. In order to examine this hypothesis we coded a variable as 0 or 1 if the forecast was an over- or under-estimate of the true value. The same was done on a second variable but based on what the sign was expected to be conditional on growth and the relationship between the book and market value of equity. Our variables correctly predict the sign of the error for more than 60% of the observations. We then run a χ^2 test to examine whether the two variables were different in a statistical significant sense. For the aggregate sample the null hypothesis that there is no relationship between the two variables is rejected at any conventional significance level which suggests that the variables in our model have high explanatory power about the sign of the error using capitalized earnings[10].

Our results about the relationship between accounting and economic depreciation that, under the cash flow profile assumptions made, accumulated accounting depreciation is higher than the economic one suggest that the monetary value of the valuation error using the book value of assets will be an increasing function of growth. However, the error as a percentage of the firm's value will be a decreasing function of growth and asymptotically, the book value of equity will be equal to market capitalization. As in the case of capitalized earnings we are conducting a test of a joint hypothesis: that the book value of equity is less than the market value and that the

Table 5.4 Rank correlation coefficients between growth and the valuation error using the book value of equity.

YEAR	M<S	M>S
1972	.003	.326
1973	.133	.016
1974	.120	.264
1975	.263	-.055
1976	.168	.285
1977	.223	.200
1978	.169	.239
1979	.111	.143
1980	.230	.343
1981	.109	-.048
1982	.260	.149
1983	.071	.345
1984	.089	.369
1985	-.102	.295
1986	-.289	.286
1987	-.224	.176

[10] We also run the test for individual years but, in many cases, the assumptions underlying the test were not met and therefore we do not report results on a yearly basis.

correlation should be negative. Thus, we split the sample in two groups of firms: the first comprises the firms for which book value is less than market and the second the rest for which we expect positive correlation between the market-to-book ratio and growth. Results are presented in table 5.4: the rank correlation between growth and the market-to-book ratio within groups was generally positive and not different from each other (for 14 and 13 years respectively correlation was positive).

We also examined whether the book value of equity is, generally, an underestimate of market value. We first examined the number of observations for which the book value of equity is an underestimate of the market value and found that they are about 57% of the total sample though there is significant variation from year to year. Assuming that the probability of a firm having either accelerated or decelerated depreciation is 50% at any year, we used a simple binomial test (as a rule of thumb test) to see whether the distribution of firms is random. Our results were that the null hypothesis of randomness could be rejected for all 16 years in the sample; for 10 years depreciation for most firms is decelerated and for 6, accelerated.

The second group of results that we want to test concerns the relative performance of the two valuation rules (capitalized earnings and book value of equity) as a function of growth.

From the results presented in table 5.1 it follows that the book value of equity will be a better guide to value than capitalized earnings if the absolute value of the rate of growth is higher than the capitalization rate: we compared the Mean Absolute Percentage Error of our forecasts for the firms whose (absolute) value of the growth rate over the previous year outstripped the mean price-earnings ratio and found no difference in the performance of the two rules conditional on growth.

We also examined the growth rate at which the forecasted market capitalization based on the book value of equity will be equal to that based on capitalized earnings and the growth rate for which they will be equal but of opposite sign. First, using OLS regression, we estimated for every year in the sample the relationship between the valuation error using capitalized earnings or the book value of equity and the firm's growth rate. Even though the relationship in the examples of the previous section exhibits obvious non-linearities we modelled the relationship as linear because higher order terms for growth were not statistically significant. Even so, the explanatory power of the regressions (as measured by the R^2) was trivial a result which, when compared with the rank correlation results presented earlier, suggests that the linearity assumption is not a good approximation. Subsequently, we solved these equations to find the growth rates for which the errors would have been equal and equal in size but of opposite sign. The results are presented in table 5.5; as can be seen for almost every year in the sample, the implied growth rates were extremely high (or, extremely high but with negative sign) compared to the growth rates observed. This implies,

Table 5.5 Implied growth rates for equal error and opposite sign error using the two valuation approaches.

YEAR	Equal Error	Opposite Sign Error
1972	163.3%	163.3%
1973	102.4%	72.1%
1974	-156.3%	-32.5%
1975	9.7%	-33.5%
1976	5989.5%	-1.0%
1977	50.6%	16.4%
1978	16.5%	27.8%
1979	115.7%	20.7%
1980	28.4%	162.3%
1981	-74.1%	-34.6%
1982	-184.5%	-0.8%
1983	48.9%	-19.9%
1984	-89.0%	-50.6%
1985	129.3%	-1917.0%
1986	2541.4%	192.0%
1987	-893.5%	153.0%

respectively, very low earnings multipliers and negative ones. From these results we conclude that growth alone (at least in the way modelled), has very little explanatory power of the comparative performance of the two valuation rules. In addition, we tested equation 12 directly; after simple algebraic manipulation the equation estimated was:

$$\frac{EARN}{MCAP-SHAR} = \beta_0 + \beta_1 \frac{MCAP}{MCAP-SHAR} + \beta_2(-g) + e \qquad (16)$$

Two testable hypotheses arise from this equation:

H_{01}: $\beta_1 = r$

H_{02}: $\beta_2 = 1$

The estimated coefficients[11] of the equation are presented in table 5.6 where, for comparison, we have included the cost of capital used in this chapter's tests and the average earnings in the sample. Both hypotheses were rejected (at the 5% level) for all the periods in the sample. However, in almost every case the estimated coefficient β_1 was 'near' the expected value but was more consistent with the average PE ratio than the cost of capital as measured in this section. Finally, to examine whether our knowledge of the growth rate can help us improve the combined forecast methodology we assumed that the weights applied to the two approaches were a linear function of the growth rate. We then tested whether this model yields better forecasts than a model where the weights are fixed for all the firms in the sample. The results were that on average, using growth adjusted weights increases the forecasting power (i.e. decreases the RMSE of the residuals) of our model by more than 11%.

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[11] T-statistics are not reported.

Table 5.6 Estimated coefficients of equation 16.

YEAR	Intercept	MCAP	Growth	Cost of Capital	Earnings Yield
1972	-.176	.110	-.279	.169	.092
1973	-.021	.148	.176	.209	.180
1974	-.036	.151	.179	.183	.189
1975	-.022	.121	.228	.173	.132
1976	-.146	.159	-.158	.178	.162
1977	-.079	.145	-.229	.150	.156
1978	.069	.179	.145	.203	.140
1979	-.095	.157	.032	.252	.167
1980	-.031	.149	.179	.205	.137
1981	.054	.101	.054	.216	.108
1982	-.309	.061	1.073	.192	.091
1983	.044	.118	-.080	.175	.089
1984	-.060	.110	.059	.213	.086
1985	-.066	.064	-.059	.198	.077
1986	.134	.043	-.483	.185	.067
1987	.024	.063	-.071	.173	.079

5.5 Conclusions

Numerous papers have examined the theoretical relationship between the Accounting Rate of Return and the IRR for a firm. In this chapter, under some fairly general assumptions about the economic environment, we developed a theoretical model of the error caused by the use of stylized accounting depreciation schedules, when valuing a company using capitalized accounting earnings and the book value of equity. We found a simple relationship between the error using capitalized earnings and growth and the under- (or, over-) valuation of the firm's assets in the balance sheet. This relationship suggests that for most of the observed growth rates, capitalized earnings will outperform market-to-book ratios as a valuation model a result consistent with the empirical evidence presented in chapter 2. We also modelled the valuation error using the book value of equity as a (non-linear) function of the growth rate and the depreciation method used. Our results suggest, that in general the book value of the firm will be less than the market one.

Finally, we conducted some simple tests of our model. The results generally support our model of growth and the size (and sign) of the error using either of the two approaches. However, there is no evidence to support our conclusions about the relative performance of the two rules. Nevertheless, they suggest that if we know the growth rate, we can improve on the combined forecast model by using firm specific weights.

CHAPTER 6

SUMMARY AND CONCLUDING REMARKS

The objectives of this thesis were to develop company valuation models that use accounting data for situations, such as MBOs, IPOs and tax assessment where a market valuation of the firm is not available. Our focus was what the value of a firm would have been if quoted and we did not address such issues as the appropriate discounts due to lack of liquidity. At the same time, there were a number of positive research issues that we wanted to address such as what is the appropriate functional specification of the price-accounting variables relationships, the timeliness of accounting statements, the explanatory power of publicly available data on the market capitalization of quoted firms.

We now turn to reviewing our research and commenting on its conclusions.

The basic research in this area is reviewed in chapter 1 but appropriate references are made throughout the thesis. Nevertheless, the academic (as opposed to in house research for financial institutions) research in this area was up to the last two years very limited.

All the empirical work in the thesis was done for a sample of UK firms, quoted on the London Stock Exchange, with December accounting year ends for the period 1971-1987.

In chapter 2, we examine the simplest possible valuation models: the market to book, price-earnings and price-dividends ratios which are the most frequently used models. A ratio relationship can be written as a regression equation conditional on the assumptions of a zero intercept and a linear (or log-linear) relationship. The choice of characteristic ratio, which is simply the number of times by which we multiply earnings to get an estimate of market capitalization, depends on the distributional assumptions made about the error. A major part of chapter 2, is an empirical examination of the statistical validity of ratios as valuation models; the conclusions were that the relationship between market capitalization and the accounting variables being examined, is approximately log-linear. Thus, the characteristic ratio is defined as the exponent of the mean of the log-transformed ratios and the better ratio for valuation purposes is the one which has the smallest standard deviation. The first issue we wanted to address was which is the best definition of earnings and book value of the firm for valuation purposes within the context of these univariate models. Net earnings and the book value of equity are the best variables in their groups but the price-dividends ratio slightly outperforms the price earnings ratio as the best univariate model. However, because the errors from the three models are less than perfectly correlated we found that a combined forecast methodology significantly outperforms the ratio models. Chapter 2 concludes by examining the performance of the valuation ratios based on accounting data as we move away from the announcement date of the financial statements; the results were that there is a steady increase in the error.

Chapter 3 expands on the results of chapter 2, by looking at variables that might explain the cross sectional distribution of the valuation ratios. From finance theory the obvious choices were measures of growth and risk; however, in practice the definition of these variables was data instigated. The growth over the previous year in the book value of the firm's assets best explains the distribution of the market-to-book value of the equity and price-dividends ratio whereas growth in earnings best explained the price-earnings ratio. This last effect was explained in terms of the observed mean reversion properties of accounting earnings. Two measures of risk were also tested for: beta and leverage which is best described as a measure of a firm's financial risk. The use of beta is clearly impossible for the valuation of non-quoted firms but in addition it was found to be of trivial explanatory power. Leverage was a significant explanatory variable for the cross-sectional distribution of the valuation ratios but its effects were not consistent over time. Finally, in line with financial industry practice, we tested for industry effects and found that, on average, using industry specific multipliers reduces the forecasting error by less than 5% for the price-earnings and price-dividends ratios and 6.9% for the market-to-book ratio. We also tested for size effects, which are a significant factor for cross sectional differences in returns, but found that they are of marginal importance as explanatory variables for the cross sectional distribution of the valuation ratios. We also found that forecasting errors in one year were highly correlated with those in subsequent years. A pooled regression model where each valuation ratio was regressed against leverage, the relevant measure of growth, and dummy variables for industry effects and time effects could explain only 50% of the valuation ratios' distribution. This suggests that there are strong firm-specific effects. Furthermore, even a combined forecast based on the best of these models will be underestimating or overestimating true market capitalization by a median 21% (averaged over the 16 years in the sample).

In chapter 4, we examined more complicated valuation models which allow for the components of earnings or the balance sheet to be capitalised at different rates. The test in this chapter had two distinct aims: first, to examine whether the components of the profit and loss account or the balance sheet have differential information content (i.e., whether they are priced at the same rate). The second issue we wanted to address was whether the components possess incremental information content over net earnings or the book value of equity and thus, whether we should be using valuation models with disaggregated data. Though our literature review shows that this relationship, based on the Litzenberger-Rao model, is usually modelled as a linear one, our tests based on the Box-Cox transformation suggest that the relationship is log-linear, at least for British data.

A number of different break downs of earnings were tested for: gross profit, depreciation, other income, net interest charges and tax. These were shown to have differential information both against each other and against aggregate earnings and they have incremental information content though very small. In the next stage, exceptional items were separated from the other components for the years 1980-1987 for which this was possible and they were also found to have both differential and incremental information content. By contrast, extraordinary items possess no information content that is relevant for valuation purposes. This is also true for adjustments that allows us to get a cash earnings number from accounting earnings. Finally, the book value of equity was modelled as a function of cash, current assets (net of current liabilities), fixed assets, intangible assets, long term liabilities and other liabilities. In this case, the conclusion was that the components of the balance sheet possess differential information content but no incremental information.

The models we discuss in these chapters represent a progression from the most simple to more complicated but, how do they perform against models that are

Table 6.1 Comparison of the forecasting performance of the combined forecast based on the best performing models versus the pricing error of IPOs.

	Best Model	IPOs Primary Market	IPOs USM
Standard deviation	.252	.216	.386
Mean	0%	10.0%	13.9%
Maximum	122.1%	90.6%	N/A
Number of observations	1293	91	240

actually employed in the market? Certainly, our models are better than the rules of thumb or even the more sophisticated models used by the courts in valuing companies for tax purposes or in issuing 'fairness' opinions for MBOs. However, the area where securities houses spend most research effort is in the pricing of initial public offerings (IPOs) for which they have developed sophisticated valuation models and are privy to more (and more timely) information than that published in the financial statements and the subset of that used in our tests. Thus, in table 6.1, we present the performance of the 'best' of our models against the price performance of IPOs, during the period 1981-1984, from the offer date to the close of the first day of trading[1]. Our best model was constructed as a combined forecast conditional on the forecasts from the market-to-book value of equity, price-earnings[2] and price-dividends ratios adjusted for growth, risk (as

[1] The IPOs data are from tables 6.14 and 6.20 from de Ridder (1986) and is adjusted for market effects.

[2] Our earnings based forecast could have been slightly improved by using a disaggregated earnings model where different weights were assigned on gross profit, depreciation, other income, net interest payments, tax payments and exceptional items. This is the same with equation 6 of chapter 4 and includes adjustments for growth and leverage.

proxied by accounting leverage[3]) and industry dummies.

In this test a major problem is to ensure that we are comparing the same things. As a first step we limited our estimates to 1980-1983 period for which price data with the IPOs are used. The mean return of IPOs was obviously not what we wanted to look at because we know that the issue price has a built-in underpricing whereas, since we use we use least-squares methodology, we have a zero mean error (in the sample). Thus, we should compare the root mean square error of our forecasts versus the standard deviation of the returns of the IPOs from the offer date to the close of first day of trading.

Results presented in table 6.1 show that the performance of our models is significantly better than the performance of IPOs in the USM and slightly worse than that in the primary market[4]. These results can be interpreted as evidence that the role of investments bankers is mainly the exclusion of outliers from the sample which is used to obtain the multipliers for the accounting variables and the normalization (for example, deleting from accounting earnings, income from one-off transactions) of these variables.

Finally, in chapter 5 we develop theoretical models of the difference between the error in valuing a firm using capitalized earnings and the book value of assets net of depreciation. The economic setting used in these models is a very simple one; the firm's cost of capital was assumed to be a deterministic variable, which varies among firms depending on their risk. It was also assumed that there are no taxes

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[3] It should be noted that our definition of book value of equity, and consequently of leverage, changed to reflect the conclusions of chapter 4, on disaggregated book value that deferred taxes are treated by the capital market as part of equity.

[4] The performance of the models presented here show a substantial improvement from those presented earlier. This is mainly due to the change in the definition of leverage.

or that accounting depreciation for tax purposes is the same for financial reporting. The firm in our model was assumed to be in a steady growth state and to be totally equity financed. Our results were that the relative performance of a valuation based on the book value of assets versus one based on capitalized earnings depends on the relative size of the growth rate and the required rate of return. Two interesting cases were that if the rate of growth is zero, capitalized earnings will be a perfect estimate of market value and if the rate is equal to but of opposite sign to the cost of capital, the error using the two valuation methods will be equal in size but of opposite sign. From our model it also follows that, if accounting depreciation differs from economic depreciation, the book value of assets will never be the same as market value but will asymptotically go towards the market value if the firm's growth rate is infinitely large.

Subsequently, we examined what determines the sign of the error or, put in another way, whether the book value of the assets is an under- or over- estimate of their market value. This depends on the difference between accounting and economic depreciation. In order for the model to be mathematically tractable, we assumed that the cash flows from the firm's investments are a monotonic function of time and showed that if cash flows are an increasing function of time (or an annuity) and the firm uses straight line or declining balance accounting depreciation, economic depreciation will be decelerated. This means that accumulated accounting depreciation is higher than the accumulated economic one and therefore the book value is an under-estimate of market value.

The results about the relationship between growth and the relative size of the error when valuing a company using the book value of assets versus using capitalized earnings were then subjected to an empirical investigation which provided limited evidence in favour of the validity of our model.

The research issue of firm valuation using accounting data is a fascinating one because of its importance for models that assume that the market value of firms is determined by fundamental variables and its obvious practical implications. Our empirical research has suggested improvements in the specification of the equations used in the tests, the combined forecast methodology which improves the accuracy of the forecasts and that most of the components of earnings are 'valued' at a different rate by the capital market. In chapter 5, we examined what determines the sign and size of the error using capitalized earnings versus using the book value of assets. Clearly however, there is much scope for empirical research that improves the variables we used as measures of growth and risk and examine the non-linearities in the relationship between accounting data and market value. But, perhaps, the most promising field of work is modelling how economic value is mapped into accounting value.

BIBLIOGRAPHY

Ball, R. and R. Watts. 1972. Some Time Series Properties of Accounting Income. Journal of Finance. 663-682.

Barron, M. J. 1984. Some Empirical Evidence on the Year End Dates of Larger British Companies. London Business School working paper.

Barth, M. E., W. H. Beaver and M. A. Wolfson. 1990. Components of Earnings and the Structure of Bank Share Prices. Financial Analysts Journal. (May-June): 53-60.

Barth, M. E., W. H. Beaver and C. H. Stinson. 1991. Supplemental Data and the Structure of Thrift Share Prices. Accounting Review. (January): 56-66.

Barwise, P., C. Higson, A. Likierman and P. Marsh. 1989. Accounting for Brands. ICAEW.

Beaver, W. H. and D. Morse. 1978. What Determines Price-Earnings Ratios? Financial Analysts Journal. (July-August): 65-76.

Beaver, W. H. and R. E. Dukes. 1972. Interperiod Tax Allocation, Earnings Expectations, and the Behaviour of Security Prices. Accounting Review. (April): 320-333.

Beaver, W. H. and W. R. Landsman. 1983. Incremental Information Content of Statement 33 Disclosures. FASB.

Beaver, W. H., C. Eger, S. Ryan and M. Wolfson. 1989. Financial Reporting, Supplemental Disclosures and Bank Share Prices. Journal of Accounting Research. (Autumn): 157-178.

Beaver, W. H., P. A. Griffin and W. R. Landsman. 1982. The Incremental Information Content of Replacement Cost Earnings. Journal of Accounting and Economics. (July): 15-39.

Beaver, W.H., R. Lambert and D. Morse. 1980. The Information Content of Security Prices. Journal of Accounting and Economics (), 3-28.

Belshley, D. A., E. Kuh and R. E. Welsh. 1980. Regression Diagnostics. John Wiley & Sons.

Black, F. 1980. The Magic in Earnings: Economic Earnings versus Accounting Earnings. Financial Analysts Journal. (November-December): 19-24.

Boatsman, J. R. and E. F. Baskin. 1981. Asset Valuation with Incomplete Markets. Accounting Review. (January): 38-53.

Bougen, P. D. and J. C. Drury. 1980. UK Statistical Distributions of Financial Ratios, 1975. Journal of Business Finance and Accounting. (Spring): 29-45.

Bowen, R. M. 1981. Valuation of Earnings Components in the Electric Utility Industry. Accounting Review. 1-22.

Bunn, D. 1989. Forecasting With More Than One Model. Journal of Forecasting. 161-166.

Christie, A. 1987. On Cross-Sectional Analysis in Accounting Research. Journal of Accounting and Economics. (December): 231-258.

Constantinides, G. M. 1987. Theory of Valuation: Overview and Recent Developments. Working Paper 205. Graduate School of Business, University of Chicago.

Davis, E., D. Dunn and W. H. Williams. 1973. Ambiguities in the Cross-Section Analysis of Per Share Financial Data. Journal of Finance. 1241-1248.

Deakin, E. 1976. Distributions of Financial Accounting Ratios. Some Empirical Evidence. Accounting Review. (January): 90-96.

DeAngelo, L. 1986. Accounting Numbers as Market Valuation Substitutes: A Study of Management Buyouts of Public Stockholders. Accounting Review. (April): 400-420.

Drtina, R. E. and J. A. Largay III. 1985. Pitfalls in Calculating Cash Flow from Operations. Accounting Review. (April): 314-326.

Durand, D. 1957. Bank Stock Prices and the Bank Capital Problem. Occasional Paper 54. NBER.

Eastaway, N. A. and H. Booth. 1985. Share Valuation Cases. Butterworths.

Fama, E. and H. Babiak. 1968. Dividend Policy: An Empirical Analysis. Journal of the American Statistical Association. (December): 1132-1161.

Feldstein, M. and R. Morck. 1983. Pension Funds and the Value of Equities. Financial Analysts Journal. (September-October): 29-39.

Foster, G. 1977. Valuation Parameters of Property Liability Companies. Journal of Finance. 823-835.

Foster, G. 1986. Financial Statement Analysis. 2nd edition. Prentice-Hall.

Frecka, T. J. and W. S. Hopwood. 1983. The Effects of Outliers on the Cross-sectional Distributional Properties of Financial Ratios. Accounting Review. (January): 558-573.

Gordon, L. A. 1974. Accounting Rate of Return vs. Economic Rate of Return. Journal of Business Finance and Accounting. (Autumn): 343-356.

Gordon, M. 1962. The Investment, Financing and Valuation of the Corporation. Irwin.

Harford, T. 1969. Pricing a Flotation. Journal of Business Finance.

Hochman, S. 1983. The Beta Coefficient: An Instrumental Variables Approach. Research in Finance, Vol. 4. 128-151. JAI Press.

Ijiri, Y. 1967. The Foundations of Accounting Measurement: A Mathematical, Economic and Behavioral Inquiry. Scholars Books Ltd.

Jennings, R. 1986. A Study of the Cross-Sectional Homogeneity of the Information Content of Accounting Income and its Components. Unpublished PhD thesis: University of California: Berkeley.

Kay, J. A. 1976. Accountants, Too, Could Be Happy in a Golden Age: The Accountants Rate of Profit and the Internal Rate of Return. Oxford Economic Papers. (November): 447-460.

Kuh, E. and J. R. Meyer. 1955. Correlation and Regression Analysis When the Data are Ratios. Econometrica. 400-416.

Landsman, W. R. and J. Magliolo. 1988. Cross-Sectional Capital Market Research and Model Specification. Accounting Review. (October): 586-604.

LeClair, M. S. 1990. Valuing the Closely-Held Corporation: The Validity and Performance of Established Valuation Procedures. Accounting Horizons. (September): 31-42.

Lev, B. 1969. Industry Averages as Targets for Financial Ratios. Journal of Accounting Research. (Autumn): 290-299.

Lev, B. 1989. On the Usefulness of Earnings and Earnings Research: Lessons and Directions from Two Decades of Empirical Research. Journal of Accounting Research. (Supplement)

Lev, B. and J.A. Ohlson. 1982. Market Based Empirical Research in Accounting: A Review, Interpretation and Extensions. Journal of Accounting Research. (Supplement): 249-322.

Lev, B. and S. Sunder. 1979. Methodological Issues in the Use of Financial

Ratios. Journal of Accounting and Economics. 187-210.

Lev, B. and S. Thiagarajan. 1991. Financial Information Analysis. Paper presented at the 14th Annual Congress of the European Accounting Association.

Lieber, Z., E. I. Melnick and J. Ronen. 1983. The Filtering of Transitory Noise in Earnings Numbers. Journal of Forecasting. 331-350.

Lipe, R. C. 1986. The Information Contained in the Components of Earnings. Journal of Accounting Research. (Supplement): 37-64.

Litzenberger, R. and C. Rao. 1971. Estimates of the Marginal Rate of Time Preference and Average Risk Aversion of Investors in Electric Utility Shares: 1960-1966. Bell Journal of Economics and Management Science (Spring): 265-277.

Livnat, J. and P. Zarowin. 1990. The Incremental Information Content of Cash Flow Components. Journal of Accounting and Economics. 25-46.

Lucas, R. 1978. Asset Prices in an Exchange Economy. Econometrica. 1429-1445.

Maddala, G. S. 1977. Econometrics. McGraw-Hill.

Maddala, G. S. 1989. Introduction to Econometrics. Maxwell Macmillan International Editions.

McDonald, B. and M. H. Morris. 1984. The Statistical Validity of the Ratio Method in Financial Analysis: An Empirical Examination. Journal of Business Finance and Accounting. (Spring): 89-97.

McLeay, S. 1986. The Ratio of Means and the Mean of Ratios and Other Benchmarks: An Examination of Characteristic Financial Ratios in the French Corporate Sector. Finance; The Journal of the French Finance Association. 75-93.

Miller, M. and F. Modigliani. 1961. Dividend Policy, Growth, and the Valuation of Shares. Journal of Business. (October): 411-433.

Modigliani, F. and M. Miller. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. American Economic Review. (June): 261-297.

Olsen, J.C. 1985. Valuation Implications of SFAS no. 33 Data for Electric Utility Investors. Journal of Accounting Research. (Supplement): 141-154.

Peasnell, K. V. 1982. Some Formal Connections Between Economic Values and Yields and Accounting Numbers. Journal of Business Finance and Accounting. (Autumn): 361-381.

Ricketts, D. and R. Stover. 1978. An Examinations of Commercial Bank Financial Ratios. Journal of Bank Research. (Summer): 121-124.

Ridder, A. de. 1986. Access to the Stock Market. Federation of Swedish Industries.

Ross, S. A. 1988. Comment on the Modigliani-Miller Propositions. Journal of Economic Perspectives. (Fall): 127-134.

Rubinstein, M. 1976. The Valuation of Uncertain Income Streams and the Pricing of Options. Bell Journal of Economics and Management Science. 407-425.

Shapiro, S. S. and M. B. Wilk. 1965. An Analysis of Variance Test for Normality (complete samples). Biometrika. 591-611.

Solomon, E. 1970. Alternative Rate of Return Concepts and their Implications for Utility Regulation. Bell Journal of Economics and Management Science.

Stauffer, T. R. 1971. The Measurement of Corporate Rates of Return: A Generalized Formulation. Bell Journal of Economics and Management Science. (Autumn): 434-469.

Stephens, M. A. 1975. Asymptotic Properties for Covariance Matrices of Order Statistics. Biometrika. 23-28.

Tinbergen, J. 1938. The Dynamics of Share Price Formation. Review of Economics and Statistics. 153-160.

Whittington, G. 1980. Some Basic Properties of Accounting Ratios. Journal of Business Finance and Accounting. 219-232.