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PhD thesis

GEOGRAPHICAL SEGMENT DISCLOSURE AND CAPITAL MARKET RISK ASSESSMENT OF MULTINATIONAL ENTERPRISES

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GEOGRAPHICAL SEGMENT DISCLOSURE AND CAPITAL MARKET RISK ASSESSMENT OF MULTINATIONAL ENTERPRISES

ABSTRACT

This study examines the geographical segment disclosure practices of UK based multinationals in a capital asset pricing framework during the period 1973-1982. Thirty six companies were chosen from "The Times 1000" for the year 1981-82 which had substantial overseas sales (at least 10% of consolidated sales), had year end on 31 December, had continuous listing on the London stock exchange for the nine year period, and had either continuously disclosed geographical segment information in their financial statements in each of the years, or had changed their geographical segment disclosure practices from non-disclosure to disclosure on 31 December 1977.

An intervention analysis was carried out to test the impact of intervention (change in disclosure practice) on the systematic risk profile of the treatment group (twentyone companies), as compared with the control group (fifteen companies). Moving regression was used to generate a time series of betas, and beta of betas was used to test the stability of betas over time. Results showed that geographical segment data

had information content; that the London stock market was efficient in a semistrong sense; and that there were overall reductions in risk arising from geographical segment disclosure accruing to the treatment group companies as a consequence of changing their disclosure practices.

The contribution to knowledge from this research lies in its being one of the few market efficiency studies based on the London stock market, and the first to test the market's response to geographical segment disclosures.

This research also provides evidence relevant to the debate on segmental disclosure in the United Kingdom.

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CHAPTER I

INTRODUCTION

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.0 The Environment

It is generally believed that data provided in the financial statements "directly affect the way in which conflicting interests are resolved" (Ijiri, 1967, p 67). This view, although popularly believed to be true, may not necessarily be the whole truth. It is also possible, that there is a flow of influence in the opposite direction - the pressure group theory, which believes that the development of financial reporting practice is affected by the conflicting interests of various user groups such as management, consumers, investors, creditors, regulatory bodies, and others (Aranya, 1979). Developments in geographical segmental disclosure can be seen in the light of these pressure groups.

Although the demand for segmental financial disclosure has gathered momentum only in the 1970s, (Skousen, 1970), this is not an isolated phenomenon. In the 19th century, joint stock companies evolved in response to the substantial financing needs of corporations in the wake of the industrial revolution, which the pre-19th century form of owner-manager organisations could not satisfy (Yamey, 1960; Ma, 1982). As substantial additional financings were sought, and joint stock corporations were formed, demand for financial information geared to the needs of the shareholders also grew. The Joint Stock Corporations Act of 1844 in the UK was probably the first in the world to pioneer such information disclosure, requiring companies to present a 'full and fair' balance sheet to shareholders, although it did not specify the form and contents or valuation methods to be used (Edey and Panipatki, 1956, pp 356-357).

As the industrial revolution became diffused from its UK base in the 19th century, disclosure requirements similar to those of the UK were pronounced by regulatory authorities in other countries of the continent of Europe and North America and subsequently in the rest of the world to protect the interests of investors and others from unscrupulous acts by insiders such as managers and directors. The US Securities Act of 1933, and Securities Exchange Act of 1934 are two such initiatives on regulating financial reporting by corporations to protect the interests of investors and other user groups in the aftermath of the 1929 crash, and pressures from the New York Stock Exchange. An overview of the chronological development of company financial reporting can be found in Zeff (1979) in the US context, and in Nobes and Parker (1979) in the UK context.

As the industrial revolution matured, and technology became more sophisticated, businesses expanded to reap the benefits of a larger scale of operation, and smaller organisations merged with larger ones. As the merger movement gathered momentum in the second half of the 20th century, business activities became increasingly diversified (Steiner, 1975) and expanded across national frontiers, even ignoring product-market logic, in the form of conglomerates (Mueller, 1980). Just as the industrial revolution resulted in general financial disclosure being demanded, reflecting the change from owner management in the pre-19th century to joint stock corporations, so did the development of business combinations and diversification in the 1960s and after give rise to a demand for segmental disclosure as mergers and diversifications resulted in less and less meaningful information being available to investors and other user groups (Ronen, 1982).

In the United States of America the Subcommittee on Antitrust and Monopoly of the Senate Committee on the Judiciary began hearings on the economic concentration in American industry in September 1964. Various pressure groups represented by users such as accountants and financial analysts gave evidence to the Subcommittee on Antitrust and Monopoly demanding more meaningful segmental disclosure which culminated in the Securities and Exchange Commission (SEC) requiring disclosure by diversified companies of the results of operations by line of business in 1969, and subsequently the Financial Accounting Standards Board (FASB) publishing Financial Accounting Standard (FAS) No. 14 on segment reporting in 1976. Developments surrounding the segment reporting issue in the USA have been chronicled by Skousen (1970).

Segment reporting as required by the SEC or the FASB is mainly of the line of business variety. While this is a legitimate area of disclosure, as business organisations have become more and more transnational, a further development in information required for users is data on geographical performance. While there is some evidence of debate in the international capital markets literature on the benefits of geographical diversification (Grubel, 1968; Levy and Sarnat, 1970; Agmon, 1973), there has been very little research on geographical diversification in the context of financial reporting. Yet, "Segmentation on a geographical basis is not an alternative to segmentation on the basis of line of business activity. It is distinctly and significantly different, as foreign countries often exhibit different risk and return profiles..." (Gray, 1981, p 39).

This is the environment of geographical segmental disclosure. There has been no accounting standard or exposure draft on segmental disclosure in the United Kingdom, although the Accounting Standards (Steering) Committee in Corporate Report (1975, paras 6.49-6.51) has found segmental disclosure to be a plausible mode of financial reporting. The UK Companies Act 1981 and the London Stock Exchange Listing Agreement (1979) also require geographical segmental disclosure, although such requirements are not very rigorous largely due to practical difficulties of segment identification, materiality and meaningfulness.

Apart from the UK and the USA, various international bodies also have made pronouncements regarding segmental disclosure, including geographical disclosure. A comparative analysis of segmental disclosure requirements by various national and international bodies appears in chapter III (section 3.2) following.

1.1 The Disclosure Issue

The disclosure issue in the context of this research is the issue of information disclosure. Information is not synonymous with data. While data are simply facts which are obtained through empirical observation, and knowledge a group of law like generalisations relating data to the environment, information is the resulting co-ordination of data with knowledge when data are screened, edited and evaluated for use by a specific user in a given situation (Caspari, 1968). Thus, any system of financial disclosure need be user oriented, taking cognizance of user needs and user environment (AAA, 1977).

Information, once public, has public goods characteristics (Demski, 1974). In a multiperson setting user needs and user environments can be various. In such diverse setting, if Pareto optimality is unattainable, then second best (Prest and Turvey, 1965) will have to do, where a disclosure system should be such that given the social and institutional constraints, the system should be acceptable by the majority.

There are costs as well as benefits of disclosure. Information has to be produced as well as disseminated. It can be argued that disclosure decisions are best left to the market mechanism. In an efficient market, all information would be impounded in stock prices. This may be true of public information, but market efficiency in the strong form sense, reflecting private information is far from proved (Dyckman, Downes and Magee, 1975; Jensen, 1978). It can be argued that "self interest" or "capture" theory would operate in any system of voluntary disclosure where companies would produce and disclose information only up to the point where the benefits from disclosure in the form of lower cost of financing and obtaining credit are not negated by costs of information production, dissemination and competitive disadvantages (Mautz and May, 1978).

It can also be argued that left to the free market, a disclosure system might not work in the best interests of the society. Good news are likely to be disclosed while bad news might be suppressed (Horowitz and Kolodny, 1980), resulting in moral hazard problems (Arrow, 1971).

If voluntary disclosure is inadequate, mandatory disclosure might be an alternative. Yet, mandatory disclosure could result in information overload (section 2.221) from the user viewpoint, additional costs of information production and competitive disadvantages from the producers' viewpoint, and costs of bureaucracy from the societal viewpoint. To recommend mandatory disclosure practice, it will have to be shown that the realised inadequacies of market outcomes are greater than potential inadequacies of non-market efforts to ameliorate them (Wolf, 1979).

The disclosure issue is thus an issue of social choice; of striking the right balance between mandatory and voluntary disclosure systems taking into account the multi-person nature of information and non-transitivity of individual and social choices (Arrow, 1951).

1.2 Geographical Disclosure and Risk

The geographical segmental disclosure problem is distinctly different from line of business disclosure problem because foreign countries often exhibit different risk-return profiles due to varying histories of economic development, cultural differences, and differing host government ambitions and requirements (Kobrin et al, 1980). Disclosure of geographical prospects by multinationals can help investors in the assessment of risk return prospects of multinationals since finer information can result in a better understanding of the aggregate (Marschak and Radner, 1972).

In an efficient market, finer geographical information is likely to be reflected in the stock prices resulting in better investment or divestment decisions by individuals. In a two parameter mean-variance efficient portfolio when all firm related unsystematic risk can be diversified away (Sharpe, 1964) all that matters is systematic risk. If finer information about geographical prospects affects the volatility of stock prices, then it may be worthwhile investigating if such information will also affect the systematic risk of conglomerates. International capital market literature (Lessard, 1974) posits that a multinational company's risk can be decomposed into industry, country and world factors. If the country factor is a significant influence, then it is possible that geographical segment disclosure resulting in finer information about country prospects will also affect a multinational's risk.

1.3 The Objective of this study

The objective of this study is to examine the association between multinationals' systematic risk and their geographical segment disclosure practice. This association will be examined by testing two hypotheses:-

1 If geographical segment data have information content, then there will be an association between geographical segment disclosure and multinationals' beta without prejudice as to the direction in which the betas might move. If this association is supported, then it will substantiate the notion of market efficiency in a semi-strong sense so far as geographical segment information is concerned, and provide evidence in support of the international market model which suggests that multinationals' beta can be decomposed into world, country and industry factors. This is the main hypothesis of this thesis.

2 If finer information in the form of geographical segment data reduces overall uncertainty about the company's prospects, then such reduced uncertainty may result in a reduction in the total variability of the company's stock prices. To the extent that total variability of the company's stock prices includes systematic risk, it is possible that on average there will be an association between geographical segment disclosure and reduced systematic risk. If this second hypothesis is supported, it will give weight to earlier research by Choi (1973 b), Dhaliwal (1978) and others who have found evidence that improved disclosure can result in a lower cost of equity capital.

The two above hypotheses will be tested in the context of UK based multinationals during the period 1973-1982.

1.4 Limitations

The objective of this study as outlined earlier (section 1.2) is of necessity limited. The limitations are as follows:-

(i) This research will concentrate on geographical segment disclosure. By concentrating on geographical disclosure, it will naturally not emphasise other forms of disclosure such as line of business. The reason for concentrating on geographical disclosure is that while line of business disclosure has been extensively investigated by earlier researchers (eg Kinney, 1971; Collins, 1976a) in the USA, there have been very little published research investigating geographical segmental disclosure.

(ii) It will examine a UK database rather than US or other database, primarily because research in the area of segmental disclosure on UK database have been very few (Emmanuel and Pick, 1980 being the exception).

(iii) It will examine disclosure benefits only, and exclude costs from the scope of the investigation, to keep the research in manageable size.

(iv) It will concentrate on one user group only, the investors and not investigate disclosure benefits to other user groups such as employees, trade unions, consumers etc because of the difficulties in obtaining meaningful data for user groups other than investors.

(v) Even within the context of benefits to investors it will only investigate the association between risk and geographical segment disclosure ignoring other benefits such as improved forecasting ability of segmental information.

1.5 Database and Methodology

Database and methodology of this research are explained in chapter VII, and an overview is also given in appendix VII(E).

Database and methodology of this research will be geared to the achievement of the limited objective outlined in sections 1.3 and 1.4 above. Since the proposed area of investigation is the segmental geographical disclosure practice of UK based multinationals, the companies to be chosen must be of UK origin, substantially large, with a significant amount of foreign sales, and have a common year end to minimise the impact of seasonal fluctuations in their fortunes and consequently on their stock prices.

As the companies' systematic risk profiles are to be examined, the time series to be chosen must be one with a reasonable length, five to ten years, for which continuous stock prices will be available. The index to be chosen as a market proxy must similarly be continuous. Stock prices for the companies' will have to be adjusted for capitalisation issues and dividends.

Since geographical segment disclosure practices are to be investigated, the companies chosen will have to be grouped into treatment and control groups, and risk characteristics of the treatment group will have to be compared with that of the control group. To be able to compare this risk profile differences between the two groups effectively, an intervention point will have to be chosen at which the treatment group will have changed its segmental disclosure practices. There will have to be enough observations on either side of the intervention point to enable a meaningful time series measurement.

Underlying characteristics of the data will have to be examined to establish appropriate methods for testing. For instance if the underlying data are serially correlated or unstable, intervention analysis might be used instead of cumulative average residual method.

Appropriate statistical tests and significance level will have to be chosen to be able to draw meaningful conclusions. Finally, to improve external validity of the conclusions which may be drawn, confounding variables will have to be identified, and their influences on the results tested.

1.6 Expected Contribution to Knowledge

Expected contribution to knowledge stemming from this research are as follows:-

(i) Since disclosure benefit studies until now have primarily been conducted on US data, this research will contribute to the fund of knowledge by extending disclosure benefit studies to UK based companies of which there has been only one (Emmanuel and Pick, 1980).

(ii) It will probably be the first ever study on segmental geographical disclosure benefits in the UK context, since Emmanuel and Pick's research only investigated the forecasting ability of industry segmental data.

(iii) By testing market reaction to segmental geographical information in the London Stock Market, it will provide evidence of market efficiency or otherwise of the London Stock Exchange, in a semi-strong sense.

(iv) By testing for country influence, as one of the components of disaggregated beta, it will provide evidence in favour or otherwise of one of the possible 'k' factors in the Arbitage Pricing Model of Capital Asset Pricing.

(v) It will test the applicability of the cumulative average residuals in capital market studies by examining the underlying characteristics of the datapoints in the timeseries, and possibly showing the applicability of intervention analysis.

(vi) It will contribute to the dormant issue of segmental disclosure in financial reporting in the United Kingdom. The Accounting Standards committee did examine this issue in the Corporate Report (1975) but very little has been done about it since then.

1.7 An Overview

Earlier sections of this chapter have introduced the segmental geographical disclosure issue in the UK context, explained research objectives and limitations, described possible approaches in database and methodology, and stated the possible contributions to knowledge stemming from this research. In this section, an overview will be provided showing how the objective of this research is likely to be achieved.

Chapter II will set the scene by explaining the theoretical background of information disclosure following which segmental disclosure issues will be analysed in chapter III. Since this research is about information disclosure in the context of the capital market, chapter IV will provide a background of information processing efficiency of the stock market, and chapter V will examine the risk assessment aspects.

Prior research in the area of segmental disclosure in general, and segmental geographical disclosure in particular will be analysed in chapter VI, setting the scene for empirical analysis. Hypotheses, database and experimental design of the empirical aspects of this research will be explained in chapter VII, and the results will be analysed and interpreted in chapter VIII.

Chapter IX will explore the implications of this research for market efficiency, for risk measurement, and for disclosure policy formulation. Chapter X will contain a summary of what has been achieved in this research, and what has not, and point to some areas of future research. A bibliography of all references cited in this research will be provided in chapter XI.

First, the theory of information disclosure, of which geographical segment disclosure is a subset, will be examined.

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CHAPTER II

THEORY OF INFORMATION DISCLOSURE

CHAPTER II

Sections

Figures

2.0 Introduction

This research is about segmental disclosure and multinationals' risk assessment. Thus, there are two important strands in this research: (i) financial reporting aspects and (ii) risk profile aspects. This chapter will be concerned with the financial reporting aspects. In particular the theoretical foundation of disclosure, of which segmental geographical disclosure is a subset, will be the main concern of this chapter.

Since disclosure is about information, this chapter will discuss both disclosure and information in a general sense. First, the normative nature of disclosure will be discussed and the nature of user needs and user environment will be explored. Such user needs and user environment concepts will be utilized in establishing a disclosure framework.

Information concepts will then be defined, and the quantitative and qualitative aspects of information will be explored. Distinctions will be made between the physical approaches to information theory and the psychological approaches. Finally, special problems of information disclosure in a multiperson setting will be analysed.

2.1 Disclosure

The central purpose of financial reporting is the disclosure of economic data about reporting entities.

> "... at a very general level, accounting writers appear to agree that the central purpose of financial accounting is the systematic provision of economic data about reporting entities ..." (AAA, 1977, p.1)

In this systematic provision of economic data about reporting entities, a distinction is sometimes made between 'decision based systems' and 'accountability based systems.' A system that is decision based is centered on the decision maker, namely the user of information. A system that is accountability based, on the other hand, focuses on the relationship between the producer of the information and the user of the information. (Ijiri, 1983).

Irrespective of which framework one uses, "users" play a key role in establishing financial reporting objectives.

It is possible to conceive of a large number of criteria as being relevant in the evaluation of financial reporting systems. AAA (1977, pp.16-17) lists reliability, relevance for decision making, timeliness, comparability, predictive ability and optimal quantity and cost as being some of these criteria. It is possible that there are others. But all these criteria are just subsets of one overall criterion - "usefulness." (Peasnell, 1973).

If usefulness is the overall criterion, then user needs should be paramount in designing and evaluating financial reporting systems. Appropriate disclosure of financial data and relevant information to the users is thus a key issue in financial reporting. An understanding of user characteristics, and the environment in which users operate would thus be a prerequisite in the formulation of an appropriate disclosure policy in financial reporting.

2.11 User needs

The set (or sets) of users of financial accounting reports need to be specified before a reporting system appropriate for such users can be designed and evaluated. In more recent years users have been seen not as a homogeneous group such as shareholders, but as consisting of divergent interest groups such as creditors, employees, regulatory authorities, the general public, consumers, and many others in addition to shareholders. (Demski, 1974; Corporate Report, 1975; AAA, 1977).

Even when the population of users is specified, a number of questions remain about the behaviour of users needs which require clarification. Some of these questions are:

1. To what extent do beliefs and preferences vary across users?
2. Do differences in user beliefs and preferences affect (i) the demand for, and (ii) use of accounting reports?

3. Are users influenced by 'form' as well as by 'content' of accounting reports?
4. When faced with multiple sources of data, how do users combine the various data into a composite assessment?
5. Do answers to any of the above questions change when one looks at users in the aggregate rather than individually?

(AAA, 1977).

These are important questions, and in many cases there are interdependencies. Moreover user needs are not independent of user environment. The environment in which the user operates may change his perception of needs for financial reports.

2.12 User Environment

User specification and user needs are important in establishing an appropriate disclosure framework. Equally important is an understanding of the environment in which the user is likely to operate. (AAA,1977).

Some of the important environmental issues relevant in the setting up of a disclosure framework are:

1. When competing sources of information exist who should produce the information? Cost considerations in such cases will have to be weighed against the efficiency of such information with regard to both form and content.

2. Information 'efficiency' of the market is another important environmental issue. To what extent are securities markets 'efficient' in reflecting available information? If there are market failures, is intervention necessarily desirable?

3. Externalities may exist among users. Disclosure of segmental results by line of business or by territories, for instance, may reduce the entity's competitive strength if potential or existing competitors are able to use such information to the detriment of the discloser.

4. Externalities among producers of information can also be an important consideration. Information disclosed by one source may affect disclosure by another.

These are some of the environmental issues in a disclosure context. It is possible newer environmental issues will emerge over time as the institutional structure of society changes. Simultaneous consideration of user needs and user environment enhances the possibility of the formulation of a plausible disclosure framework.

2.13 A Disclosure Framework

A plausible disclosure framework should take into account both user needs and user environment. Users are the beneficiaries of disclosure. Therefore, if users are identified as investors, then the pertinent information to disclose will be the risk-return profile of the entity. If users are identified as employees of the organization, then potential continuity of employment will probably be the main concern.

Since beliefs and preferences of user groups vary in a multi-group situation, disclosure emphasis may have to be different even in disclosing the same information in different environmental context. 'Sophisticated' users such as financial analysts may not be particularly concerned with 'form' as they can extract 'contents' easily, while unsophisticated users may be greatly influenced by 'form' of disclosure.

Even the same user may have multiple objectives, and the same information may have to be disclosed in different settings. There may be potential conflict here since the meaning of the data may change depending on the context in which such data is disclosed.

Finally, any individual user is also a member of a group. An item disclosed may have different consequences in an individual setting from those in an aggregate setting.

Taking segmental disclosure as a specific issue, some of the pertinent questions may be formulated as follows:

1. Is there a need for segmental disclosure, from the individual point of view and the societal viewpoint?

2. Who would be the likely users of such information, and to what end?

3. What are the likely benefits from such disclosure?

4. What are the likely costs, and who should bear such costs?

5. Should all entities be asked to disclose segmental information, or only those with 'substantial' business identified by turnover, trading profits, or capital employed?

6. Are there incentives for voluntary disclosure, or should such segmental disclosure be mandatory?

7. If segmental disclosure is warranted, how should segments be identified? Should segments be identified by line of business, by territories, or something else?

8. If segments are identified by territories, how should such territories be identified? Is it by continent, by countries, or simply by home and export?

9. What should be the contents of such segmental geographical disclosure? Should it be sales, profits, capital employed, or some others, or some combination thereof.

These are just some of the questions. Answers to each one of these can be many. Possible answers to these questions need careful consideration before a plausible disclosure framework can be established.

Financial reporting is about disclosure of economic data about reporting entities. To be meaningful such disclosure has to be of value to users. In a multi-person setting user objectives and abilities differ. Therefore, to maintain usefulness, disclosure methods and forms must vary depending on user need and user environment. Environmental considerations include externalities among users, among producers, and between producers and users. Disclosure ramifications thus overflow into the areas of interrelationships between groups and within groups. An understanding of information theory can enhance one's understanding of these interrelationships.

2.2 Information

In a user oriented framework of accounting, the purpose of financial reporting is the disclosure of financial and related information to users such as investors, creditors and others. Since disclosure is disclosure of information, an understanding of information theory concepts will be beneficial in understanding the nature of information disclosure.

Before the ramifications of information theory can be explored, some of the definitions related to information concept need to be clarified. In the information theory literature a distinction is made between (i) data (ii) knowledge and (iii) information. Caspari (1968, p.8) for instance has distinguished these three concepts as follows: Data are simply facts, which are obtained through empirical observations. Knowledge is a group of law-like generalisations which relate data to their environment; information is the resultant coordination of data with knowledge when data are screened, edited and evaluated for use by a specific user in a given situation. Thus knowledge is the means by which data become useful to the user; knowledge may become information when it is used in making a decision.

The definition of information as given above is the one accepted in the social sciences. However, early developments in information theory which were in the physical sciences (mainly in telecommunication) had no such user orientation. Information in telecommunications was devoid of 'meaning'. According to Shannon and Weaver (1949) "information must not be confused with meaning" (p.8). Information system in telecommunications context consisted of five components: source, transmitter, channel, receiver and destination. The system was an objective physical system, sender oriented and mechanical.

Developments of information theory in the social sciences have been mainly in psychology where the physical signal transference concepts have been merged with perceptional aspects of human beings resulting in Human Information Processing (HIP) theory which has taken into account the receivers' objectives (Brunswik, 1952; Miller, 1960). More recently the ramifications of information concepts have been extended to the societal context (Demski, 1974), and in the context of organizational environment (Feldman and March, 1981).

In the sections following information theory will be explored both in a quantitative sense as well as in a qualitative sense in a single person setting; subsequently information choice in a multiperson setting will be analysed.

2.21 Amount of Information (The Bayesian Approach)

Information theory as developed by Shannon (1949) in telecommunications was primarily directed at measuring the amount of information contained in a message. The objective of such an approach to quantification can be grouped into three categories:

(i) to provide analytical means for measuring the capability of transmission channels in order to determine the optimal size;

(ii) to minimize the undesirable effect of "noise"; and

(iii) to determine the amount of redundancy in a message in order to economise on its size.

The information theory approach to quantification is based upon the premise that, for any problem, there are a certain number of possible answers to which probabilities may be attached.
When information about the problem is received, the original probabilities undergo a transformation. Some answers may no longer exist as a possibility and their probabilities become

zero, while the probabilities of other answers may increase, decrease or remain unchanged. Information is defined in this context as a function of the two sets of probabilities: the one before the reception of the message and the other after it. Thus, knowledge of the changes in the probabilities permits measurement of the amount of information contained in the message that induced these changes.

2.211 Uncertainty Reduction

Information is related to the decrease in the amount of doubt concerning the occurrence of an event. Therefore, the amount of information is a function of the unexpectedness of an event. Learning the occurrence of an unexpected event is worth far more than if it is expected. The greater the expectation or probability associated with the occurrence of an event, the smaller is the amount of information contained in a report of its occurrence.

A prior estimate of the amount of information expected from a message labelled "entropy" is the summation of the probability of each possible event times the amount of information associated with its occurrence. The minimum condition under which information can be transmitted is that in which a choice or selection must be made between two alternatives. The maximum uncertainty will exist when the two alternatives have the same probability of occurrence, as in the toss of a coin. By definition, wherever a choice is made between two alternatives which on an a priori basis are equally likely, it is specified that the choice has transmitted one unit of information. This unit is called the "bit" - a contraction of the words "binary digit". One unit of information is necessary to make a binary decision. Thus, if there are 8 possibilities and each one is equally likely to be selected, and only one of these 8 is chosen, the amount of information transmitted is 3 bits: $2^3 = 8$.

Blackwell and Girschik (1954) formalised this uncertainty reduction aspect of information by emphasising the receiver of the information, and used Bayesian Decision Theory. The result of Blackwell's theorum most frequently used in accounting literature states:

> Given two (noiseless) systems, Y and 'Y', Y will be at least as valuable as 'Y' for every probability density, and for every payoff function, if and only if Y is at least as fine as 'Y'.
>
> (Marschak and Radner, 1972, pp.64-66)

The mathematical relationship between uncertainty and probability is given by the logarithm of one divided by the probability of selecting a given element from the set of elements.

Symbolically, if we define -

H = degree of uncertainty, and

p = probability, then

$H = \log (1/p) = - \log p.$

In the two limiting cases -

if $p = 1$, then $H = 0$

if $p = 0$, then $H = \infty$

In most choice situations, however, we have -

$0 < p < 1$

$\infty > H > 0$

If the possible number of equiprobable events is reduced in the process of choice from the initial probability p_o to p_1 after information signals are received, the degree of reduced uncertainty which is also known as the quantity of information ($\bar{H}$) is measured in bits (binary units, for example yes and no answers) by the following expression:

$$\bar{H} = \log_2 p_o - \log_2 p_1$$

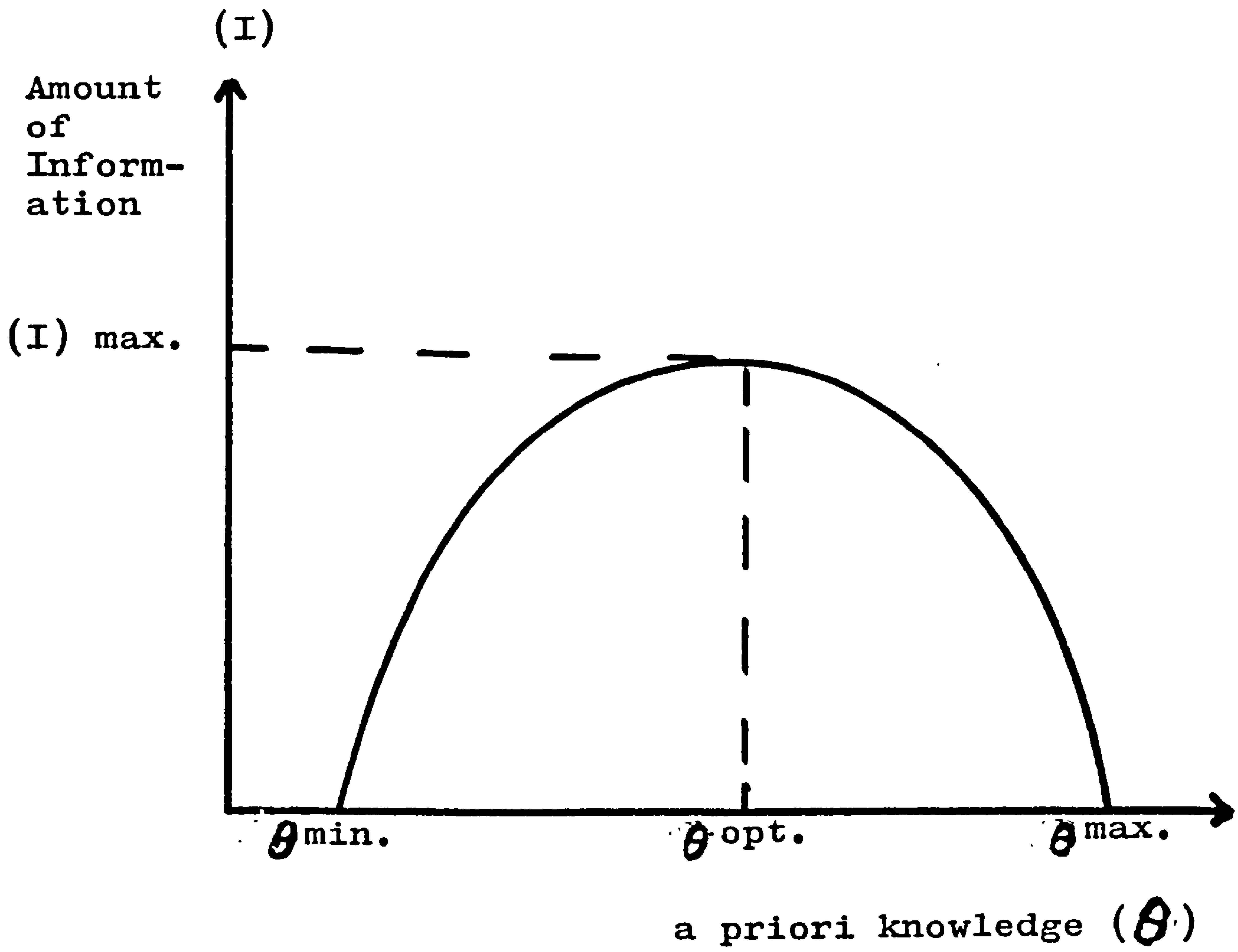
$$= \log_2 (p_o / p_1) \text{ bits}$$

Feltham (1972, p.9) has defined information as

> "the meaning derived from data, provided the knowledge of the person receiving those data is changed ... data are information if their receipt results in change in the receiver's probability distribution".

To derive "meaning" it is important to consider the role of a priori knowledge. Gorelik (1975) has mapped the relationship between a priori knowledge, and the quantity of semantic information from a message as follows:
(Figure 2.1)

A Priori Knowledge and Amount of Information



θ min. = Minimum amount of a priori knowledge necessary for the receiver to begin to understand a given message.

θ opt. = The optimal amount of a priori knowledge enabling the receiver to extract all the information from a given message.

θ max. = The amount of a priori knowledge with which the receiver will extract nothing new for himself from a given message.

(Gorelik, 1975, pp.120-121)

Figure 2.1

Figure 2.1 shows that at a certain level of a priori knowledge maximum amount of information is obtained; θ optimum is this level. If a priori knowledge is very little or non existent, very little or no information is obtained from the data because the receiver is not able to relate the data to any decision setting. At the other end of the scale if a vast amount of relevant a priori knowledge is already in the possession of the receiver, the data has no surprise value, hence no information is obtained from the data.

2.22 Value of Information

In a user oriented discipline such as accounting, knowing the amount of information is not enough, it is important to be able to establish of what value the information is to the user.

Value is that quality of anything which makes it desirable. Marschak and Radner (1972, p.85) have defined value of information as follows:

> "Value of information is that cost which equate the maximum net expected utility for the given information structure to the maximum net expected utility obtained with no information."

It is implied in the definition of value of information that the value of information generally arises from an interaction between: (i) information, (ii) receiver of the information and (iii) the receiver's goals or needs. In this context information has value only as long as it facilitates the achievement of some goals, or satisfies some need of a given receiver. Further, value of information results from an interaction of objective factor (information) and subjective factor (user). Moreover, value of information can be related to the concept of variety or distinctness. Value can be related to a choice of a rare, and therefore, valuable element from some set of elements. Relevance, accuracy, timeliness and other factors can also enhance value of information by making it more useful. (AAA.1977, p.16). In general, to be of value, information must cause a better decision to be made than would be made without the aid of that information. The monetary value of information is the additional profit which may be obtained, or loss which may be avoided, through the use of the information.

2.221 Information Overload

Implicit in the value of information discussed above is the perception of usefulness of information by the user for decision making purposes. This perception of usefulness depends on judgmental capability of the receiver of the information.

The decision maker's judgmental capability is affected by information overload. The phenomenon of information overload has been discussed both in accounting and in the psychology literature. (Bedford, 1973; Bedford and Baldouni, 1962; Miller, 1960; Revsine, 1970; and Schroder, Driver and Streufert, 1967).

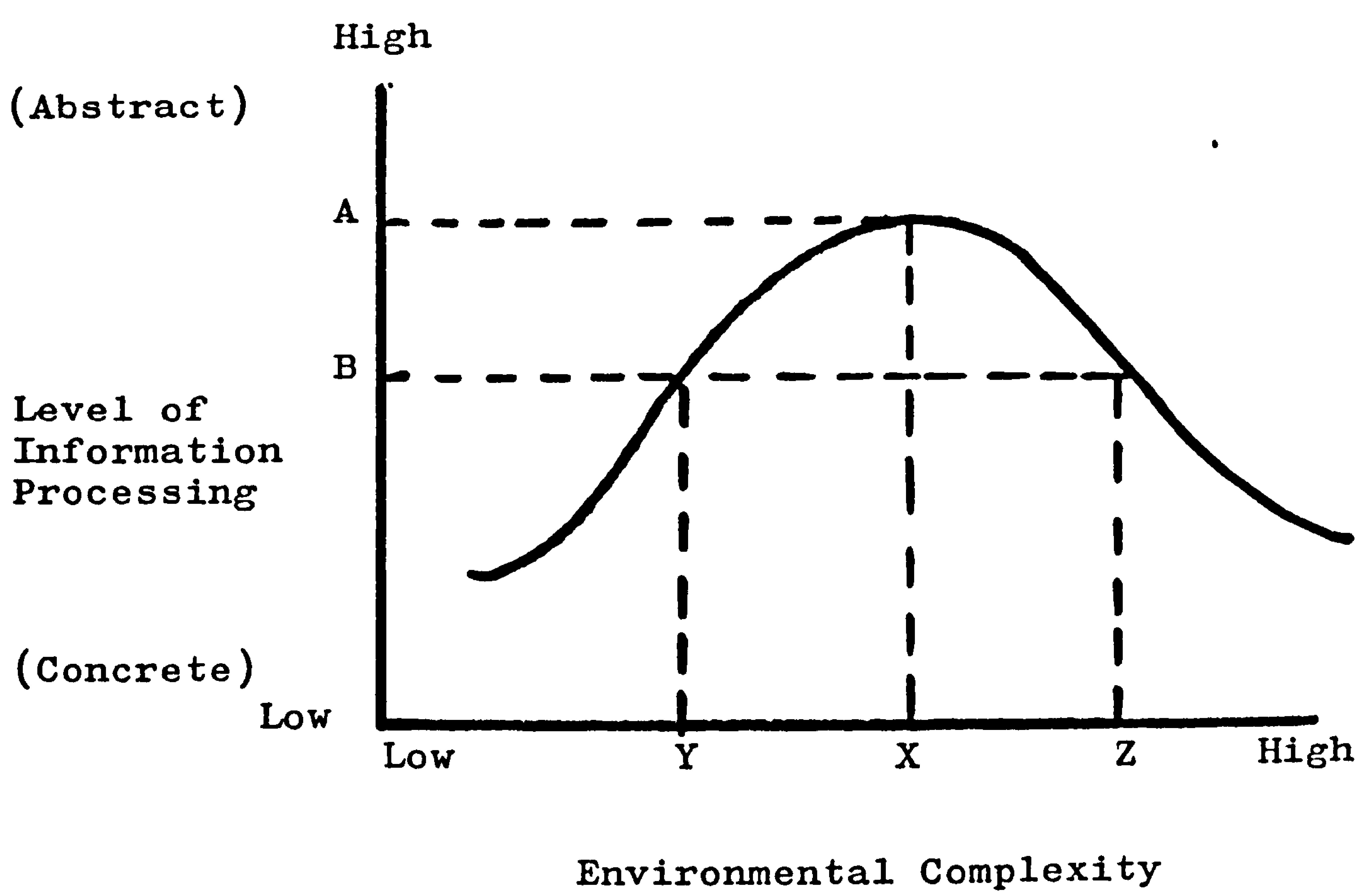
As the complexity of information available to a decision maker increases, the individual's conceptual processing level becomes more and more abstract, i.e. he perceives more and more dimensions to the decision and integrates the data using relatively sophisticated analytical techniques. At some point, however, the information to be processed becomes so complex that the decision maker reverts to a more concrete level of processing the data. He does this because he is no longer able to mentally manipulate all the data which is now available.

Revsine (1970) introduced this model of Human Information Processing in accounting literature following Schroder, Driver and Streufert (1967) who developed this theory of individuals and groups functioning in complex social situations in the field of psychology. Schroder, Driver and Streufert (SDS) developed and empirically tested this human information processing (HIP) model which establishes a curvilinear relationship between the level of information processing and environmental complexity as shown in Figure 2.2.

Disregarding individual differences, information processing by "people in general" reaches a maximum level of structural complexity at some optimal level of environmental complexity (point X in Figure 2.2). Increasing or decreasing environmental complexity (points Y and Z) from the optimal point (X) lowers the conceptual level from A to B.

According to SDS environmental complexity is composed of two distinct sets of properties. The primary property set includes information load, information diversity and the rate of information change. The secondary property set is comprised of two motivational elements - noxity, the severity of adverse consequences of behaviour; and eucity, the reward or promise given by an environment.

The General Relationship Between Environmental Complexity and Behavioural Complexity



(Schroder, Driver and Streufert, 1967, p.37)

Figure 2.2

Environmental Complexity Vs Information Processing

(For Different Levels of Personalities)

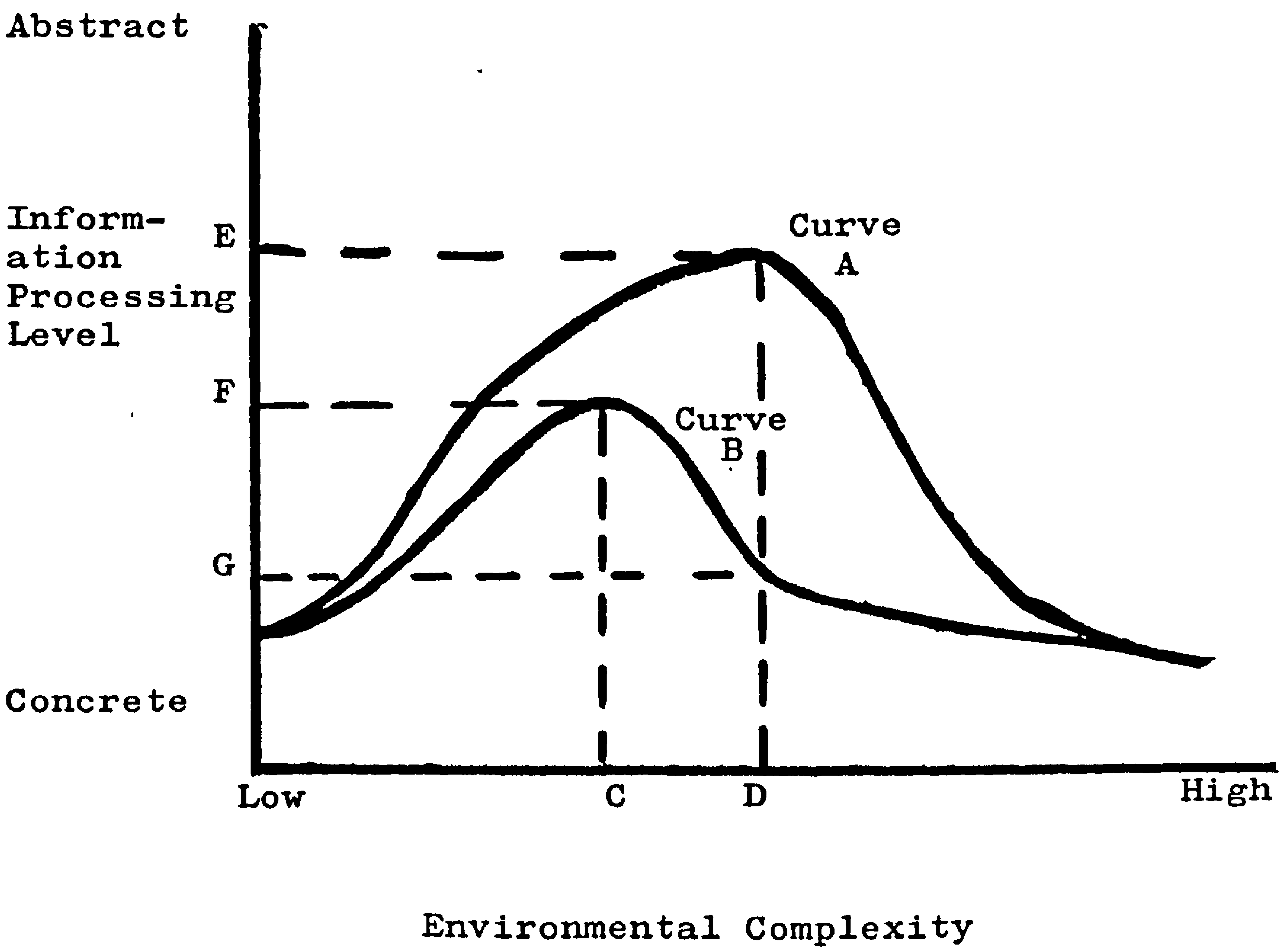


Figure 2.3

Figure 2.3 extends the theoretical relationships shown in Figure 2.2 to the question whether the "peak" of the curve is the same for all individuals. If innately abstract decision makers have a higher peak, for example, then the notion of an optimal level of environmental complexity for corporate disclosure is probably naive (Revsine, 1973). This also means that the probability is low of designing a corporate disclosure system that fits the conceptual processing level needs of all individuals.

Individual differences in the level of information processing ability may be expressed as a family of U curves as shown in Figure 2.3. According to SDS (p.39), individual differences in conceptual level (in one stimulus area) measured around the mid or optimal point on the scale of environmental complexity will progressively decrease as the environment becomes more extreme in either direction.

Curve A in Figure 2.3 represents innately abstract decision makers, while curve B represents decision makers whose information processing ability is innately concrete. Maximum differences between behavioural complexity for any two curves expressing information processing ability occurs at the optimal level for the more abstract group. The distance E-G in Figure 2.3 is larger than the distance E-F.

Information overload is thus a function of environmental complexity and the decision makers' ability to process such complex information for decision making. Because individual information processing abilities differ his judgmental response to environmental conditions will also differ as a consequence. Brunswik's Lens model has taken this response accuracy of subjects (decision makers) and produced an integrative human information processing theory.

2.222 The Lens Model (The Regression Approach)

The concept of value of information brings in the psychological aspects of the information problem into focus. The engineering approach to information (Shannon and Weaver, 1949) is essentially one of a theory of coding and transmission alone, concentrating on the sender. Statistical decision theory and reduction of uncertainty approaches (Blackwell and Girschik, 1954) concentrated on the receiver alone leaving out the communication component which links the receiver and the sender. Marschak (1968) has shown this partial nature of information theory as adapted by engineers and statisticians. Psychologists provided the missing link. While engineers and statisticians looked at the quantity of information, psychologists (Brunswik, 1952, 1955, 1956; Schroder, Driver and Streufert, 1967) concentrated on the quality of information.

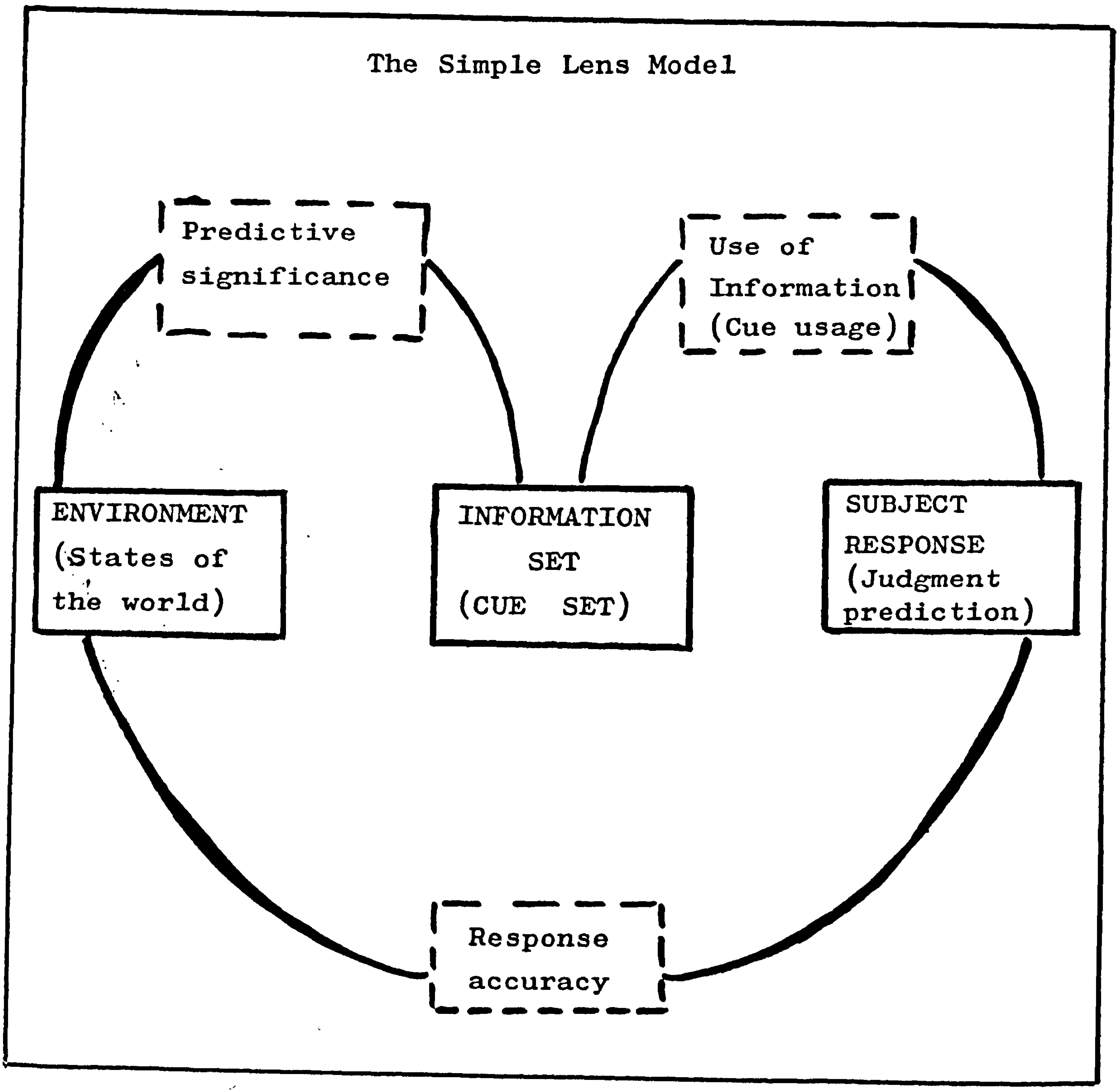


Figure 2.4

INPUT → PROCESS → OUTPUT

I Information set (cues)

A. Scaling characteristics of individual cues:
   1. Level of measurement (nominal, ordinal, etc.)
   2. Discrete or continuous
   3. Deterministic or probabilistic

B. Statistical Properties of the information set:
   1. Number of cues
   2. Distributional characteristics
   3. Interrelationship of cues
   4. Underlying dimensionality

C. Information Content (Predictive Significance)
   1. Bias (systematic error)
   2. Reliability (random error)
   3. Form of relationship to criterion

D. Method of presentation
   1. Format (numerical-graphical-verbal)
   2. Sequence
   3. Aggregated or disaggregated (precombination of data)

E. Context:
   1. Physical viewing conditions:
   2. Instructions
      a. Objective
      b. Costs and rewards
      c. Information about cue attributes
   3. Task characteristics:
      a. Type
      b. Response mode
      c. Social influences
      d. Uniformity of information over cases
   4. Feedback

II Judge (decision maker)

A. Judge characteristics
   1. Human-mechanical
   2. Number of judges
   3. Personal characteristics
      a. Intellectual ability
      b. Personality
      c. Cognitive structure
      d. Attitudes
      e. Demographic (eg., age, sex)
   4. Task related characteristics
      a. Prior experience
      -stored information
      b. Interest and involvement

B. Characteristics of decision rule
   1. Form (linear, configural compensatory, etc.)
   2. Cue usage (weighting)
   3. Stability (change-learning)
   4. Heuristics

III Judgment-prediction-decision

A. Qualities of the judgment
   1. Accuracy
   2. Speed
   3. Reliability
      a. consistency
      b. consensus
      c. convergence
   4. Response biases
   5. Predictability

B. Self-insight
   1. Subjective cue usage
   2. Perceived decision quality
   3. Perceptions of characteristics of information set.

CLASSIFICATION OF INFORMATION PROCESSING VARIABLES

(Libby and Lewis, 1982, p. 233)

Figure 2.4a

Brunswik (1952) proposed the Lens Model in which the relationship between the environment (states of the world), the information set, and subject response were analysed to establish response accuracy via cue usage and predictive significance. The basic framework of the lens model is shown in Figure 2.4. Figure 2.4a shows a detailed classification of information processing variables (Libby and Lewis, 1982, p.233). Brunswik portrays the decision maker as (i) being separated from the event of interest by time or space, (ii) faced with multiple overlapping cues which are imperfect predictors of the environment, and (iii) probabilistically combining these cues to form a judgment.

In effect, the environment is observed through a "lens" of imperfect cues. The focus is on judgmental achievement. The model suggests that judgmental achievement will be a function of both the environment and the decision maker (the subject). This dual effect implies that a complete understanding of decision making requires that the decision maker and the environment be studied jointly. The interaction between the individual and the environment is described by a number of relationships, including those among the cues, those between the cues and the criterion event, between the cues and the judge's (subject's) response, and those between the criterion event and the judge's response.

Brunswik's lens model developed out of his philosophy of "probabilistic functionalism" which led him to the study of an organism's success and failures in an uncertain world (Slovic and Lichtenstein, 1971, p.655). Brunswik developed the lens model to represent the probabilistic interrelations between organismic and environmental components of the judgment situation. Dudycha and Naylor (1966) has detailed some important relationships in the lens model in terms of multiple regression statistics. (Figure 2.5).

The variables X_1 X_2 ... X_k are cues or information sources that define each stimulus object. The cue dimensions must be quantifiable (if only to the extent of a yes-no coding). Each cue dimension has a specific degree of relevance to the true state of the world. This true state, also called the criterion value, is designated as Y_e. For example, the cues to be a set of financial ratios and the criterion value could be the existence of future bankruptcy; similarly cues could be a set of segmental disclosure practice, and the criterion value a certain level of systematic risk. The relevance of the J th information

Regression Formulation of the Lens Model

Adapted from: Dudycha and Naylor (1966)

Figure 2.5

source in the environment is indicated by the correlation, r_{je} across stimuli between cue X_j and criterion value Y_e.

This value, r_{je} is called the ecological validity of the j th cue. The interrcorrelations between cues are given by the r_{ij} values.

The ecological validity of a cue is a univariate measure and corresponds to Beaver's (1968) univariate predictive ability measure.

To determine the multivariate relationship between all the cues and the criterion event a linear regression model is formed:

$$\hat{Y}_e = \sum_{i=1}^{k} b_{ie} X_i$$

The multiple correlation coefficient $R_e = r\, Y_e \hat{Y}_e$ indicates the degree to which the weighted combination of cues serve to predict the state of Y_e. This measure is called the environmental predictability.

The RHS of the model represents the decision maker system. The decision maker's reliance on individual cues is measured by the univariate correlation between the cue (X_j) and the subject response (Y_s) and is called the utilization coefficient (r_{js}). If a cue is not selected or ignored, it is given a zero weight. The subject's decision making strategy or policy is given by the linear regression model

$$\hat{Y}_s = \sum_{i=1}^{K} b_{is} X_i$$

The multiple correlation coefficient $R_s = r\, Y_s \hat{Y}_s$ indicates how well the decision maker's judgments can be predicted by a linear combination of cue values. This is also known as the subject's response linearity. The importance of each of the cues in the environment and for the subject is measured by the value of the coefficients b_{ie}, and b_{is}.

Two important summary measures in the lens model are:

(i) the achievement index:

$$r_a = r\, Y_e\, Y_s$$

and (ii) the matching index:

$$G = r\, \hat{Y}_e\, \hat{Y}_s$$

Matching index represents the accuracy of cue utilization, while the achievement index is an expost measure of judgment accuracy.

Libby (1981) has shown that these two summary measures are related as follows:

$$r_a = G\, R_e\, R_s$$

$$\text{Achievement index} = \begin{pmatrix}\text{Matching}\\ \text{index}\end{pmatrix} \times \begin{pmatrix}\text{Environmental}\\ \text{predictability}\end{pmatrix} \times \begin{pmatrix}\text{Response}\\ \text{linearity}\end{pmatrix}$$

This shows that achievement index, the expost measure of judgment accuracy (r_a), is a function of:

1. the matching index, (G), measuring the accuracy of cue weighting or utilization
2. predictability of the environment, or predictive ability of the information, (R_e), and
3. predictability of the individual, his response linearity or consistency (R_s).

2.23 Bayesian Vs Regression Approaches

The Lens approach as described in the previous section is primarily descriptive whereas the Bayesian approach as described in section 2.21 is primarily normative. Models which guide accounting and research can rarely ignore either of these two dimensions. Normative models which lack some descriptive validity imply little for system design issue. Also, descriptive models which rely on principles that are not logically derived from goal premises are unlikely to remain in use (Mock and Vasarhelyi, 1978, p.415). In order to be able to appreciate the contribution made by the Bayesian (information economics) approach and the Lens model (the regression approach) to the understanding of the information processing problem, a comparative analysis will be attempted.

Comparative analyses of Bayesian and regression approaches have been made in the past by Slovic and Lichenstein (1971) and Mock and Vasarhelyi (1978). Following Brunswik (1952) a wide variety of mathematical models have been developed to capture judgmental policies in the Lens model. The most prominent of these models is the linear regression model used in Figure 2.5, developed by Hoffman (1960). Subsequently the linear discriminant function has been used by Rodwan and Hake (1964) in cue weighting process, and non linear formulations such as curvilinear and exponential models have also been attempted (Slovic and Lichenstein, 1971, p.659).

While the Bayesian approach concentrates on the major elements of information and decision process, the Lens model emphasises human information processing elements. Since it is primarily a descriptive model, the lens model may be deemed to be more representative of empirical information processing systems. Its strength lies in its inclusion of both information processing rules and relevant behavioural variables (such as overload constraints) into the framework.

However, failure to explicitly consider decision models and user objectives is a drawback of the Lens model.

The modern impetus for what is called the Bayesian paradigm can be traced to von Neuman and Morgenstern (1947) who revived interest in maximization of expected utility as a core principle of rational decision making and to Savage (1954) who fused the concepts of personal probability and utility into a theory of decision making under uncertainty conditions. The Bayesian approach is thus embedded within the framework of decision theory. Its basic principles are that opinions should be expressed in terms of subjective or personal probabilities, and that optimal revision of such opinions, in the light of relevant new information should be made via Bayes' theorem.

Because of its concern with decision making, the output of Bayesian analysis is not a single prediction (a point estimate), but rather a distribution of probabilities over a set of hypothesized states of the world. These probabilities can then be used, in combination with information about payoffs associated with various decision possibilities and states of the world to implement any of a number of decision rules, including the maximization of expected utility.

Bayes' theorem is thus an exante normative formulation. It specifies certain internally consistent relationships among probabilistic opinions and serves to prescribe, in this sense, how decision makers should behave. One major weakness of this approach to information processing is the absence of explicit consideration of human information processing, behavioural variables and behavioural relationships.

Slovic and Lichenstein (1971, pp.671-674) have analysed the major differences between regression approach and the Bayesian approach in information processing under three categories: (i) input (ii) the subject's response and (iii) subjective composition rules as follows:

Correlation approach	Bayesian approach
1. Input	
a. The correlation paradigm typically involves dimensions of quantitative information.	Data presented within the Bayesian studies, by contrast are often discrete or qualitative items.
b. Lens model research often uses items that are often correlated in a fashion representative of the real world.	Bayes' theorem, in its analytically convenient forms requires conditionally independent data.

2. <u>The Subject's response</u>	
Correlational approaches usually deal with a single valued prediction (point estimate) about some conceptually continuous hypothesis.	Bayesians would say that there is a probability distribution over this continuous distribution and that the subject's single judgment must represent the output of some implied decision process in which some implied decision rule is applied.
3. <u>Subjective composition rules</u>	
a. The simple additive model plays a key role in correlation studies.	Bayes' theorem is multiplicative in form.
b. Correlational studies rely on global measures which reflect importance across an entire dimension or data source such as correlations (r_{is}) or regression weights (b_{is}).	Bayesians are usually interested in the subjective impact of each datum, as measured by its subjective likelihood ratio. In the Bayesian approach the source or dimensionality of the datum is irrelevant.
c. Most correlational research deals with the static aspect of information processing.	Bayesian paradigm looks at fixed hypotheses and examines the manner in which the subjective probabilities of these hypotheses are revised in the light of new information.

In spite of apparent differences between the Bayesian and regression approaches, there are points of isomorphism. Each paradigm is based on a theoretical model of the composition rules whereby informational input is integrated into a judgmental response. The relationship between the decision maker and his environment is the concern of both approaches. Both models compare what the decision maker is doing with what he should be doing. Yet both are incomplete. Both are concerned with the decision maker as an individual, not as members of groups, in an organizational context, or in a multiperson setting.

2.24 Information in a Multiperson Setting

Value of information in a multiperson setting can be different from that in a single person context. Demski (1974, 1980), Beaver and Demski (1974), and Beaver (1981) have analysed the problem of information processing in a multiperson setting following Arrow (1951) in a social choice framework. The fundamental problem for information analysis in a multiperson framework is that utility functions of individuals can not be added to establish a group utility function in a social choice setting.

In a single person setting, costless additional information can do no harm. It is at least as good as less.

Because of the personal and subjective nature of value of information, where individual objectives can be divergent, value of information is unlikely to be congruent across individuals. This can lead to a heterogenity of demand for financial information across investors, for instance. Thus in a multiperson setting, a key feature of information is that economic consequences of the information system may affect constitutents in different ways.

Information choice in a collective setting can violate Pareto optimality principle, resulting in Arrow's impossibility theorem in a purist world. Possible resolutions of such impossibility dilemma in a pragmatic sense have been put forward by Cushing (1977) and Bromwich (1980).

A further extension of information processing in a multiperson context is information analysis in an organizational context (Feldman and March, 1981). The classical representation of organizational choice is a simple extension of decision theory versions of individual choice (Luce and Raiffa, 1957). The value of information in a simple classical world depends in a well-defined manner on the information's relevance to the decision to be made and on its precision, cost and reliability. The underlying assumptions of information choice in such a classical world include expectations of the following type:

> Relevant information will be gathered and analysed prior to decision making; information gathered will be used in making that decision; available information will be examined before more information is sought; needs for more information will be determined prior to seeking more information; and information that is irrelevant to a decision will not be gathered.
>
> (Feldman and March, 1981, p.172).

Such apparent rationality in information gathering and utilization does not hold in an organizational context. Overproduction of information in an organizational context can result due to (i) information incentives, (ii) surveillance reasons (iii) strategic nature of information, and (iv) symbolic nature of information itself.

(i) Information incentives: Organizations provide incentives for gathering more information than is optimal due to a systematic bias in estimating costs and benefits of information. Such bias can be caused due to the fact that often information-gathering functions are separated from information-using functions where the users accept the responsibility for the utilization of information while delegating the responsibility for its availability. Moreover, in an uncertain world post hoc accountability is often required of decision makers and organizations. Individuals and organizations gather information in anticipation of such requirements although in effect such information may not be used.

(ii) Surveillance reasons: Instead of seeing organizations as seeking information in order to choose between alternatives, it is possible to see organizations as scanning the environment for surprises, or for assurance that there are none. Such analysis is an exploratory approach to data analysis, and is in contrast to the decision theory model of information analysis which is of the hypothesis testing type. Such systems for surveillance are justified in terms of expected decisions and environments to be faced, where the information gathering process is long while decision times are short.

(iii) Strategic nature of information: In an organizational setting information can command power. In the context of conflict of interests information is gathered with consciousness of potential decision consequences (Feldman and March, 1971, p.176). Agency theory analysis (Jensen and Meckling, 1976; Fama, 1980), and analysis of information uncertainty (Hirshleifer and Riley, 1979), can be conceived of as attempts at the resolution of such power conflict.

(iv) Information as symbol: Organizational decisions allocate scarce resources and are thereby of considerable social and individual importance. But decision making in organizations is more important than the outcomes it produces. It is an arena for exercising social values, for displaying authority, and for exhibiting proper behaviour and attitudes with respect to a central ideological construct of the concept of intelligent choice. Bureaucratic organizations are edifices built on ideas of rationality. The cornerstones of rationality are values regarding decision making (Weber, 1947).

> "The gathering of information provides a ritualistic assurance that appropriate attitudes about decision making exist. Within such a scenario of performance, information is not simply a basis for action, it is a representation of competence and a reaffirmation of social virtue"
>
> (Feldman and March, 1981, p.177)

Symbols of competence are simultaneously symbols of social efficiency. Because the acts of seeking and using information in decisions have more symbolic value to the actors and to the society, individuals and organizations will consistently gather more information than can be justified in conventional decision theory terms.

2.3 Summary

Chapter II has been concerned with the theory of information disclosure. First user needs and user environments have been explored following which various ramifications of information theory have been discussed. Information has been distinguished from data and knowledge to establish a meaningful definition of information. Development of information theory has been traced and the similarities and differences between information economics and psychological approaches have been analysed. The important Brunswikian Lens model has been discussed in particular and its importance in information processing has been shown. All this has been done in a single person context. In the concluding section the multiperson nature of financial information has been recognized, and the difficulties of information processing in a multiperson context have been analysed both in a social choice context as well as in an organizational context.

Having thus explained the theory of information disclosure in general, the scene has been set for exploring the issues in segmental disclosure in particular. Chapter III which follows will be concerned with segmental disclosure issues.

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CHAPTER III

SEGMENTAL DISCLOSURE ISSUES

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Segmental Disclosure Issues

3.0 Introduction

In the previous chapter information theory concepts have been discussed in general in the context of financial reporting. Chapter III will be concerned with one specific aspect of information disclosure - Segmental Disclosure Issues. This chapter is organized as follows :

First segmental disclosure in an environmental setting will be mapped, showing how the need for segmental disclosure has arisen in the wake of changes in the economic environment in recent years - the merger and take-over scene will be analysed, and their impact on segmental disclosure issues will be explored.

Second, following these changes in the economic environment what societal response there has been will be discussed under the heading of Segmental Disclosure Requirements. This section will discuss the various segmental disclosure requirements imposed by national and international regulatory authorities such as governmental and standard setting authorities, and the rationale behind such requirements.

The extent to which such segmental disclosure requirements have benefitted various sections in the society and the society as a whole will be explored in the next section: Segmental Disclosure Criteria. Three specific criteria will be examined: predictive ability, decision usefulness, and social welfare maximization, as being representative of the whole spectrum.

Finally, Segmental Geographical Disclosure, which is of special interest in this research will be discussed under a separate heading drawing together various segmental geographical disclosure issues.

First, the segmental disclosure environment.

3.1 Segmental Disclosure Environment

In recent years there has been a general trend, especially by large companies, towards diversification in terms of both business activity and geographical location (Steiner, 1975; Dubin, 1976; Mueller, 1980). In the postwar period, the first increases in merger activity on a sizeable scale took place in the 1950s in UK and the USA. As the merger movement gained momentum, a typical quoted company in the UK in the mid-sixties had a one in three chance of dying through merger. In the USA, at the height of the merger wave, during 1966-68, 462 large manufacturing and mining companies were acquired accounting for 10 per cent of total assets of all large companies (assets larger than US $10 million) as they existed in 1964 (Hughes and Singh, 1980, p 6).

The motives for companies thus spreading their activities across products and markets as well as across national boundaries include alleged risk reduction benefits such as stability of earnings and sales (Dunning, 1974; Rugman, 1976).

A further trend within this merger movement has been a movement towards conglomerate merger away from product-market emphasis to conglomerate merger (table 3.1).

Distribution of Assets Acquired in Large* Mergers by Type and Period (percentages) in the USA

	1948-51	1960-63	1969	1971
Horizontal/Vertical	62	37	27	24
Product-market extension	38	46	35	32
Conglomerate merger	0	17	38	44
	100	100	100	100

* Individual company assets total $10 million at least.

Source: Steiner, 1975, p 24

Table 3.1

Conglomerate mergers are nonsynergistic (Ronen, 1982). Such mergers do not necessarily have any product-market logic. The rationale in conglomerate merger would appear to be increase in size and increased return on capital employed in the short run (Drucker, 1964). There is no clearly accepted definition of a conglomerate firm. Steiner (1975, p 18) has attempted to define a conglomerate firm in terms of the absence of a well defined interconnection among the products or services it provides that could be used to predict which products or services it might add to its line.

Mergers result in loss of information in that data about individual segments that were previously available to the users because the segments were separate legal entities would be provided only in the aggregate as they relate to the new entity after the merger. User groups affected by such loss of information due to mergers can be varied. The Corporate Report (1975) has defined the groups of users who have a right to information about the corporate entity as follows :

(i) the equity investor group, (ii) the loan creditor group, (iii) the employee group, (iv) the analyst-advisor group, (v) the business contact group, (vi) the government, and (vii) the public.

The above list may not be exhaustive, but in essence it emphasises the nature of diversity of the user groups and their objectives.

Users, such as those identified above,would find it difficult to analyse the prospects of the corporation unless decomposed data about the corporation's operations are made available. This is so because customers may want to be able to obtain continuity of supply, suppliers would want to be assured of payment for goods and supplies, investors would like to know the degree of safety of their investments in the company and the higher return prospects. Similar arguments can be advanced for each potential or existing user group. In sum, segmental information would make it possible to make better decisions so far as users of company information are concerned. Although it is possible that detailed information about the segments would be provided after the merger, such voluntary disclosure can be constrained by private gains to the company, its managers and the stockholders. A consequence of the realisation of such potential losses to the community has been the enactment of segmental disclosure requirements by various national and international bodies the more important of which are described in the following section.

3.2 Segmental Disclosure Requirements

One of the earliest segmental disclosure requirement in the western world is in the Swedish Stock Corporations Act of 1944 which required the disclosure of information about the profitability of various operations carried out by diversified companies registered in Sweden (Walker, 1968). This has subsequently been amended in 1975.

Currently, the most comprehensive set of segmental disclosure requirement exists in the USA where the Financial Accounting Standards Board (FASB) in 1976 published FAS 14 which specified financial reporting requirements for segments of a business enterprise. The FASB states the purpose of FAS 14 being

> "to assist financial statement users in analysing and understanding the enterprise's financial statements by permitting better assessment of enterprise's past performance and future prospects" (para 5).

FAS 14 requires that the financial statements of a business enterprise include information about the enterprise's operations in different industries, its foreign operations and export sales, and its major customers, in the form of a disaggregation of the consolidated financial information. For industry segments (line of business) it requires revenue, operating profit or loss, and identifiable assets, if any of the above three items represents more than 10% of consolidated total for the enterprise as a whole.

This 10% rule is also applicable to foreign operations and export sales in that if the revenue generated from, or identifiable assets employed in foreign operations are 10% or more of the consolidated total, then revenue, operating profit or loss, and identifiable assets appropriate to those foreign operations will have to be disclosed.

The FASB recognizes the difficulties that management may face in identifying segments due to interdependencies that may exist between segments, and due to diversities of operations in product lines as well as in various geographical locations.

A great deal of discretion is therefore given to the management in defining identifiable segments. FAS 14, para 34, states :

> "Each enterprise shall group its foreign operations on the basis of the differences that are most important in its particular circumstances. Factors to be considered include proximity, economic affinity, similarities in business environment, and the nature, scale, and degree of interrelationship of the enterprise's operations in the various countries."

The FASB statement No 14 is the culmination of various underlying forces converging on the US scene. Starting in the mid 1960s, in the wake of the merger boom, a number of professional organisations, including the Financial Analysts' Federation, Financial Executives' Research Foundation, and the National Association of Accountants sponsored research studies to assess the desirability and feasibility of disclosing information for line of business (LOB) segments in external reports. In 1969, the Securities and Exchange Commission (SEC) issued requirements for reporting LOB in registration statements, which were subsequently extended in 1970 to annual reports filed with the SEC on form 10-K. In 1973 the New York Stock Exchange (NYSE) issued a recommendation urging that LOB information of the type 10-K be included in annual reports to security holders. Since the NYSE is the largest stock exchange in the world, the SEC followed the NYSE recommendations and extended the requirements for filing LOB reports in the annual reports to security holders of all companies filing with the SEC. In 1974, the Federal Trade Commission (FTC) initiated an annual LOB reporting programme to enable it to publish aggregate data on corporations engaged in trade and commerce in the USA. Finally in 1976, the FAS 14 was recommended. A chronicle of events surrounding the segment reporting issue in the early years appears in Skousen (1970).

In the United Kingdom segmental disclosure requirements are contained in the Companies Acts and in the London Stock Exchange Listing Agreement (1979). Segmental disclosure requirements in the UK are similar though less comprehensive as those of the USA. Unlike the USA, there are no requirements in the UK to disclose identifiable assets, for instance for each segment. The UK Companies Act 1967, S16(1) requires the directors' report to contain a statement of principal activities of the company and its subsidiaries in the course of the financial year and any significant changes in that year; S17 requires the disclosure of turnover and profits. The Companies Act 1981 is more comprehensive and brings the UK situation in line with the European Economic Community's (EEC) fourth directive (1978) on harmonisation. The 1981 Act, schedule I, part III, section 55, states :

> "(1) If in the course of the financial year the company has carried on business of two or more classes that, in the opinion of the directors, differ substantially from each other, there shall be stated in respect of each class (describing it) -
>
> (a) the amount of the turnover attributable to that class; and
>
> (b) the amount of the profit or loss of the company before taxation which is in the opinion of the directors attributable to that class.
>
> (2) If in the course of the financial year the company has supplied markets that, in the opinion of the directors, differ substantially from each other, the amount of turnover attributable to each such markets shall also be stated. ...."market" means a market delimited by geographical bounds ....

> (5) Where in the opinion of the directors the disclosure of any information required by this paragraph would be seriously prejudicial to the interests of the company, that information need not be disclosed, but the fact that such information has not been disclosed must be stated."

The London Stock Exchange Listing Agreement (1979), concentrates on geographical analysis and leaves out line of business disclosure altogether. The Listing Agreement, para 10(c) requires the provision of a statement showing geographical analysis of turnover and contribution for certain companies as follows :

> "A broad geographical analysis by turnover by way of figures or percentages, not necessarily given country by country, will be acceptable. No geographical analysis of turnover is required unless 'overseas operations' (outside the Republic of Ireland and United Kingdom) comprise more than 10% of the turnover. Where analysis is required, the analysis should be by continent but if 50% of the total 'overseas operations' relates to one continent, a further analysis, for example by country within that continent, will be required.
>
> In respect of trading results an appropriate statement should be included where, for a proper appraisal of the business of the company (or group), shareholders should be aware of significant contributions derived from activities carried out in any one country ..."

The Accounting Standards (Steering) Committee in the Corporate Report (1975) also favoured segmental disclosure by geographical area rather than by line of business because it is "less difficult to implement".

Thus flexibility and practicality have been the overriding consideration in UK requirements. Management has been given the discretion to decide what is in the best interests of the users, when to disclose, and in many instances, how much to disclose.

Apart from the UK and the USA, similar segmental disclosure requirements exist in many industrial countries such as Canada, countries in the EEC, the Scandanavian countries, Australia and others. But the requirements have not been uniform, although the harmonisation programme in the EEC countries is a step in this direction.

The International Accounting Standards Committee (IASC) has attempted harmonization of segmental disclosure practices across its member countries, and produced IAS 14 in 1981. Its basis has been the US and UK segmental disclosure requirements although it has been influenced apparently by third world memberships in asking for segmental profits, assets employed, and bases for intersegment transfer prices. IAS 14, para 22, requires :

> "For each reported industry and geographical segment, the following financial information should be disclosed -
>
> (a) sales or other operating revenues, distinguishing between revenue derived from outside the enterprise and revenue derived from other segments,
>
> (b) segment results,
>
> (c) segment assets employed, expressed either in money amounts or as percentages of the consolidated totals, and
>
> (d) the basis of inter-segment pricing."

In addition para 24 of IAS 14 requires that changes in identification of segments and changes in accounting practices used in reporting information which have a material effect on the segment information should be disclosed.

Whereas the UK and US requirements were mainly for the benefit of users within the country, the IAS requirements were tailored more for the requirements of the transnationals and their interfaces with the host countries. The Organisation for Economic Cooperation and Development (OECD) in 1979 produced a guideline for multinationals which has also been aimed at segmental disclosure requirements for multinationals with the special emphasis of fostering transnational investment. The emphasis in the OECD guidelines has been on consolidation methods and inter unit transfer pricing which are sensitive issues to the host countries' government and public. It makes special mention of 'respect for national laws and tax bases' which may affect capital movement across countries and affect national economic development in host countries.

Like the OECD, the United Nations Economic and Social Council's Commission on Transnational Corporations(UNCTC) (1977) has been concerned with the relations between the multinationals and the host countries. However, with the UN the emphasis has been different. The UNCTC proposals have been greatly influenced by the needs and aspirations of developing countries' governments (Gray, Shaw and McSweeney, 1981).

Figure 3.1 is a summary of some of the major segmental disclosure requirements mentioned here.

Disclosure requirements and recommendations explored above show the distinct influence of user groups and the cultural environments. UK and US disclosure requirements are primarily for the consumption for the users within the country, while international disclosure requirements are for fostering better relations between countries where in many cases the objectives and cultural environments are very different. While line of business disclosure might have been enough in the absence of conglomerate mergers, in the wake of conglomerate mergers, mergers across national boundaries and expansion in third world countries, multinationals are increasingly required to disclose not only sales and profits, but also the accounting policies and currency translation methods which affect the bases determining such sales and profits. In many cases multinationals may have two audiences: one in the home country and one abroad. The requirements for the two groups may be different.

Such detailed requirements for segmental disclosure by conglomerate multinationals bring in the problems of relevance and meaningfulness, especially when the business is an integrated one, when there are possible competitive disadvantages to disclosure, and when such disclosure requires a great deal of investment of time and money in the production and dissemination of information. These are issues concerning the costs and benefits of disclosure which will be discussed in the next section.

	USA	UK		EEC	OECD	UN	IASC
	FAS(14), 1976	Companies Act 1981	London Stock Exchange (1979) Listing Requirement para 10c	Article 43.1(8), Fourth Directive, Issued 1978	Guidelines for MNC, 1979	Proposal for MNC, 1977	IAS 14, 1981
LINE OF BUSINESS							
Sales revenue	x	x		x	x	x	x
Operating profits	x	x				x	x
Assets	x					x	x
Capital expenditure	x				x	x	
Depreciation	x					x	
No of employees						x	
GEOGRAPHICAL							
Sales revenue	x	x	x	x	x	x	x
Operating profits	x		x		x	x	x
Assets	x				x	x	x
Capital expenditure					x	x	
Depreciation	x					x	
No of employees					x	x	
OTHERS							
Transfer pricing policy	x				x	x	x
Major customers	x						

Segmental Disclosure Requirements: A Summary

Figure 3.1

3.3 Segmental Disclosure Criteria

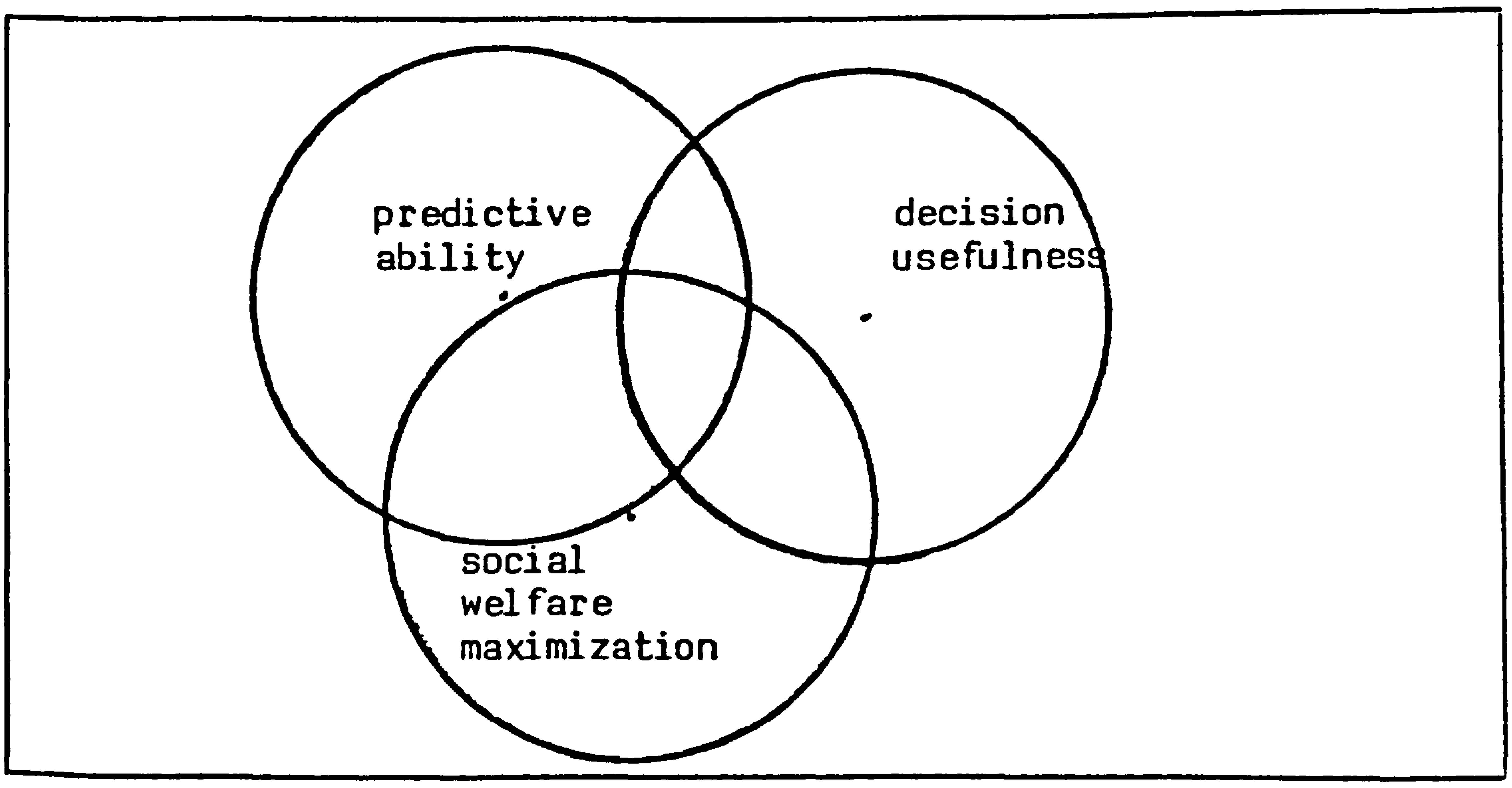
Segmental disclosure entails the disclosure of disaggregated information about the entity over and above aggregate information about the entity. Since disclosure of additional information is involved, it will be appropriate to examine segmental disclosure arguments in the light of disclosure arguments in general. Although there is no agreement in the literature on a comprehensive set of disclosure criteria the following three are usually accepted as being comprehensive enough :

A The Predictive Ability criterion (Beaver, Kennelly and Voss, 1968);

B The Decision Usefulness criterion (Anton, 1964; AAA, 1977);

C The Social Welfare Maximization criterion (Hirshleifer, 1971; Demski, 1974; Hakansson, 1977; Ross, 1979).

Though identified as separate, these three criteria are interdependent. Decision usefulness may result in increased social welfare by increasing the utility of users of information. Similarly predictive value may be one of the criteria of decision usefulness (figure 3.2).



Interdependence of Disclosure Criteria

Figure 3.2

Disclosure of segmental information should satisfy at least one of the three above criteria.

3.31 Predictive ability criterion

Segmentation implies disaggregation or decomposition. Following Blackwell and Girshick's (1954) theorem of 'fineness of information' structure, it can be argued that the disaggregation of a complex information signal can enhance understanding and hence improve prediction of future values of the information series.

Aggregating data results in loss of information which could be used to discover economic hypotheses, to improve the precision of estimation, to test existing hypotheses and to measure effects which are being clouded by aggregation (Orcutt, Watts and Edwards, 1968).

One measure of information loss as a result of aggregation is entropy (Lev, 1969; Theil, 1972). Entropy is the expected information content in a message. Based on the entropy criterion, the loss of information due to aggregation is measured by the difference between the entropies of disaggregated (H) and the aggregated (H') set of items :

$$H - H' = P_S H_S$$

where P_S is the combined share of the two items aggregated (S) and H_S is the entropy of the pair. In this measurement of loss of information due to aggregation there are two important considerations :

(i) information loss increases as the size of the combined item becomes larger relative to a related total; and

(ii) the loss increases as the two items to be combined become more equal to each other.

Thus, the relative sizes of the items within the aggregated pair as well as between the pair and a related total are reflected in the aggregation decision. Therefore, the stability over time of the relative sizes of aggregated items may have a significant effect on the information loss.

The reluctance to aggregate unstable decompositions is not merely intuitive. On the average, prediction of a variable whose time series is very volatile is more difficult (ie, subject to more error) than that of a stable variable. Thus, if we accept the notion that the main objective of financial statements is to provide information for prediction purposes, we would supply more detailed (disaggregated) information about unstable variables. Porcano (1976) has similarly concluded that if the segments are in similar industries, then apparently segment data will contain less information than would be the case if the segments were in dissimilar industries.

However, it is not correct to suggest that disaggregation will always improve predictive ability. Barnea and Lakonishok (1980, p 26) have suggested that whether disaggregation will produce more accurate forecasts depends on three factors :

(1) The relative quality of forecasting techniques applied to the aggregated data as measured by Theil's (1966) U^2 statistic which is defined as the ratio of the variance of the forecasts' error ($\hat{\sigma}^2$) to the variance of the underlying forecasted variable (σ^2).

$$U_j^2 = \frac{\hat{\sigma}_j^2}{\sigma_j^2}; \qquad j = 1,2,...$$

(2) The magnitude of the correlation between the variables used in forecasting; and

(3) The magnitude of the correlation between the forecasting errors.

In simpler terms, whether disaggregation results in improved predictive ability depends upon (i) the forecasting technique applied, and (ii) the structure of the data used in forecasting.

Further, in a social science setting, there is an additional factor - the decision maker's data handling ability (Revsine, 1970) which has been ignored in the information theory approach to disaggregation as developed in the physical sciences.

The entropy approach to disaggregation in financial statement analysis has been criticised by Abdel-Khalik (1974) on the following grounds :

(1) It takes the point of view of the suppliers of data, and ignores that of users.

(2) It may measure the amount of decomposition in financial statements, but not the amount of information, and

(3) It is improper to equate proportions in any classification with a probability distribution.

These shortcomings of the entropy approach to disaggregation reflects the restricted nature of the definition of information in information theory. Specifically, since information is defined in terms of probability only, the subjective meaning of a message to the receiver is ignored in the measurement of the information content. This view implies that the accountant cannot optimally decide about the aggregation unless he has perfect knowledge of both the users' decision models and their utility (preference) functions. Such knowledge would be necessary for the accountant to minimise the users' expected loss from using aggregated rather than the individual data. When individuals differ in the ranking of several alternatives (ie, they have different preference functions) there usually exists no "social ranking" which simultaneously satisfies the individual preferences.

The entropy measure of information in disaggregation is appropriate in closed physical systems which are not decision model oriented. Accounting being an open system, the underlying aggregation or disaggregation decision is dictated by conventions, and principles of decision usefulness (Lev,1970; Bernhardt and Copeland, 1970; Abdel-Khalik,1974).

3.32 Decision Usefulness Criterion

Entropy measures of segmental information disclosure have been found inadequate due to lack of decision orientation in the previous section. Anton (1964, p.2) has suggested that one of the important requirements of an accounting system is that it "should be integrated with the planning and control system" relevant to the users. Lev (1973) has argued in favour of segmental disclosure by stating that business organisations are homeostatic in that they seek to maintain equilibrium relationships. Any structural changes, planned or unplanned, are of interest to the financial analyst for identifying changes in management strategy or signalling an ability by management to maintain a desired structure.

Decision usefulness of segmental data has been analysed in several research studies. Such studies include opinion surveys (Bradish, 1965; Mautz,1968; Backer and McFarland,1968); field experiments (Stallman,1969); and earnings predictability and stock price volatility studies (Kinney, 1971,1972; Kochanek,1974; Collins, 1975; Horowitz and Kolodny, 1977; Collins and Simonds, 1979; and Emmanuel and Pick, 1980). A comprehensive analysis of such studies appears in chapter VI. Almost all of these studies have found disclosure of segmental information beneficial in a decision making context.

Benefits of segmental disclosure in a decision making context can be grouped into micro and macro contexts. In a micro or individual decision context it can be envisaged that customers, suppliers, equity investors, lenders, employees, and management will all find disclosure of segmental information beneficial.

Agency cost theory (Jensen and Meckling, 1976) supports the idea that an increase in financial disclosure results in a reduction in the firm's equity cost of capital. If investors find it worthwhile to obtain detailed information regarding the firm, then the price they are willing to pay for the firm's stock will be inversely related to the cost of obtaining that information. In other words, the cost of obtaining financial information will be borne by the firm directly, or it will be imposed upon the firm via the stock price setting mechanism. If it is assumed that firms can provide information regarding their operation at smaller cost than external parties, then firms which anticipate seeking external financing would increase the extent of their disclosure because the resulting decrease in the cost of capital would benefit current shareholders in two ways :

(i) the market value of their holdings would increase; and

(ii) they would be able to obtain the desired amount of new financing at the least sacrifice.

Similar arguments about reduction in the firm's equity cost of capital in the event of detailed disclosure have been advanced by Singhvi (1967), Choi (1973b), and Kochanek (1974). A slightly different view of the impact of segmental disclosure on the firm's equity cost of capital has been put forward by Ronen (1982). Ronen argues that disclosure of segment information will usually induce a revision of investors' expectation regarding future earnings. But this revision of expectations effect can be either favourable or unfavourable from the standpoint of the induced changes in stock prices. The sign and magnitude of the revision of expectations effect will depend on the structure of the segments' information - that is the variance-covariance matrix of the segments' reported numbers with reported numbers by other firms in the market and the values of those firms. It is intuitively possible to expect the revision of expectations effect to be more pronounced (positive or negative) the less positively intercorrelated the segments' reported earnings streams.

Apart from the impact of disclosure on equity cost of capital which can be beneficial to the company in timing new financing decisions, equity holders will be better able to assess the prospects of their investments in the company, lenders will be able to assess bankruptcy risks better as a consequence of detailed product market prospects being available, trade unions and employees can judge more accurately the possibility of continuity of employment, customers will be able to assess the possibility of continuity of supplies, and suppliers assured of the continuity of business. Similarly analyst-advisor groups will be able to generate more meaningful assessments of the company's prospects for dissemination to other user groups, and the stewardship function over management will be better exercised as management will be exposed to detailed examination of their performance by investors and other interest groups.

In a macro sense "business can initiate activities and expand in new directions with less risk, and, therefore, at lower cost than might otherwise be possible; rate of return on investments will tend to be higher because fewer false starts or errors of total ignorance are likely" (Rappaport and Lerner, 1972, p 7). More disclosure in a macro setting may lead to more investor confidence resulting in greater capital formation; governmental decisions will be based on sounder bases for regulatory activities, subsidies and encouragement for specific sectors;

anti trust and monopoly legislations will be enacted in a framework of fuller information, and forecasting the growth of different sectors of the economy may be better achieved.

Government decisions about balance of payments, foreign exchange management, inward investment policy, repatriation of dividend and capital, pollution, discriminatory practices and social responsibility of management, and many others can be taken in a more informed environment.

That segmental disclosure will have advantages is not in dispute. Yet it is not necessarily true that "the more information is available to the market participants, the better the allocation of resources in the economy" (May and Sundem, 1973), if costs of disclosure, direct and indirect are taken into account. Disclosure is not a free good (Benston, 1969). At the strategic level, the relative desirability of different levels of disclosure is unclear; it is premature, and potentially incorrect to conclude that more disclosure is preferable to less (Beaver, 1974). Segmental disclosure may lead to competitive disadvantages; additional disclsoure could, in principle act as a deterrent to informational and innovational activities that would benefit the productive sector (Mautz and May, 1978); costs of producing and disseminating information could exceed benefits (Phillips and Zecher, 1981); beyond a certain limit additional disclosure may lead to information overload (Revsine, 1970) and dysfunctional behaviour on the part of the managers of the firm (Feldman and March, 1981).

Segmental disclosure can destroy or threaten a competitive advantage. Competition encourages efficiency, innovation, and risk taking, thus contributing to wealth creation and economic welfare. Competitive disadvantage in segmental disclosure may arise due to (i) timing as well as (ii) extent of disclosure. The extent of competitive disadvantage will depend on the number and variety of interests finding the information useful and the degree to which disclosure relates to some measures of success in markets, products or customers. Apart from competitive disadvantage to the company which is easily recognizable, it is conceivable that segmental disclosure's competitive disadvantage can extend to disadvantage between suppliers, employees, investors, creditors, and probably others.

At the tactical or operational level there are problems of meaningfulness and materiality. Problems of meaningfulness emerge in the form of segment identification in general and cost allocation and transfer pricing problems in particular when segmental profits are required to be disclosed (Mautz, 1968; Emmanuel and Gray, 1977b and 1978).

Segment identification in a conglomerate can be subjective. In general there are no natural classes of business activity. The question of whether two or more classes of business differ substantially from one another can be entirely contingent on the circumstances of the firm and the choice of their managers (Walker, 1968, p 29). Such managerial choice can be a function of the need for decision decomposition in an organisation (Demski and Feltham, 1976).

Depending on the need for decision decomposition segments could be identified along one or more of the following lines : (Gray 1981)

(i) line of business, (ii) legal entities, (iii) organisational divisions, (iv) markets, (v) industry groups or (vi) geographical divisions.

In segments so identified, decision decomposition needs can arise in two major situations :

(1) When the decision maker has a number of activities to select, and for whatever reason, separately selects subsets of these activities instead of selecting them simultaneously. One common example is the use of separate inventory models for each type of material handled by a purchasing department.

(2) When the decision maker divides his operations into a number of departments and then delegates authority, over some elements of the organizational operations to different managers. Cost allocations are used in such circumstances to construct departmental performance measures that the decision maker then uses to influence the action selected by his managers.

Arrow (1964(a), p 398) refers to this as organisational control and points out that it divides itself naturally into two parts: the choice of operating rules instructing members of the organisation how to act; and the choice of enforcement rules to persuade or compel them to act in accordance with the operating rules.

To facilitate this organisational control and motivation of managers transfer prices are used. Transfer prices are monetary values which attach to the movement of goods or services between segments of the same company. They may be valued by any number of methods which may differ between segments of companies or even change from one period to another. Such methods include: standard costs, marginal costs, cost plus, external selling price, or any combination of these.

The particular method employed would depend upon :

(i) the organisational context: management objective, technology, organisational structure etc; (ii) management information and control system; (iii) performance criterion adopted or (iv) minimization of tax burden for the corporation as a whole. (Goetz, 1967; ICMA, 1981; Kaplan, 1982)

To achieve this intersegment transfer pricing objective cost allocations are necessary in many situations. Several accounting mechanisms can be grouped under the general title of joint cost allocation. Shorter reporting periods or finer classification of reports generate a higher proportion of joint costs.

The allocating mechanism over time or across segments (in many cases) is arbitrary. Professional standards allow deferral of some costs to future periods (for example product costs through inventory valuation, and equipment costs through depreciation), while other costs might be treated as current expenditure in the period in which they occur (for example, advertising, and research and development expenditures). Similarly allocation by segments is often based on arbitrary procedures.

In spite of such arbitrariness in allocation over time or over segments, cost allocations can serve as useful proxy variables for certain difficult to observe costs. They are desirable mechanisms for motivating and controlling managers under conditions of decentralised decision making (Zimmerman, 1979, p 519). But they do not necessarily give a true picture of the profitability of the division or segment. Since cost allocations do not help derive meaningful profits, it is illegitimate to use arbitrary allocations in calculations of the profits for business segments. One can only ascertain the gross contributions of such segments to indirect costs and corporate net income (Walker, 1968, p 37).

Problems of segment identification and materiality, and consequent problems of transfer pricing and cost allocations in segment reporting as mentioned above are byproducts of the differences between internal (management) accounting objectives and the objectives of external reporting. Internal accounting principles are those which work for that particular company. There is no need for them ever to have been accepted by anyone else, nor need they be consistent company-wide, nor from period to period. Quite another set of standards applies to financial reports issued by a company for use by outsiders.

Publicly reported data are expected to meet certain established standards of propriety,homogeneity in nature and presentation, consistency over time and with the reports of other companies. In contrast, data provided for internal purposes may have any one of a number of uses in the area of motivation and control (Mautz, 1968).

Difficulties of segment identification and consequent problems cost allocation and transfer pricing issues are well recognised by standard setting bodies. For instance the FASB states :

> "Information prepared in conformity with those standards may be of limited usefulness for comparing an industry segment of one enterprise with a similar industry segment of another enterprise. Inter-industry comparison of industry segments would require a fairly detailed prescription of the line or bases of disaggregation to be followed by all enterprises, as well as specification of the bases of accounting for inter-segment transfers and methods of allocating costs common to two or more segments." (FAS 14, para 76.)

Because of these difficulties in segment identification, segment materiality, inter-segment transfer pricing and cost allocation, there is need for flexibility in segment reporting. Yet, too much flexibility and managerial discretion can negate many of the arguments in favour of segment reporting since managerial discretion can induce arbitrary allocations to suit company and management objectives at the expense of user objectives.

How much managerial discretion is then desirable in segment reporting? If managers are likely to maximize their personal objectives at the expense of user objectives, should segmental disclosure be mandatory? Are there sufficient incentives to adequate voluntary segmental disclosure? If such incentives are inadequate, what are the costs and benefits of mandatory disclosure? Answers, if any, to such questions are in the domain of social welfare maximization criterion of segmental disclosure.

3.33 Social Welfare Maximization Criterion

Social welfare maximization in the context of segmental disclosure issues encompass macro questions which affect resources allocation in a societal sense. The issues here are :

(1) Assuming segmental disclosure is desirable, are there adequate incentives for voluntary disclosure?

(2) In the absence of adequate voluntary disclosure should mandatory disclosure be advocated?

(3) What are the costs and benefits of mandatory disclosure?

In a survey of reporting practices of 300 large companies in the United Kingdom for the year 1981-82, the ICAEW (1982) reported that 76% disclosed some form of geographical area based information, and 72% disclosed line of business data. But how meaningful is this information, given that in the United Kingdom the Companies Act 1981, and the Stock Exchange Listing Agreement give a large amount of discretion to management in the identification of segments, and the extent of reporting? Are companies disclosing only those information that suits them best, manipulating them to pass on the information they like to, and leaving out bits that they do not want to disclose? In the absence of any possibilities of audit of segmental data, there is no way of verifying the meaningfulness of segmental disclosure. Mautz and May (1978), Ronen and Livnat (1981) and Ronen (1982) have analysed the extent and incentives for voluntary disclosure of segment information. Some of the arguments advanced by them will be discussed here.

The attitude of a company's management towards segmental disclosure may change over time as circumstances change. It can be argued that originally a company's management would be opposed to segmental disclosure because of one or more of the following reasons :

(i) possible competitive disadvantage if meaningful information is disclosed; (ii) possible misinterpretation by users who are unfamiliar with the company's operations; and (iii) because of jointness of many activities in the organization management might argue that they should be judged on the overall results of the organisation than on individual segment results.

However, as the company becomes more and more diversified and needs more access to the capital market, it may find that financial analysts who could not understand what a conglomerate stood for would lose interest in the company with the possible consequence that the company's stocks would not be in as much demand as would have been the case, the investing public would lose interest in the company's shares, and the price earnings multiple would fall. In such a case the company would favour some form of voluntary disclosure of more information. But the attitude of the management towards segmental disclosure would be inhibited by self interest. Mautz and May in a survey of management attitude towards segmental disclosure summarises management attitude as follows :

"Disclose anything necessary to compete for capital and credit as long as disclosure does not result in competitive disadvantage to the company.

Disclose anything necessary to inform shareholders and creditors of the company's success and financial condition that does not result in competitive disadvantage to the company.

Disclose nothing more unless demonstrable benefits to the company from disclosure exceed the costs, both direct and indirect." (Mautz and May, 1978, pp 283-284.)

Self interest thus dominates the disclosure philosophy of the management of a company. Agency theory (Jensen and Meckling, 1976) and incentive signalling analysis (Ronen and Livnat, 1981) also supports this self interest view of segmental disclosure. In some cases managers of the conglomerate entities would continue to provide information on the merged segments; but their decision to disclose such information voluntarily would be induced by the expected impact of the disclosure on the wealth of the conglomerate entity stockholders and, thus, indirectly on the welfare of the managers (Ronen, 1982, p 42).

If voluntary disclosure is induced by self interest only, then it is conceivable there are circumstances in which information will not be disclosed if the private costs to the company concerned is greater than the public benefit to the society as a whole. Research studies and opinion surveys such as Mautz (1968), Kinney (1971), Collins and Simonds (1979), Emmanuel and Pick (1980) and others described in chapter VI have found segmental disclosure beneficial to investors and other users. The fact that such studies have found segmental disclosure beneficial to users suggests that some socially valuable segment information was suppressed as the result of mergers and acquisitions prior to the mandatory requirements to disclose such information in the USA. Even when mandatory disclosure is in force, some information would still be lost since the requirements do not cause the reproduction of all pre-merger information.

It would appear therefore that mandatory disclosure would be socially beneficial in some cases. Yet there are problems with mandatory disclosure. Mandatory disclosure inevitably involves allocation of costs resulting in moral hazard problems. Moral hazard would arise in that managements of firms that did not choose voluntarily to disclose segmental information may, in the event of mandatory disclosure select the mechanism that is likely to produce the most favourable effect on stock prices.

Further, there would be cost of enacting and enforcing regulations. Last, but not least, mandatory disclosure may result in information being produced by inefficient producers, as Gonedes, Dopuch and Penman suggested :

> "Disclosure laws may induce a suboptimal allocation of resources because they may lead to the production of information that would not be produced by the coalitions operating on personal account; or they may induce a suboptimal result because they do not lead to production by the most efficient producer."
> (Gonedes, Dopuch and Penman, 1976, p 99)

Disclosure is not a free good to the society. Costs associated with disclosure may be borne by the disclosing company while the benefits may be reaped by those who do not pay for the disclosure costs. In consideration of social benefits to many user groups mandatory disclosure may be advocated, but such mandatory disclosure can result in direct costs such as costs of information production and dissemination, costs of regulation, as well as indirect costs such as dysfunctional managerial behaviour and moral hazard. Difficulties in segment identification and cost allocation necessitates that managerial discretion be given to the disclosing company, yet at the same time the existence of such discretion can negate many of the potential arguments in favour of segmental disclosure. There is thus no clear choice in segmental disclosure as yet.

Segmental disclosure issues are multidimensional and dynamic. The purpose of this current research is to contribute to this debate by providing incremental knowledge about geographical segmental disclosure in a capital market context.

3.4 Segmental Geographical Disclosure

Many of the issues in segmental disclosure discussed in earlier sections in this chapter, such as segment identification, materiality, managerial discretion, are common to line of business disclosure as well as geographical disclosure. Yet there are distinct differences.

Geographical segmental disclosure has become an issue especially in the context of expansion and diversification across national frontiers. Foreign countries often exhibit different risk and return profiles due to their history of economic development, cultural differences (Jaggi, 1975), legal environment, interest rate differentials, currency movement restrictions, and differing host government ambitions and requirements (Steiner, 1975; Mueller, 1980).

In an empirical study of US multinationals across the world, Kobrin (1980) found political stability, foreign investment climate, and profit remittances and exchange control as the three most important aspects of the overseas environment in identifying risk, while labour strikes, expropriation and administrative procedures ranked rather low as risk factors in the opinion of the respondents who were managers of multinational firms.

But more importantly, Kobrin found that there was a lack of any systematic risk assessment in the strategic sense by the multinationals so far as overseas businesses were concerned. Risk assessments reported were primarily reactive, bottom up, subjective and often ethnocentric.

The existence of such a situation is less than optimal in that decisions to withdraw or expand investments are being made without due regard to consequences. A lack of a rational system in risk assessment across geographical frontiers by multinational conglomerates ignores the notion that risk assessment is a continuous process in which the discontinuities in the form of political upheaval or similar occurrences are only manifestations of an accumulation of underlying incremental changes in the socio-economic structure. The nature, form, and intensity of such changes in distant foreign markets make issues in segmental geographical disclosure distinctly different from issues in line of business disclosure, although complementary.

Because of cultural, economic and political differences the tax environment and legal requirements can also be different in foreign territories. Conglomerates operating in different countries are expected to follow the legal and cultural differences in each of these countries (OECD, 1976, 1979). Yet when the legal and tax environments in these countries differ from each other, conflicting situations can, and often do arise when intersegment transfer bases and accounting policies are required to be disclosed.

In circumstances where the legal and tax environments differ between countries in which multinational operations are based promoting better understanding of multinationals' operations by host governments can be a difficult task. Geographical segmental disclosure, in spite of the difficulties in producing meaningful data, will help promote such understanding by giving an appreciation of the multinational conglomerate's corporate strategy.

Another moot point in geographical segmental disclosure is the role of managerial discretion. In the US the FASB in discussing information about foreign operations and export sales states :

> "... the distinction between domestic and foreign operations was very difficult to make ... The Board's intention had been to allow judgment ... the variety of ways in which foreign operations are conducted made it impossible to define appropriate geographic areas for all enterprises. Therefore only general guidelines for that determination are set forth ... For those enterprises conducting foreign operations in two or more geographic areas, the Board considered several methods of associating foreign revenue, a measure of profitability, and identifiable assets with a particular geographic area. These methods include location of accounting records, the location of the assets, the location of the risks associated with the assets and liabilities, and the location of the customers. However the Board concluded that none of those methods would necessarily correlate the profitability and identifiable assets of a geographic area in a manner consistent with the Board's objectives ..."
>
> (FAS 14, paras 83-85)

Similarly, in the United Kingdom,

> "... markets which, in the opinion of the directors, do not differ substantially from each other shall be treated as one market" (Companies Act, 1981, section 55(4)(b));

and

> "No geographical analysis of turnover is required unless "overseas" operations" comprise more than 10% of the turnover. Where analysis is required, the analysis should be by continent but if 50% of the total "overseas operations" relates to one continent, a further analysis, for example by country within that continent will be required."
>
> (Stock Exchange Listing Agreement, 1979, para 10(c)).

Such disclosure guidelines as "allow judgment", "opinion of the directors", and "analysis should be by continent" are very general in nature and give management a wide latitude in what to disclose. Emmanuel and Gray (1978b) have suggested that such discretion should be curtailed by linking segment identification with the organisation structure of the entity. But they also state

> "The materiality concept is ... linked to managerial perceptions and not user perceptions, largely on the grounds that management are better placed to understand the nature of the business." (p 177)

The issue of managerial discretion in segmental disclosure is thus far from being resolved.

In sum, geographical segmental disclosure issues are different from LOB disclosure issues though complementary. The special features of geographical segmental disclosure issues are related to the risk assessment angle where conglomerates have to satisfy conflicting disclosure requirements between home base and foreign bases, and between foreign bases. The role of managerial discretion in segment identification in geographical disclosure is similar in nature to that of LOB disclosure, though the political flavour in geographical disclosure makes it somewhat distinct.

3.5 Summary

Chapter III has been concerned with segmental disclosure issues. First, the environmental setting in which segmental disclosure has become an issue has been explored; the merger boom and conglomerate form of business organisation in which segmental disclosure has become an issue has been examined in a historical setting.

Various institutional requirements for segmental disclosure have been described and analysed with special reference to USA, UK, and international standard setting bodies.

The costs and benefits of segmental disclosure have been examined, and difficulties such as segment identification, materiality, cost allocation and transfer pricing methods have been given special attention. Assuming segmental disclosure is to be pursued, the specific type of disclosure - mandatory or voluntary, have been investigated and incentives and difficulties in segmental disclosure have been explored.

The nature and problems of segmental geographical disclosure have been analysed and the possible costs and benefits of geographical disclosure have been explored and contrasted with the line of business form of segmental disclosure.

Having thus explored the issues of segmental disclosure with special reference to segmental geographical disclosure, the scene is now set for a study of capital market reaction to segmental disclosure. To be able to do this, first, the nature of information disclosure in capital markets will be analysed in chapter IV, following which chapter V will concentrate on the risk assessment aspects of segmental disclosure.

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C H A P T E R IV

INFORMATION DISCLOSURE IN CAPITAL MARKETS

CHAPTER IV

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4.0 Introduction

Segmental disclosure is about the disclosure of finer information about the corporate entity. One of the major users of segmental corporate information are investors (Corporate Report, 1975). Investors are interested in wealth maximization (Fisher, 1930; Hirshleifer, 1970). Given the existence of a capital market, such wealth maximization can be achieved through the stock price mechanism.

The extent to which segmental disclosure affects capital market participants depends upon how quickly the capital market reacts to such new information. This is what is known as the notion of market efficiency (Fama, 1970b).

Apart from the speed with which the new information is impounded in the stock prices, there is a further question as to the effect of such impounding of new information on the stock prices (Stiglitz, 1981). There are thus two strands in market efficiency:-

(i) The speed with which the new information is impounded in the stock prices; and

(ii) The extent to which such impounding relates to the notion of allocational efficiency.

In this chapter these two aspects of market efficiency will be analysed such that a scene can be set for examining the impact of segemental geographical disclosure in the context of capital market theories in chapter V.

Under the heading of the speed of the impounding process various market efficiency tests - weak, semi-strong and strong, as well as the concept of the fair game will be analysed. The extent to which such impounding relates to allocational efficiency will be examined in the next section in which the relationship of market efficiency with perfect markets, markets for information and pareto optimality will be discussed.

4.1 Theory of Efficient Markets

Finance literature during the sixties and seventies have been full of capital market efficiency tests (Dyckman, Downes and Magee, 1975). These tests have been categorised into weak, semi-strong and strong forms (Fama, 1970b). A weak form efficiency refers to the market reflecting all past prices, a semi-strong form reflects all published information about the shares, while the strong form efficiency supposedly reflects all "knowable" information in the market prices. The weak form efficiency is easily proved, the strong form is impossible to prove, while semi-strong form efficiency is the one around which most of the controversy hovers. Jensen summarises the controversy as follows:-

"For all practical purposes, all relevant tests of market efficiency is of semi-strong form, since strong form Efficient Market Hypothesis (EMH) is an extreme form which few people have ever treated as anything other than a logical completion of the set of possible hypotheses" (Jensen, 1978, p 97).

4.11 Weak Form Tests of Market Efficiency

Market efficiency tests are tests of information processing efficiency of the market. Weak form tests are tests of efficiency of information sets which are purely historical prices.

Weak form tests of market efficiency have developed from purely observational studies of stock prices behaviour. One of the earliest studies of stock prices behaviour was undertaken by Bachalier (1900) who set out for the first time a mathematical theory of speculative prices based on the proposition that share prices should have independent increments, which is to mean that today's price change should be independent of yesterday's. This theory was tested successfully against the French Government bond market over the period 1894-98.

Nothing much happened in testing the behaviour of stock prices in the first half of the twentieth century, until Osborne (1959) found that security prices behaved in a manner similar to that known to physicists as Brownian motion. Brownian motion was discovered by Robert Brown, a botanist, in 1827. Robert Brown, a Scotsman, born in Montrose, Scotland, in 1773, did not have the slightest interest in speculative behaviour of stock prices, but his accidental discovery has had great influence on the literature of stock prices movement. Brown had accepted a commission in 1801 to go to the northern coasts of Australia (or New Holland as it was then called) to investigate plant life. During his investigations he discovered what is now known as Brownian motion (Gillespie, 1970). Brownian motion describes the movement of particles in solution, where movements of different magnitudes may occur at any time, independent of any prior movements. So defined, Brownian motion is a particular type of random walk.

4.111 Random Walk

Studies of weak form efficiency have evolved from, and in many cases were actually tests of random walk model. The random walk model tests the statistical independence and randomness regarding the movements of security prices. The motivation in such tests is that if the prices series behave randomly then no one can make excess returns consistently.

Random walk tests are tests in the time domain as distinct from tests in the frequency domain. Time domain tests of a time series require an understanding of the underlying processes that generate the security returns (or prices).

The general form of a time series $\tilde{Y}_t$ can be expressed as:-

$$\tilde{Y}_t = d + b\,\tilde{Y}_{t-1} + \tilde{U}_t$$

ie, the value of any variable at time t can be expressed in terms of the value of the variable at the previous time period, t-1, where d is the intercept, b is the regression coefficient, and $\tilde{U}_t$ is the unexplained random element. Further assumptions in the model are that the unexplained random element or error terms, $\tilde{U}_t$ have the following properties:-

(i) $E(\tilde{U}_t) = 0$; ie the expected value of the error terms is zero.

(ii) $E(\tilde{U}_t)^2 < \alpha$; ie error terms have finite variances; and

(iii) $Cov(U_t, U_{t-j}) = 0;\ j \neq 0;$

ie the error terms are serially uncorrelated.

When b = 1 and d = 0, the time series is a strict martingale or random walk.

Appendix IV(A) summarises the terminology of time series and stationarity.

Testing weak form market efficiency in the time domain requires a distinction between a particular observed time series, called a realisation and the process that is presumed to have generated the realisation. Just as in regular statistics we try to make inferences from a sample to a population, in time series analysis we try to make inferences from a realisation to the process that generated it.

In this transition from a realisation to the process we make certain assumptions about stationarity of the time series. There are two important stationarity conditions: our first condition of stationarity is that the underlying process is stable in some statistical sense for example, normally distributed. The second condition is that observations in the series are serially independent. Gottman has formalised the two conditions as follows:-

"Condition 1: A stationary process is characterised in part by the fact that its (finite) mean and (finite) variance do not change with historical time.

Condition 2: A stationary process is characterised in part by the fact that the covariance between two random variables at t and t + k is a function only of their relative lag, k, not of the starting point, t. In other words, the covariance of this process is independent of historical time" (Gottman, 1981, pp 61-62).

The random walk model applied to the testing of capital market efficiency has the following conditions, which are seen as sufficient conditions for capital market efficiency:-

1 No transaction costs.

2 Information is costless.

3 Homogeneous expectations of investors based on current information.

Given these three above assumptions, the random walk model says that the current price of security "fully reflects" available information. This statement has two implications:-

(a) successive price changes (or more usually, successive one period returns) are identically distributed; and

(b) successive price changes (or returns) are independent.

Formally stated the random walk model could be seen as:-

$$f\ (r_{j,\ t+1}/\emptyset_t) = f\ (r_{j,\ t+1})$$

ie (i) the probability density function, f, of price changes is the same for all t, and

(ii) the conditional and marginal probability distribution of an independent random variable, given $\emptyset$, the information set, are identical.

If the underlying probability distribution of the price series is assumed to be normal, then parametric tests are valid, and serial correlation tests are appropriate. If the underlying probability distribution of the price series is not the same for all t, then parametric tests of serial correlation type are not appropriate, in which case we may need to use non-parametric tests.

4.112 Serial Correlation

Serial correlation technique provides a measure of the relationship between the value of a random variable at time t, and its value r periods earlier. The serial correlation for lag r is given by

$$\mathrm{Cov}\,(P_t, P_{t-r}) \Big/ \mathrm{Var}\,P_t$$

where P_t is the change in the price of a given security from the end of day t-1 to the end of day t.

The existence of a statistically significant amount of serial correlation negates the notion of market efficiency. Kendall (1953) has done extensive serial correlation tests for British Industrial share prices, in spot prices for cotton in New York, wheat in Chicago, and concluded in favour of weak form of market efficiency. Kendall was unable to discover any underlying trends and so could not derive any meaningful process which would help forecast future prices. Price movements appeared to be independent.

Brealey (1970) examined the Financial Times actuaries all-shares index over the period 1962-68 using a lag of one day, and observed low positive correlation.

Dryden (1970b) found inconclusive results when using serial correlation tests to a small sample (fifteen companies) on the London Stock market during 1963-64 and 1966-67.

Serial correlation tests used in the context of examining short term stationarity of stock prices have two possible limitations. (i) Assumptior of normal distribution and (ii) the magnitude of lag. Firstly, an underlying normal distribution is assumed in the prices series.

Fama (1965a) disputes the normal distribution assumption after testing the first differences in the prices of blue chip stocks on the New York stock exchange, and concludes in favour of a stable Paretian distribution with a characteristic exponent of less than 2. A stable Paretian distribution is a long tailed asymmetrical distribution in which there is evidence to believe that the distribution of residuals has infinite variance.

The economic implications of the violation of normal distribution assumptions while using serial correlation tests are as follows:-
In a Gaussian (normal) market, if the sum of a large number of price changes across some long time period turns out to be very large, chances are that individual price changes during the time period is negligible when compared to the total change. In a market that is stable Paretian with characteristic exponent less than two, the size of the total will more than likely be the result of a few very large changes that took place during much shorter sub-periods. In other words, whereas the path of the price level of a given security in a Gaussian market will be fairly continuous, in a stable Paretian market with characteristic exponent less than two will usually be discontinuous. This discontinuous nature of a stable Paretian market has practical implication. The fact that there are a large number of abrupt changes means that such a market is inherently more risky than a Gaussian market. Therefore, when dealing with stable Paretian distribution the researcher should avoid the concept of variance both in his empirical work and in any economic model he may construct. For example, from an empirical point of view, when there is reason to believe that the distribution of residuals has

infinite variance, it is not very meaningful to use a regression technique that has as its criterion the minimization of the sum of squared residuals from the regression line, since the expectation of that sum will be infinite. In such cases an alternative technique, absolute value regression could be used which minimizes the sum of absolute values of the residuals from the regression line.

The second reservation in using the serial correlation test to prove weak form efficiency of the market is about the time lag between successive prices. While serial correlation tests can explain short term price movements, their impact in explaining longer term movements have not been impressive. Granger and Morgenstern (1963) have addressed this problem and applied spectral analysis instead, to explain comparatively longer term price movements.

4.113 <u>Spectral Analysis</u>

Weak form tests of market efficiency are essentially tests of stability of a series of stock prices. Such stationarity properties can be investigated in two different ways: in the time domain, and in the frequency domain. Time domain path is the most trodden one, which investigates the serial correlation properties of successive price changes. Not so frequently cited, but relevant nevertheless, is spectral analysis which is in the frequency domain.

The basic assumption of this methodology is that if the values of one variable are known at time t=1, 2, 3, ...n then a number of functions based on this series can be calculated. These can then be used as a basis for hypotheses regarding the actual structure of the time series. Granger and Morgenstern (1963) have used spectral analysis to study the stock prices in the New York stock exchange. Their findings have been consistent with weak form market efficiency, and the serial correlation they found was very small. Not a great deal of work has been done in the frequency domain since Granger and Morgenstern, but their work has explored a new path, and has alleged superiority over traditional serial correlation analysis in that spectral method can explain not only short term movements, but long term movements in stock prices as well. Granger and Morgenstern have justified their analysis as follows:-

If the random walk hypothesis is true, in which the price at any one moment of time is the same as the price at any previous moment of time plus an independent random variable, then it should be "true when the interval between the moments is a day, week or even a month. The spectral method indicates that whereas the random walk model explains the short term movements very well, the very important long run movements are not adequately explained by this model".

(Granger and Morgenstern 1963, p 25)

Spectral analysis needs no assumption of normal distribution of the underlying price series. Other approaches which obviates the necessity of the normality assumption are information theory approach, runs test and filter test.

4.114 <u>Information Theory Tests</u>

Information theory applied to stock prices examines the probability of prices rising (falling) at any particular time point, given that it has risen (declined) at a previous time point. In brief, this is a test of information content in stock prices applying Bayesian probability.

Fama has used information theory approach to test the independence of successive stock price changes on the New York stock exchange and found evidence in favour of weak form market efficiency.
" ... it seems safe to conclude that proportions of securities advancing and declining today of New York stock exchange do not provide much help in the proportions advancing and declining tomorrow" (Fama 1965b, p 229).

Although Fama has concluded in favour of weak form of market efficiency, Theil and Leenders (1965) using the same methodology on data from Amsterdam stock exchange found evidence to the contrary.

Dryden (1968) applied information theory approach to test short term stationarity of share prices on the London stock exchange, and found evidence which does not support the weak form efficiency. Results suggest that the dependence of today's outcomes on yesterday's is stronger in London Stock exchange than in New York. This could be due to two factors: (i) New York market is more efficient than London, (ii) there are unresolved problemsin techniques of forecasting using information theory, and accepting information inaccuracy as appropriate measure of forecasting inaccuracy.

4.115 Filter Analysis

Filter analysis examines the possibility of earning above average returns using some mechanical trading rules of the following type: if the stock price increases by x per cent, buy and hold until the price decreases by x per cent from its subsequent high. If stock prices move in a trend, then this strategy will produce better results than simply buy and hold investment policy. If a rule consistently holds, then price movements are not random and the security may be improperly priced, and the market may be inefficient. In the USA filter analysis has been used to test market efficiency by Alexander (1961), Fama and Blume (1966), and Jensen and Bennington (1970) among others. Dryden (1970a) and (1970b) have used filter analysis with UK data. Results show that filters may work in the short period, but their usefulness in predicting long term price changes are limited. Jensen and Bennington have pointed out that while it is possible to derive filter rules that appear to work for a finite series of truly independent returns, what is needed to prove market inefficiency is that a rule will continue to work over other series as well. Simulating numerous filter rules over a very large data base for stocks has generally failed to identify consistently profitable trends in prices.

Filter rules are easy to test as they do not assume any distribution of underlying prices; in other words filter rules tests are non-parametric tests.

4.116 Runs Analysis

Another non-parametric test of weak form market efficiency is runs analysis. The test methodology here is the analysis of the duration (of runs) of successive price increases and successive price decreases. The results of these for individual stocks and for indices are then compared against the mathematical expectation of runs in the light of probability theory. If any significant departure exists between actual runs and those expected then this indicates there are patterns present in the data which could provide the basis for profitable investment strategies.

For example, if a price increase of any size is designated by "+" and a decrease in price by "-", any pattern might be observed over time.

Hypothetical stock		No of runs
A	+ + + + + - - - - - + + +	3
B	+ - + - + - + - + - + - +	13
C	- - + - + + + - - + + - -	7

The pattern for stock A reflects continuing trends; if the price of the stock has been increasing (decreasing) it will continue to move up (or down).

Stock B shows the opposite behaviour; a tendency of price reversal from the preceding period. Stock A has very few runs, but stock B has many.

Stock C represents an unpredictable sequence, evidenced by a number of runs equal to the number expected by chance in a totally random series.

Since each observation is counted regardless of size, runs analysis removes potential problems of non-normality in identifying independence.

Fama (1965a) made use of runs analysis, measuring their length, their direction and the number of reversals (changes in direction), testing for independence. The actual results differed very little from those expected and thus upheld the weak form definition of efficient markets theory. However, runs analysis is not a powerful test, and similar to serial correlation, results have stronger statistical than economic interpretation.

4.12 Semi-Strong Form Tests of Market Efficiency

While the weak form test of market efficiency is one of trying to beat the market using price volume information only, semi-strong form test of market efficiency includes all published information, including those in weak form. Hence, apart from price volume information, included are knowledge of earnings, dividends, public announcements by management and all other public information.

Tests of semi-strong form and strong form efficiency are difficult to design because of the variety and lack of regularity of the information involved. In general, studies of semi-strong form efficiency focus on one particular type of information, associating that information with stock price bahaviour.

Ball and Brown (1968) examined the impact of annual earnings announcements and concluded that 85 to 90 per cent of the earnings information had already been anticipated by the month the announcement was made.

Fama, Fisher, Jensen and Roll (FFJR) (1969) studied the impact of stock splits, and concluded that price behaviour reflects the anticipated dividend increases, when stocks are split.

At an aggregate level Niederhoffer (1971) studied the reaction of security prices to world events which have potentially significant consequences on the stock prices. Niederhoffer found that stock market reacted immediately to announcements of crisis proportions. Although reaction was rapid, some short run price dependencies were evident. However, as major events occur over prolonged and irregular periods, it is doubtful that they could be exploited profitably unless the investor has advance private knowledge of these events.

Marsh (1979) investigated the stock market efficiency in the context of rights issues in the London Stock Exchange. Eddy and Saunders (1980) investigated the relationship between new product announcements and stock prices. Both found evidence in favour of semi-strong form efficiency.

There are many more studies in the USA, UK and European context investigating various forms of public information and their impact on stock price changes. Overall the majority of studies have concluded in favour of market efficiency of a semi-strong variety.

Comprehensive studies of market efficiency tests are to be found in Dyckman, Downes and Magee (1975), Richards (1979) and Keane (1980, 1983).

4.13 Strong Form Market Efficiency

Strong form market efficiency implies that all information is fully reflected in stock prices at all times. If a market is strong form efficient, no investor can expect abnormally high profit from the possession of inside information. Hence strong form efficiency tests can be described as private information studies.

Insiders with access to specially exclusive information can be categorised into two groups: (i) exchange specialists and senior employees and (ii) fund managers.

Research by Niederhoffer and Osborne (1966) has shown that exchange specialists use their privileged information to obtain excess profits. Finnerty (1976) found that corporate directors and managers have inside information which could have been used to make excess profits.

In contrast, fund managers do not seem to be able to make excess profits. Studies of mutual fund returns have shown that fund managers have no special information advantage which allows them to earn consistently large returns for their customers when management and transaction costs are taken into account. (Treynor, 1965; Sharpe, 1966; Jensen, 1968). While weak form market efficiency is almost unanimous, and semi-strong form of efficiency is possible though difficult to design, strong form efficiency tests could be seen as almost meaningless except to logically complete the possible sets of tests. Information, if it is private, is not known. If it is not known, no amount of testing can possibly prove it or disprove it.

4.14 Fair Game Model

Tests of market efficiency were developed originally out of curiosity. There were no theories behind it. Researchers were primarily interested in finding out if the market could be outperformed. Random walk hypothesis tested the underlying pattern of stock price changes, the rationale in such an exercise being that if any pattern exists, money could be made. Assuming costless transaction, costless information, and agreement among investors random walk hypothesis has been accepted. But doubts remain if the theory would hold in the absence of such unrealistic assumptions. Violation of one or more of the conditions are potential sources of market inefficiency. Further, there is the question of time horizon over which market efficiency is to be tested. Serial correlation of a lag of one day may be significant in a statistical sense, and random walk may be said to have been proved. But what is the economic significance of such a proof, if serial correlation does exist in tests with a lag of one week, or one month? There can also be no test of strong form except in the very long run.

There are also questions relating to information sets, covariance or jointness of information, and perceptional problems. Finally, speed of adjustment of stock prices says nothing about the correctness of the impounding process. Investors may in fact interpret the information wrongly.

Such questions relating to the traditional analysis of market efficiency has led to ex post rationalisation in the theory of rational behaviour and fair games (Samuelson 1965), Fama (1970b).

The Fair Game model is based on the behaviour of average returns,without specifying the time horizon over which such averages are taken, and without any assumptions about the distributional properties of the price changes over time. Fair game simply says, on average the game is fair.It simply states that the conditions of market equilibrium can be stated in terms of expected returns. Fair games, thus described can be seen as the universal set, subsets of which are various forms of market efficiency tests of weak, semi-strong and strong form. We conclude in favour of stock market efficiency of a "fair" game model. Appendix IV(B) is a summary of market efficiency tests.

4.2 Market Efficiency Revisited

In the previous sections the notion of market efficiency has been extensively discussed. But the discussion so far has been only about the degree of efficiency without exploring the nature of such efficiency. An understanding of the nature of market efficiency will be enhanced if it is linked with the notion of perfect markets, markets for information, and allocational efficiency.

4.21 Perfect Markets

The notion of efficient capital markets is distinctly different from the economist's notion of perfect capital markets.

The following conditions are necessary for perfect capital markets:-

1 Markets are frictionless, ie

   (a) No transaction costs

   (b) No taxes

   (c) No government regulations, and

   (d) All assets are perfectly divisible and marketable.

2 There is perfect competition in

   (a) Product markets

   (b) Factor markets, and

   (c) Securities markets.

3 Markets for information are perfect, ie

   (a) Information is costless, and

   (b) It is simultaneously received by all individuals.

4 All individuals always attempt to maximise the present value of their wealth.

Capital market efficiency is much less restrictive than the notion of perfect capital markets outlined above.

In an efficient capital market security prices simply reflect all available information, irrespective of the nature of the information. Thus, if there are transaction costs such as brokerage fees to pay, or opportunities of making excess profits because of lack of competition, such costs or benefits will be reflected in the security prices. Since prices will reflect all available information, investors will receive accurate signals for capital allocation. Such capital allocations may, or may not be optimal in the societal context, but that is beyond the domain of capital market efficiency.

4.22 Markets for Information

Market efficiency is about information processing efficiency. The theory of information disclosure has been extensively discussed in chapter II in this research. Information, to be of value must contain something new that the receiver does not know, and must be of use in a decision making context.

> "Value of information is that cost which equate the maximum net expected utility for the given information structure to the maximum net expected utility obtained with no information".
> (section 2.22)

Thus, if a message is not relevant to the decision maker, it will not be reflected in the stock prices. An important aspect of financial disclosure is the understanding what is relevant to the decision maker.

If the information is useful to the decision maker, then the decision maker will be willing to pay for it. The amount that the decision maker will be willing to pay will depend on the expected utility of the information to him. Therefore, the value of the gain from the information, net of costs, to the user will be zero, ensuring that the markets for information is competitive. Such costs could include brokerage, taxes and costs of information search.

4.23 Allocational Efficiency

We have seen that capital markets are efficient in a "fair game" sense; we have also seen that capital market efficiency is less restrictive than perfect capital market; but what is the relationship between capital market efficiency and the economist's notion of allocational efficiency? Stiglitz has explored this area extensively. The discussion that follows here is after Stiglitz (1981).

Market efficiency has been defined by Fama as follows:-

"A market in which prices fully reflect available information is called efficient".

Fama, (1970b), p 383

Similarly, Jensen defines market efficiency as:-

"A market is efficient with respect to information set $\emptyset_t$ if it is impossible to make economic profits by trading on the basis of information set $\emptyset_t$".

Jensen, (1978), p 96

Efficiency as defined above refers to information efficiency alone, and ignores the two other requirements of Pareto optimality which are exchange efficiency and production efficiency. Moreover, efficiency of the markets must take into account the costs associated with (a) establishing markets and (b) obtaining information. Therefore, efficiency in the Fama-Jensen sense is neither necessary nor sufficient condition for Pareto optimality of the economy.

Following is a summary of the argument discussing the relationship between Pareto optimality and market efficiency:-

ECONOMIC EFFICIENCY

PARETO OPTIMALITY

A EXCHANGE EFFICIENCY

Given :
- (a) set of assets or securities;
- (b) information (beliefs) of the various participants :

Market is efficient if :

there is no rearrangement of ownership claims possible which would increase the expected utility of one individual without decreasing that of some other

C INFORMATION EFFICIENCY

Given :
Probability distributions of various events (states) :

Requires :
- (i) Markets must provide correct incentives for gathering right amount and kind of informaton.
- (ii) Market prices must reflect the information available to various traders.
- (iii) Firms must be able to convey efficiently information about their prospects to potential investors.

B PRODUCTION EFFICIENCY

Given :
- (a) technology
- (b) resources (endowment)
- (c) information

the concern is with the supply of various assets.
There are three relevant questions here :

- (i) If the firm maximized its market value will the resources allocation be optimal?
- (ii) Is there unanimity among shareholders about the value maximization objective? If not, what can we say about the equilibrium?
- (iii) Are there control mechanisms in existence to ensure that managers pursue the policies which are in the best interests of the shareholders of the firm?

Economic efficiency refers to A, B and C; while "efficient markets" requires only C.
But more to the point :
"Were the market to be efficient in the sense of Fama and Jensen, investors would have no incentive to gather information. The only information that would be reflected in the market is costless information. Thus a market which was efficient in the Fama-Jensen sense would almost certainly not be Pareto optimal."
Stiglitz, (1981) p 237

4.3 Summary

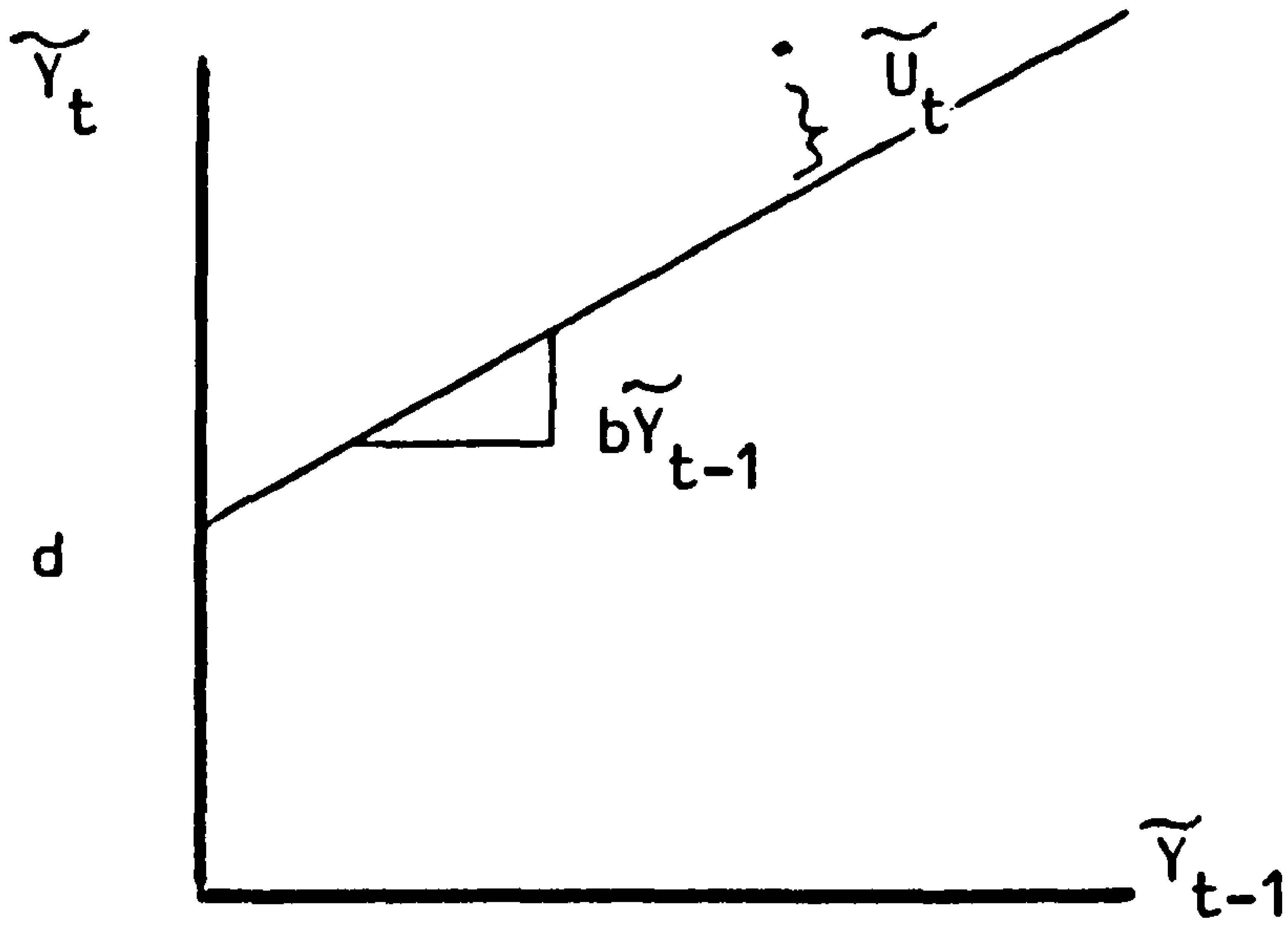
Chapter IV has been concerned with information disclosure in capital markets. Segmental geographical disclosure results in finer information being available to market participants. The extent to which the market is able to reflect this information in the stock prices of such disclosing companies is likely to affect the investment-divestment decisions of market participants.

In order to be able to examine this information impact on stock prices, (i) the theory of efficient markets, and (ii) implications of the efficient markets theory have been examined. The history of efficient markets theory has been traced, various forms of market efficiency tests have been discussed, and it has been concluded that the market is efficient in a semi-strong form sense, of a fair game variety.

In discussing the implications of market efficiency, market efficiency has been contrasted with the perfect market notion; the notion of markets for information has been explored, and it has been shown that allocational efficiency notion is distinctly different from the notion of markets efficiency.

Having thus explored the nature of information impact on capital markets, the scene is now set for exploring the role of information in risk assessment, through its impact on perceived uncertainty so far as the decision maker is concerned. This will be done in chapter V.

TIME SERIES AND STATIONARITY : TERMINOLOGY



The general form of a time series $\tilde{Y}_t$ can be expressed as :

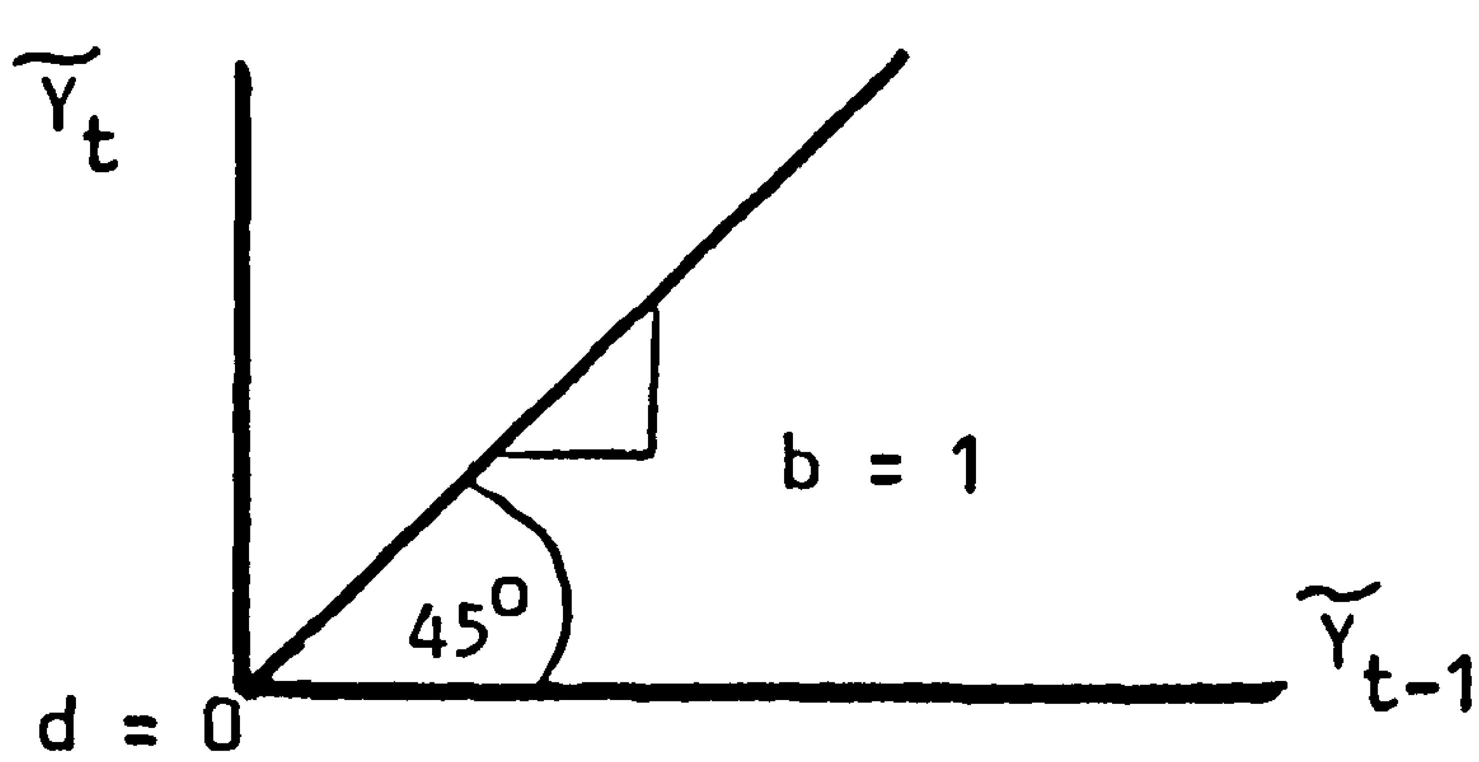
$$\tilde{Y}_t = d + b\tilde{Y}_{t-1} + \tilde{U}_t$$

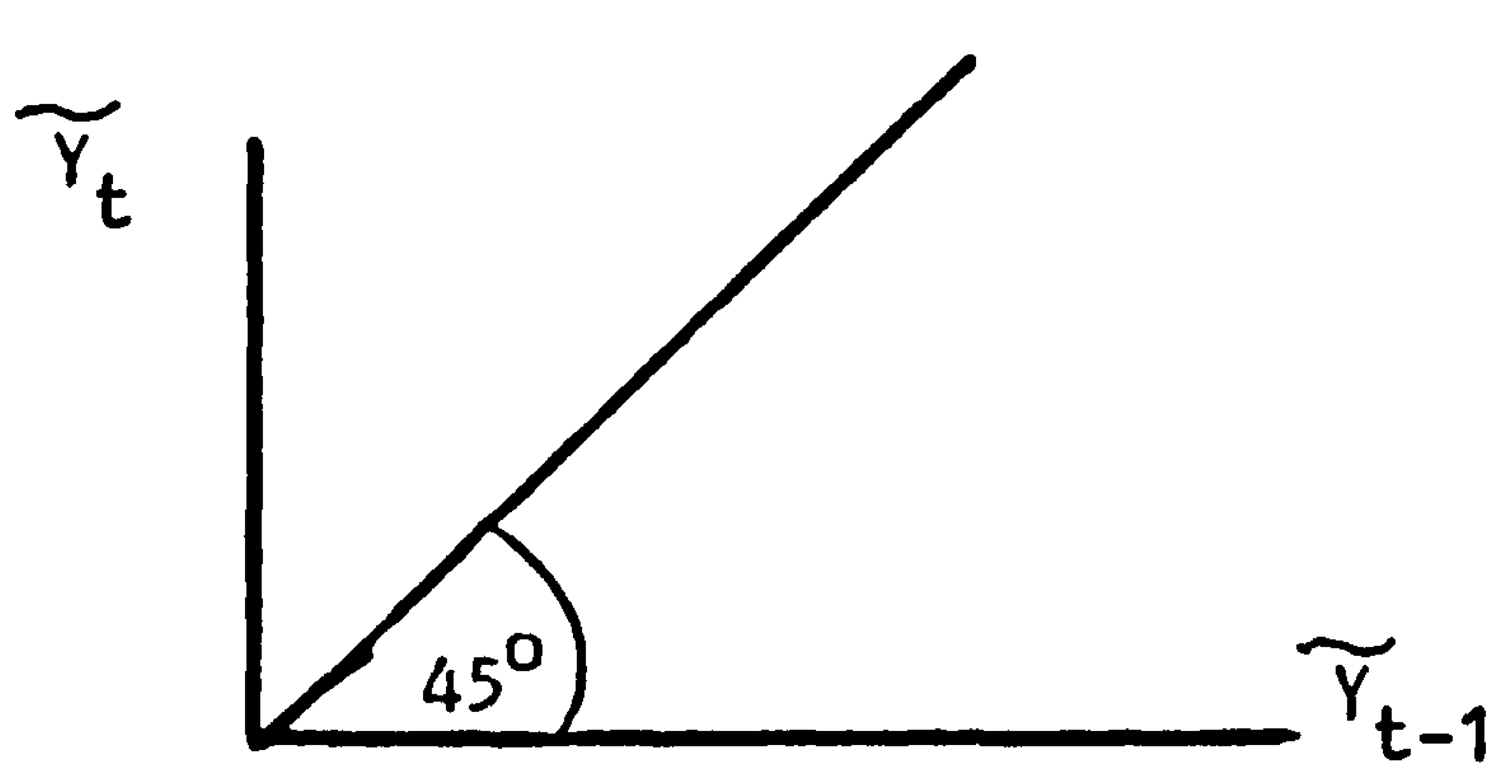
where $E\ (\tilde{U}_t) = 0$

$$E\ (\tilde{U}_t)^2 < \infty$$

$Cov\ (\tilde{U}_t, \tilde{U}_{t-j}) = 0,\ j \neq 0$

When b = 1 d = 0, the series is a strict martingale or Random Walk.



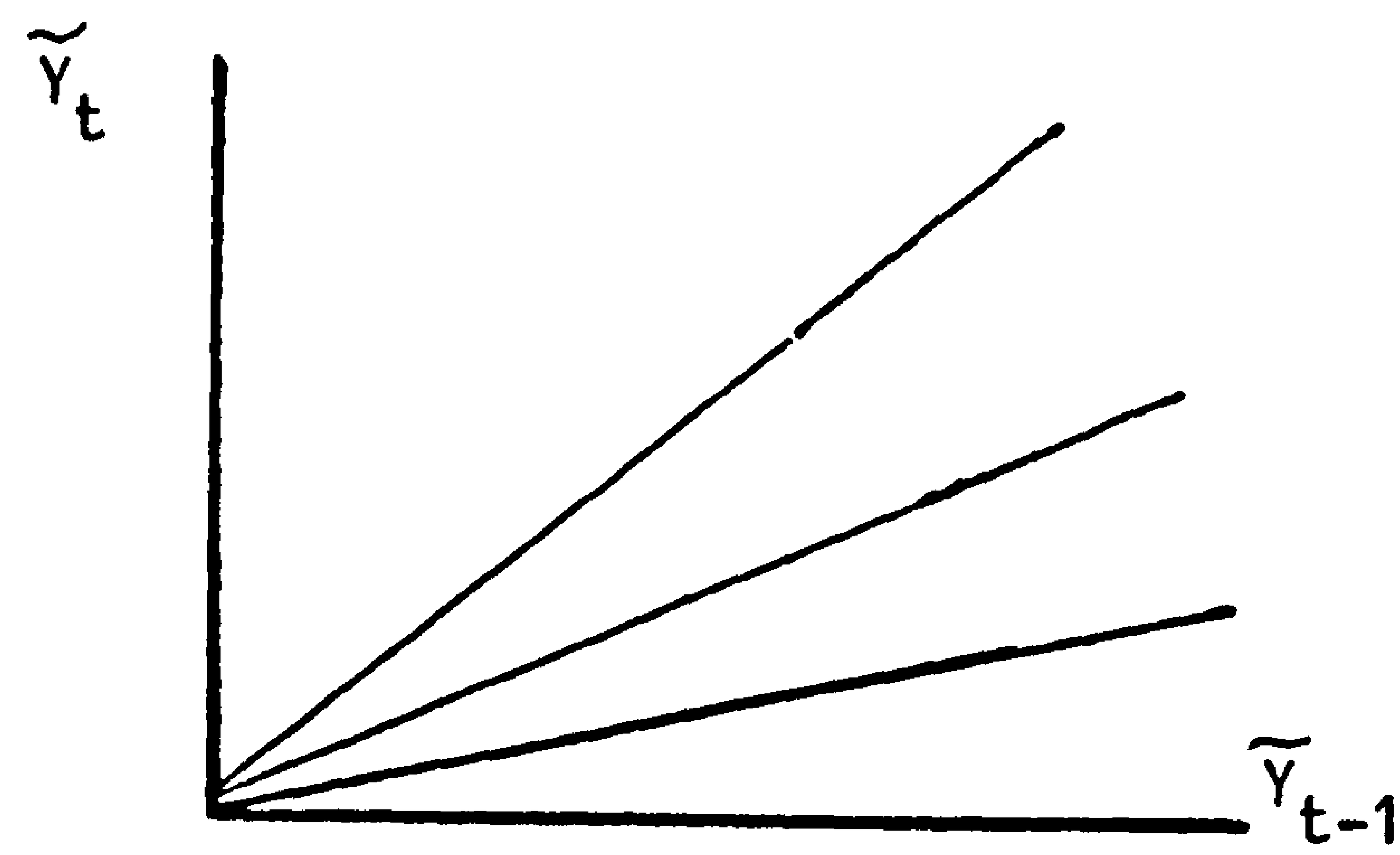


$$\tilde{Y}_t = d + b\tilde{Y}_{t-1} + \tilde{U}_t$$

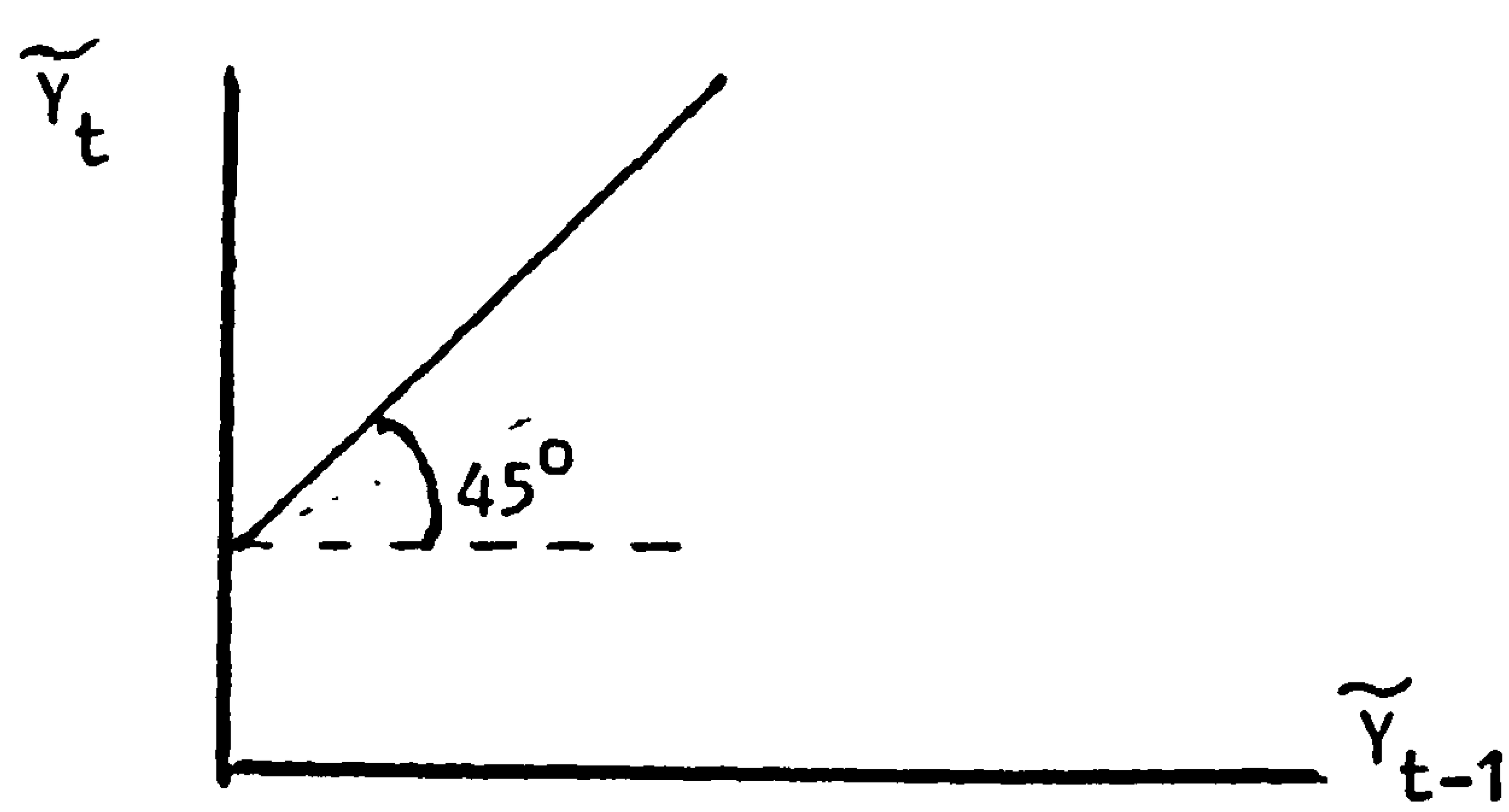
$$\tilde{Y}_t = 0 + (1)\,\tilde{Y}_{t-1} + \tilde{U}_t$$

$$\tilde{Y}_t = \tilde{Y}_{t-1} + \tilde{U}_t$$

When $b \neq 1$, $d = 0$ the series is a multiplicative semimartingale.

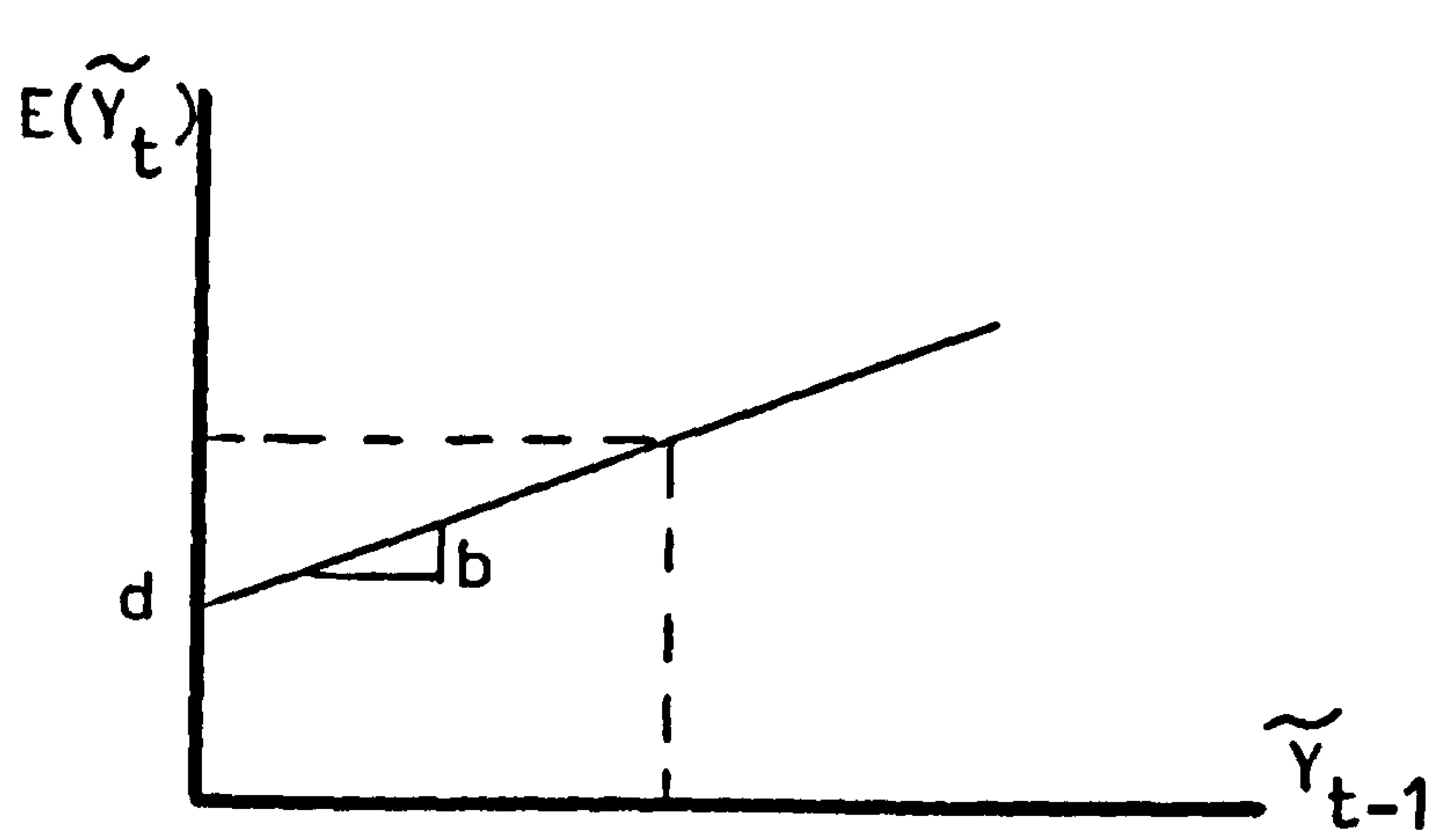


When $b = 1$, $d \neq 0$ the series is an additive semimartingale or Random Walk with a drift.



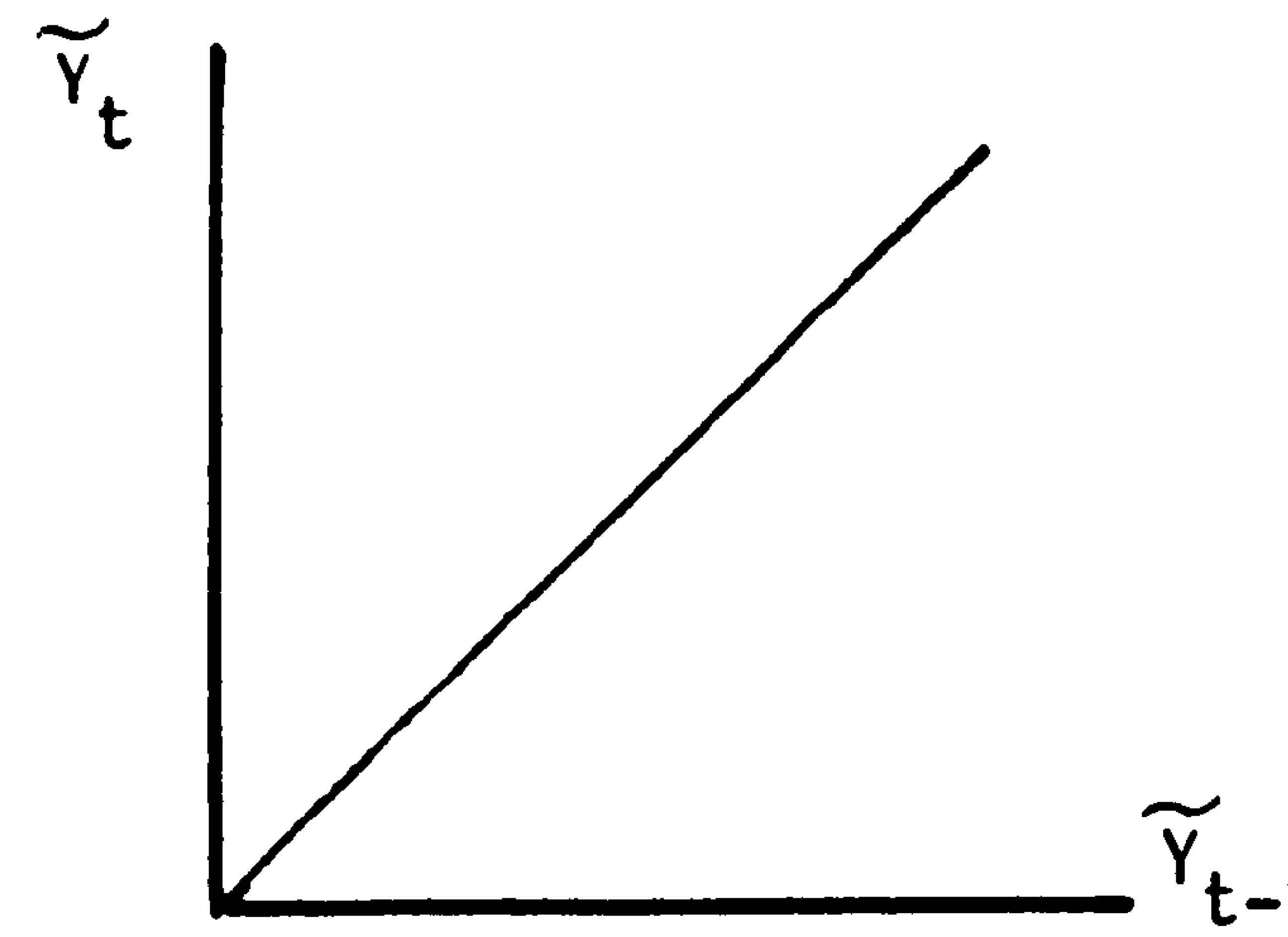
When $E(\tilde{Y}_t) < \tilde{Y}_{t-1}$ the series is <u>supermartingale</u>.

When $E(\tilde{Y}_t) > \tilde{Y}_{t-1}$ the series is <u>submartingale</u>.



A Stationary series is one in which

$E(\tilde{Y}_t) = E(\tilde{Y}_{tj-1})$ for all j



<u>A Mean Reverting series is stationary</u> when :

$$\tilde{Y}_t = M + \tilde{U}_t$$

where $E(\tilde{U}_t) = 0$, $E(\tilde{U}_t)^2 < \infty$

$$Cov\ (\tilde{U}_t, \tilde{U}_{t-j}) = 0,\ j \neq 0$$

<u>A Mean Reverting series is non-stationary</u> when :

$$\tilde{Y}_t = M_t + \tilde{U}_t$$

where M_t is a deterministic function.

<u>A Moving Av. Process</u> of order q, $M_t(q)$ is defined as :

$$\tilde{Y}_t = M + \tilde{U}_t - \theta_1 \tilde{U}_{t-1} - \theta_2 \tilde{U}_{t-2} \cdots \theta_q \tilde{U}_{t-q}$$

if $q < \infty$, MA(q) is stationary.

<u>An Auto Regressive Process</u> of order p, AR(p) is defined as :

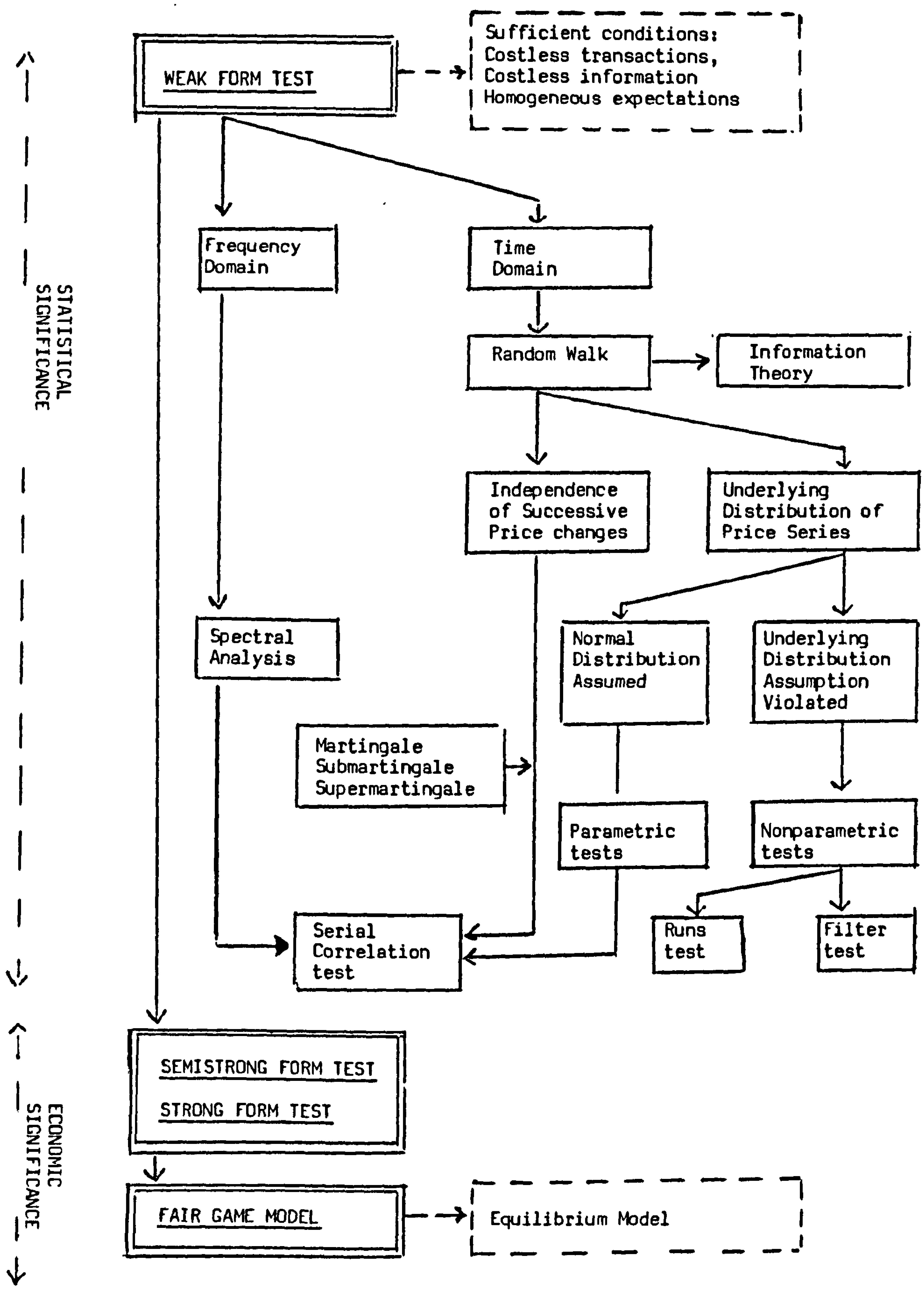
$$\tilde{Y}_t = d + (\theta_1 \tilde{Y}_{t-1} + \theta_2 \tilde{Y}_{t-2} + \ldots \theta_p \tilde{Y}_{t-p}) + \tilde{U}_t$$

The conditions for the stationarity of an AR(p) process are a function of p.

In the special case of AR(1), stationarity requires $\theta_1 < 1$.

TESTING MARKET EFFICIENCY

Appendix IV(B)



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CHAPTER V

RISK ASSESSMENT IN CAPITAL MARKETS

CHAPTER V

RISK ASSESSMENT IN CAPITAL MARKETS

Sections

Figures

Appendix

CHAPTER V

RISK ASSESSMENT IN CAPITAL MARKETS

5.0 Introduction

The notion of market efficiency and its implications have been explored in chapter IV, with a view to understanding the impact of new information in capital markets. Such new information may alter the perceptions of market participants. The extent to which this altered perception may affect the risk return prospects of investors, especially in the context of a geographically diversified investment environment is the concern of this chapter.

In this chapter, first, the notion of risk will be explained following which the two parameter portfolio theory will be described and analysed. The development of the Capital Asset Pricing Model from the theory of portfolio selection via the Market Model will be traced. Implications of the CAPM will be discussed, its link with the notion of market efficiency will be described, and various results from empirically testing the CAPM will be analysed.

Having described and analysed the CAPM, its application in the context of segmental geographical disclosure will be explored. In an ex ante formulation forecasting problems arise. Problems of forecasting beta, and beta stability in the context of a geographically diversified investment situation will be discussed, and various methods of forecasting beta will be explored. Various multifactor models will be explored and the International Market Model will be analysed, showing its relevance in the geographical segment disclosure situation.

This will then complete the theoretical framework in which prior researches in segmental geographical disclosure will be cited, hypotheses developed, and subsequently analysed and implications explored.

First the problem of risk assessment.

5.1 Risk Assessment

Conglomerates can be engaged in multiple product-markets as well as across national boundaries. Because of the diverse nature of the businesses of conglomerates, and the diverse environments they face, investors are unlikely to have complete information about the future prospects of conglomerates. This gives rise to the phenomenon of uncertainty. Uncertainty exists when the decision maker has to choose among alternate courses of actions when the consequences of his action are incompletely known to him.

A theory of choice is a set of propositions about choice rules, rules which indicate for each set of available actions that action which will in fact be taken. To formalize the theory of choice under uncertainty, it is convenient to introduce the concept of the 'state of the world', a description of the world so complete that, if true and known, the consequences of every action would be known (Arrow, 1971, p 44).

The meaning of uncertainty is that the agent does not know the state of the world. By definition, the consequences would be known if both the action and the state of the world are known.

Thus, decision making under uncertainty may be viewed as choices between alternative probability distributions of return, and the individual choices between them in accordance with a consistent set of preferences. Von Neuman and Morgenstern (1947) have shown that under reasonable assumptions about individual preferences, the individual chooses an alternative which maximizes the expected utility of returns, where utility function is determined uniquely, up to a positive linear transformation, by individual preferences.

It has been shown earlier (section 2.211) that finer information may result in a reduction of uncertainty. An operational notion of uncertainty in decision making is risk. "Risk is measurable uncertainty" (Knight, 1921, p 20). Earlier notion of risk reduction in business has been through the operation of the law of large numbers (Knight, 1921, p 257: Fisher, 1930, pp 408-409). More recently, Markowitz (1952) has introduced covariance as a measure of risk, and formulated a theory of portfolio selection based on two parameters, mean and variance.

Risk assessment attempts have also been made with the use of other measures such as semi-variance (Markowitz, 1959), skewness and higher moments (Samuelson, 1970; Jean, 1971; Francis, 1975), but due to difficulties in making such measures operational, the two parameter mean-variance model remains the most popular and practical measure used in risk assessment in capital markets, and will be used in most of the discussions in this chapter.

5.2 Portfolio Theory

Market efficiency studies as discussed earlier in chapter IV had nothing to say about risky returns. Although developments in risk adjusted returns are attributed to Markowitz (1959), in many ways the pioneering work of Fisher (1930) on the theory of interest rates under certainty conditions made it all possible. Modern capital market theory can be said to have started with Fisher. Fisher's theory of real rate of interest when extended to conditions of uncertainty resulted in two approaches:-

(i) Time-State-Preference due originally to Arrow (1964b), Debreu (1959), and popularised by Hirshleifer (1970); and

(ii) The mean-variance model following in the tradition of Markowitz.

Although the State-Preference theory is perhaps more general than the mean-variance approach, its progress in the real world has been rather limited because of the difficulty of testing it empirically. The main thrust of research in capital market theory in recent years has therefore been in the Markowitz tradition.

Quite independent of the Random Walkers, Markowitz developed a theory of portfolio selection as an extension of Neuman-Morgenstern's (1947) theory of games. Markowitz's portfolio selection model was a two parameter (mean-variance) model for risk averse investors in which the objective is to minimise risk (variance of return) for a given return. In the establishment of this "minimum variance" portfolio, the role of the individual security's variance of return was not significant, what was significant was the covariance with each other in the build-up of the portfolio.

Portfolio theory is based on several assumptions. Generally, these assumptions include:-

1 Investors consider securities in terms of risk and return to the exclusion of everything else.

2 Investors analyse securities by developing probability distributions of rates and returns.

3 Risk is defined as the total variability of returns, ie the probability distributions developed are symmetric.

4 Investors seek to gain the maximum return for a given level of risk.

A major problem in analysing risk-return relationships is caused by the fact that the security analyst is concerned with the future and therefore has to make projections. Since the analyst cannot make these projections with certainty, he must form opinions about possible returns and the probability of occurrence of each return. From the resulting distribution, the expected return of each security and the associated risk, as measured by the variance or standard deviation, can be measured. For an independent investment risk is the variance of returns. For a portfolio, on the other hand, risk is not simply a weighted average of component security risk. Portfolio risk depends upon how individual security prices move in relation to each other. If selected stocks vary less than perfectly two or more stocks that are individually very risky may be combined into a portfolio that is less risky than any of its components. The standard deviation for a portfolio therefore must include a measure of this inter-relationship, the covariance.

Once risk and return for all securities and portfolios have been calculated, combinations can be selected for investment consideration. Being concerned with this selection process Markowitz theorised how risk averse investors can analyse individual stocks and then select the most desirable portfolio tailored to the individual's particular risk-return combination preferences. After all possible combinations of securities have been identified, it is possible to select portfolios which are superior for their given risk or return class. The set of these superior portfolios is commonly called the "efficient frontier". These portfolios give the maximum return for a given level of risk or the minimum risk for a given return. (Figure 5.1)

In Figure 5.1 the curve XYZ is an efficient frontier. All points on the curve are superior to those inside it, for an investor who is risk averse. R is any point inside the curve. R is inefficient because there exists a point X on the frontier which commands the same return as R but is less risky. Similarly, there exists another point Y which commands a higher return than R, but requires no additional risk.

Capital market theory is an exercise in positive economics. Assuming that people act in certain ways, what is implied about prices, quantities held, etc in conditions of equilibrium? Our concern is to explore the following two questions in equilibrium conditions:-

1 What is the relationship between expected return and risk for portfolios? The capital market line explains this. (Figure 5.2)
2 What is the relationship between expected return and risk for securities? The security market line explains this. (Figure 5.3)

Figure 5.1

The Efficient Frontier

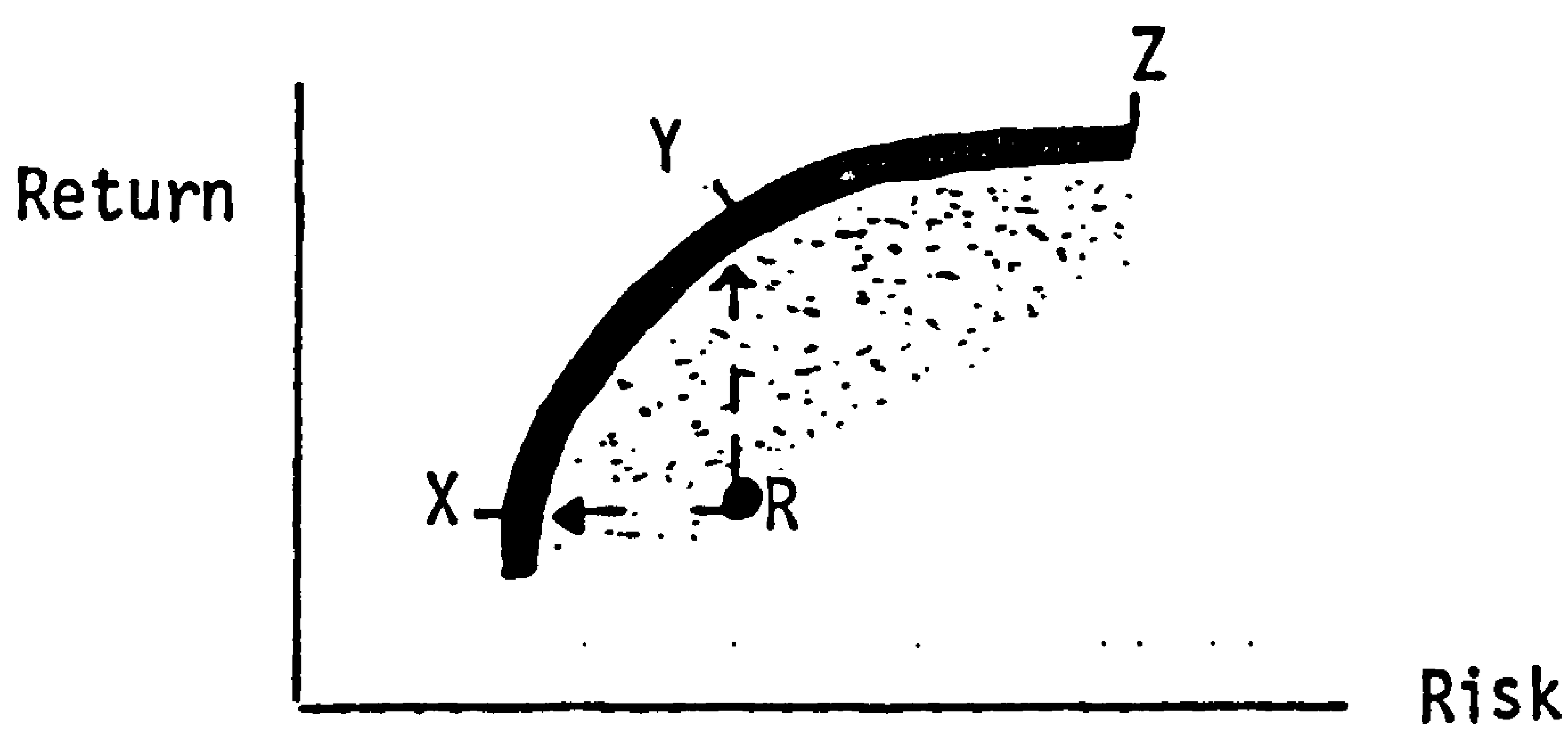
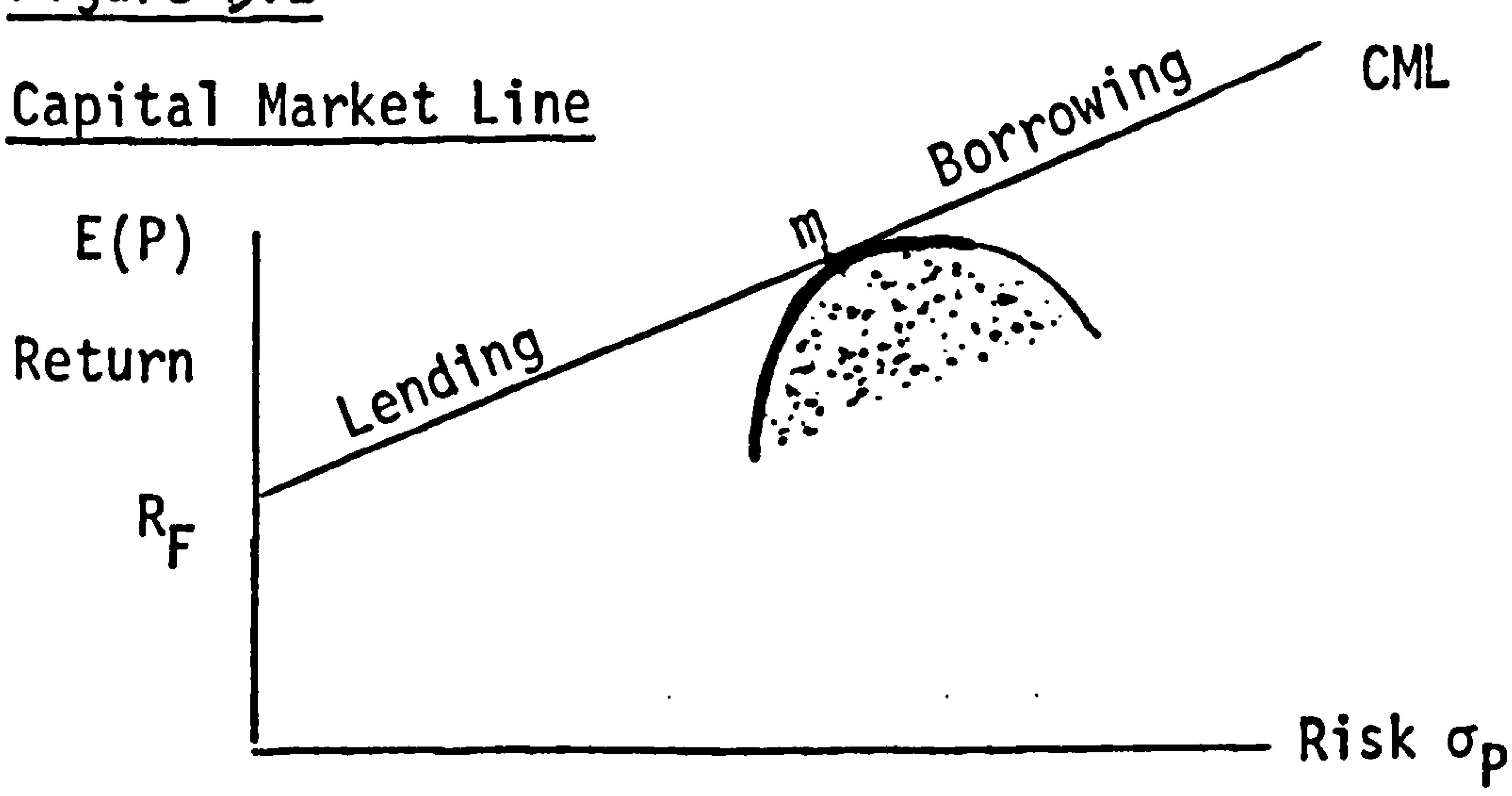


Figure 5.2

Capital Market Line



The capital market line is an efficient frontier with borrowing-lending opportunities.

Figure 5.1 and Figure 5.2

After the efficient set has been identified, the problem arises as to which portfolio along the efficient frontier should be held by the investor. In the absence of a risk-free rate of return, the answer depends on the individual's utility function.

However, not all investments are necessarily risky. Investments exist that have little or no variability, and are, therefore almost riskless. Government securities are examples of this type of investment. These securities can be introduced into the analysis. The return on these securities, R_F is the risk-free rate. A combination of investments can now be made of the risk-free investment and some point on the efficient frontier. Rays drawn from R_F will have a unique point of tangency with the efficient frontier. We call this point m. By combining the riskless security and the portfolio that lies at point m, a new set of portfolios is constructed that is superior to all portfolios on the efficient frontier except for 'm'.

If it is further assumed that investors can borrow as well as lend (invest) at the risk-free rate, the new frontier extends along the ray to the right of m. Those portfolios lying along the segment from R_F to m contain positive amounts of m and the risk-free security; those from m outward are levered to purchase additional amounts of m. Therefore, a new efficient frontier appears. This new frontier is called the "Capital Market Line" (CML). (Figure 5.2)

The algebraic expression for this capital market line is:-

$$R_P = R_F + \frac{R_m - R_F}{\sigma_m} \sigma_P$$

where R_p = expected return of a given efficient portfolio

R_F = risk-free rate

R_m = expected return of the market portfolio, m

σ_m = standard deviation of the market portfolio

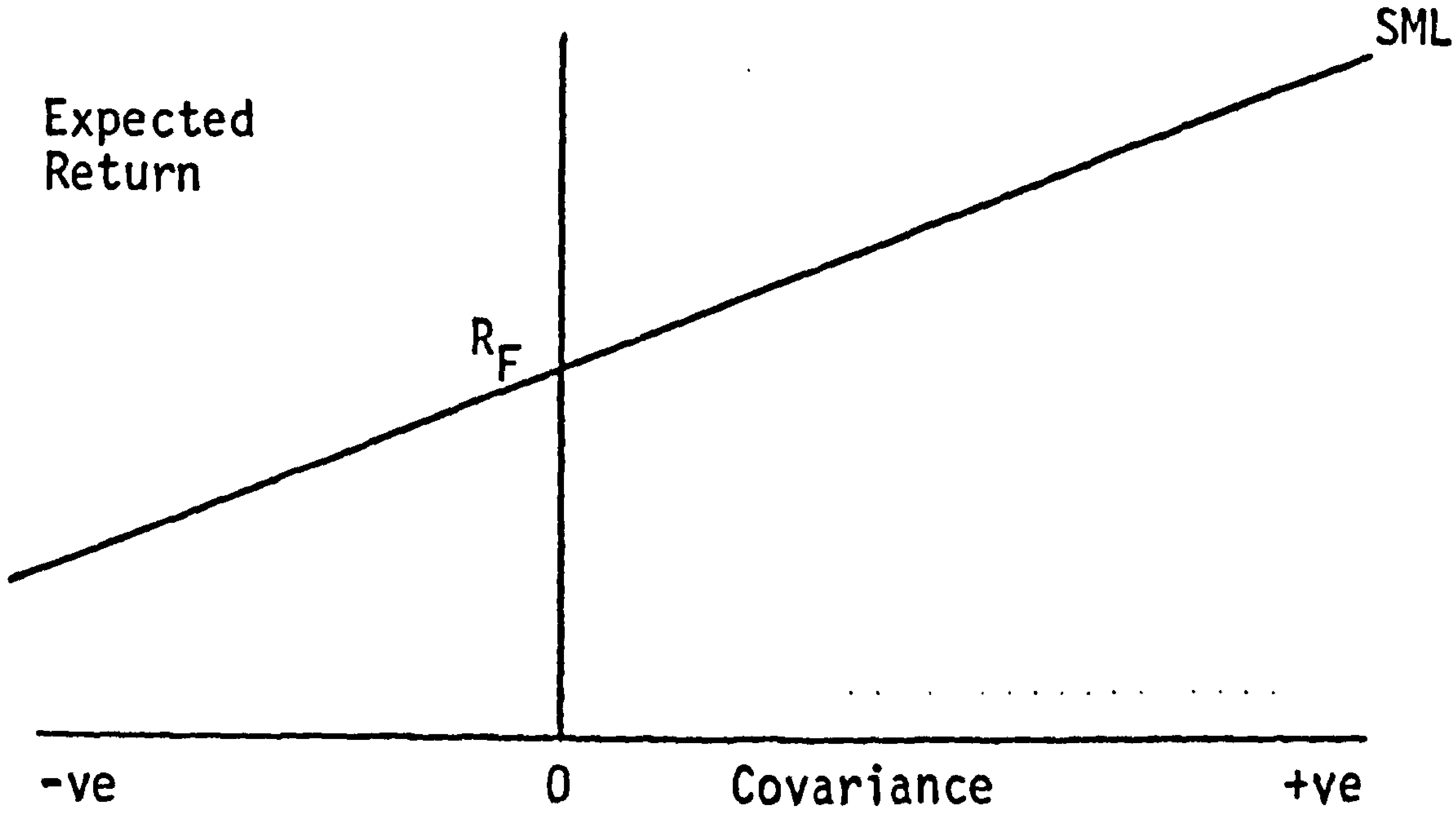
σ_p = standard deviation of the efficient portfolio

If investors have identical expectations, m is the optimal portfolio of risky investments for all investors. Thus, the sum of all holdings of m by investors should be the total market value of all securities. Since each investor would hold the same proportions of each stock, the percentage of each individual security in m would be the total market value of that stock relative to the total market value of all securities.

The expected risk-return relationship for any security or portfolio in market equilibrium can be determined similarly to the CML relationships. However, the risk of individual securities and inefficient portfolios contains an unsystematic factor. Since investors can diversify away unsystematic risk by selecting efficient portfolios, there should be no premium for unsystematic risk. Therefore, the appropriate measure of risk for these securities is not the security's total individual risk; rather, it is the security's effect on a portfolio's risk as measured by the covariance of the security and the market. The graph of this relationship in conditions of equilibrium is called the "Security Market Line" (SML). (Figure 5.3)

Figure 5.3

The Security Market Line



5.3 The Market Model

The Markowitz model described above (section 5.2) requires extensive information concerning individual security variances and covariances. Sharpe (1963) greatly simplified the Markowitz model by observing that most securities covary with the market in general. Thus, the covariance among individual securities could be abandoned in favour of a measure of movement of securities with the market. This measure would indicate each security's sensitivity relative to the market and could be used in the same manner as covariance to identify efficient portfolios. Securities would be related to each other through their relation to the market in general, and a market index could be used as a proxy for market performance. (Figure 5.4 and Figure 5.5)

Figure 5.4

The Market Portfolio

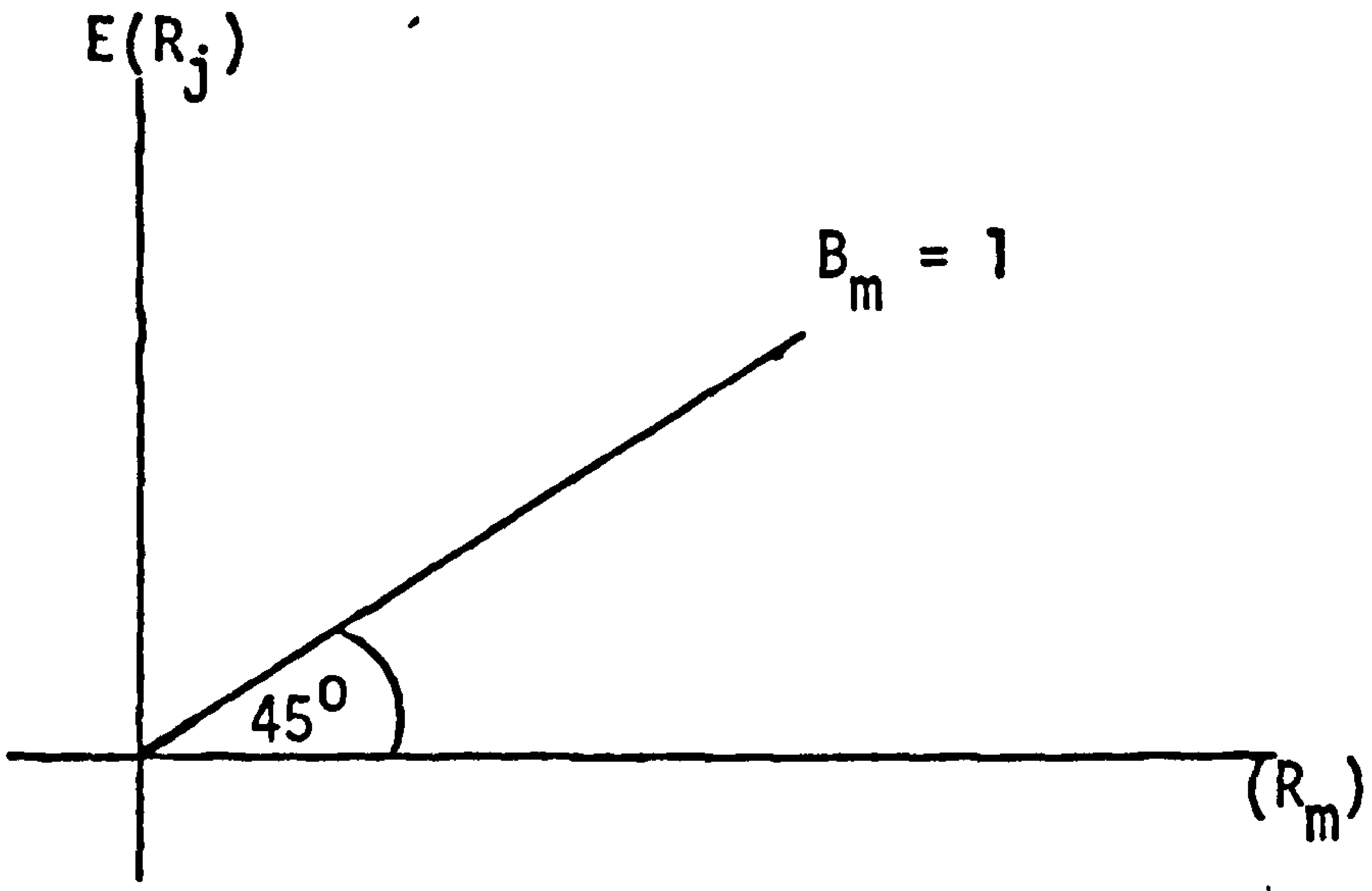
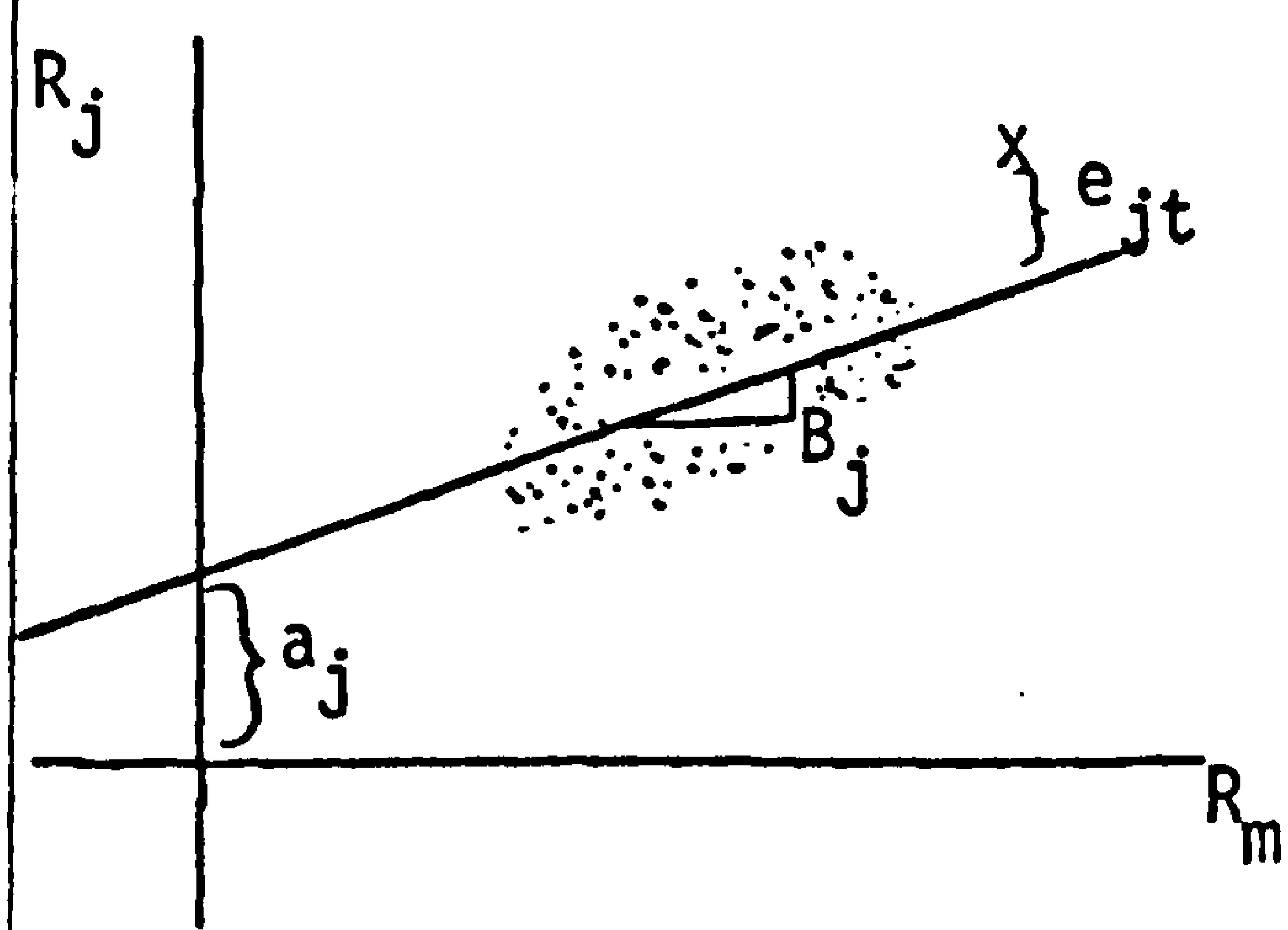


Figure 5.5

The Market Model



$$B_j = \frac{\text{Cov } R_j \ R_m}{\sigma^2 \ R_m}$$

Figure 5.4 and Figure 5.5

The market or index portfolio has $B_m = 1$, ie, $\dfrac{Cov_{mm}}{\sigma^2_m} = \dfrac{\sigma^2_m}{\sigma^2_m} = 1$

A formal statement of the market model would be as follows:-

R_{jt}	$= a_j$	$+ B_j$	R_{mt}	$+ e_{jt}$
return on security j for period t	intercept	slope	general market factor	residual with mean and variance zero (varies independently of R_{mt})

Diagramatically, one can easily take a scatter of monthly returns on any security j, with corresponding monthly returns on the market index, R_m, and fit a line through the scatter, freehand or using OLS (Ordinary Least Square); the intercept, the slope and the residual will emerge without any difficulty. (Figure 5.5)

The market model is thus a representation of security returns in terms of a general market factor. The model states that the relationship between individual security's return and that of the return from the market as a whole is linear. The model further states that the stochastic portion of a security's return can be decomposed into two elements:-

(i) A systematic or market related component ($B_j\ R_{mt}$) reflecting the common movement of single security's return with the market factor, and

(ii) an individualistic component made up of ($a_j + e_{jt}$).

This market model not only simplified computations of covariance* but gave the theorists an understanding of the return generating process with which the equilibrium return for a security could be estimated. Actual returns from any security over a period could now be compared, and observations be made as to the existence of abnormal returns. This would be a more methodical test of market efficiency because in an efficient market it would be impossible to make excess returns consistently.

5.4 The Capital Asset Pricing Model

From the market model we need proceed only a small step to arrive at the Capital Asset Pricing Model (the CAPM). The CAPM (i) transfers the ex-post market model concept to ex-ante general equilibrium conditions and (ii) expresses it in terms of R_f, the risk-free rate of return.

Thus while the Market Model is: $R_j = a_j + B_j R_m + e_j$

the CAPM is: $E(\tilde{R}_j) = R_f + B_j [E(\tilde{R}_m) - R_f]$

where $E(\tilde{R}_j)$ is the equilibrium expected return on any asset j

$E(R_m)$ is the equilibrium expected return on market portfolio

R_f is the rate of interest given, risk-free. This is given exogenously, at which the lending rate equals the borrowing rate.

$$B_j = \frac{\mathrm{Cov} R_j\ R_m}{\mathrm{Var}\ R_m}$$

* In order to assess the variance of the return on a portfolio, in the Markowitz system one needed $N+(N^2 - N)/2$ computations, which for N = 1,000 is 500, 500. Using the market model of Sharpe, this is reduced to only 2N + 1, which for N 1,000 is only 2,001.

Cov R_j R_m is the covariance between the return on asset j and the market portfolio.

Var R_m = variance of the return on the market portfolio.

The e_j of the market model drops out in the equilibrium condition of the CAPM since the e_j (a major component of the unsystematic risk) can be diversified away in an efficient portfolio. (Appendix V(A))

The implication of this formulation is that the appropriate measure of riskiness ofan investment is not the variance of the return of the investment, but the investment's relationship with the market. This is so because the unsystematic risk can be diversified away, what cannot be diversified away is the nature of the investment itself. This is B_j, the systematic risk.

The assumptions of the CAPM are the assumptions of the building blocks on which it is built, plus a few of its own. These assumptions are:-

A Related to portfolio theory:

1. Investors are risk averse,
   single period expected utility
   maximisers of ter~~m~~inal wealth.
2. Portfolios are mean-variance of return efficient.
3. Assets are perfectly divisible and marketable.

B Assumptions of perfect market:

1. Investors are price takers.
2. There exists a single price.
3. No capital rationing.
4. No taxes, no transaction costs.

C Assumptions of market efficiency (information processing efficiency):

Market prices adequately reflect all available information without undue delay.

D Related to the market model:

The return on a security is linearly related to some market factor (the systematic risk).

E Peculiar to the CAPM only:

1 Conditions of the existence of an equilibrium -

a) investors have identical subjective estimates of means, variances and covariances of return on assets.

b) The quantities of all assets are given.

2 There exists, an exogeneously given risk-free rate, R_f, (at which investors can invest or lend any unlimited amount).

5.41 <u>The Implications of the CAPM</u>

The CAPM as outlined in the previous section explains asset prices. Asset risk premia depend not on the total risk of the asset but rather on the relationship between the asset and the market portfolio, ie its Beta, can determine the premium for an individual asset.

Implications of the asset pricing model are most easily seen in terms of excess returns. By subtracting the risk-free rate from all returns the axes are made to intersect at $R_f R_f$ instead of at 0, 0. In this manner the intercept of any security or portfolio characteristic line directly measures expected performance relative to the market. This technique was first developed by Jensen (1969), who labelled the vertical intercept as differential returns.

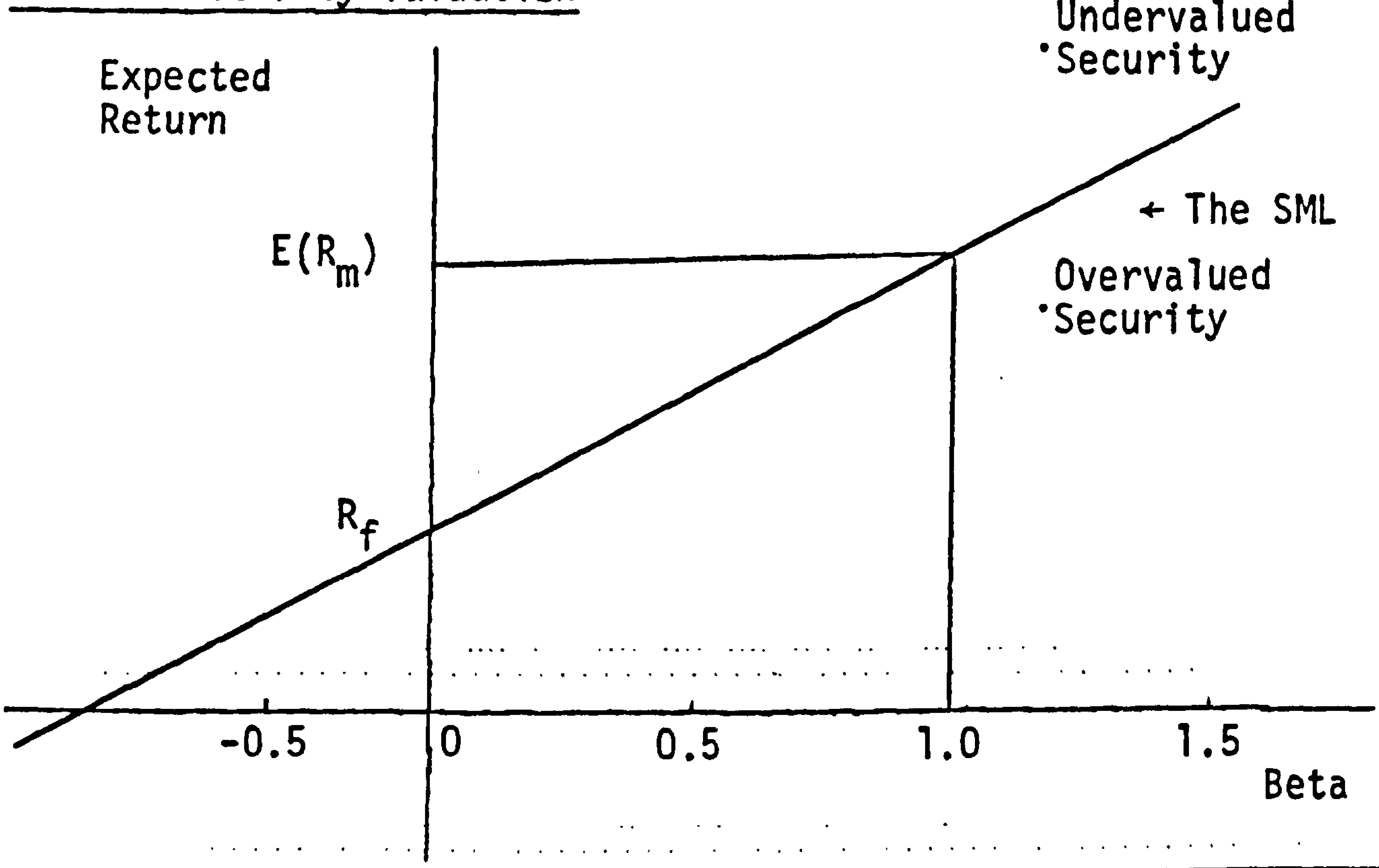
In market equilibrium where all securities are properly priced, all differential returns are zero. Undervalued securities will have positive differential returns and overvalued securities will have negative differential returns.

While the concept of differential returns is valid for comparisons with the market, it is not accurate in making direct comparisons between two securities. One cannot say that because security J's differential return of 6% exceeds security L's differential return of 1%, security J represents a better buy. This is because security J may have a larger beta signifying a greater risk. Only where one security has a larger differential return and the same or smaller beta is it necessarily superior.

The CAPM identifies security returns net of risk-free rate as proportional to the expected net market return, where beta serves as the constant of proportionality. As a consequence of this relationship all securities in equilibrium plot along a straight line called the security market line introduced in section 5.2. It can be plotted by drawing a line between the R_f at beta zero and the total market return at beta of one. The line is extended to negative values of beta to recognise that individual securities can (but alas, seldom do) move, on average, contrary to other investments. (Figure 5.6)

Figure 5.6

SML and Security Valuation



Further characteristics of the SML can be shown by rearranging and substituting in some of the equations we already know:-

$$R_j = (R_m - R_f)\, B_j$$

$$R_j = (R_m - R_f)\, \frac{cov_{jm}}{\sigma^2_m}$$

$$R_j = \frac{R_m - R_f}{\sigma^2_m}\, cov_{jm}$$

In expectation terms:-

$$E(R_j) = \frac{E(R_m) - R_f}{\sigma^2_m} . cov_{jm}$$

The first term of the equation on the RHS, ie $(R_m - R_f)/\sigma^2_m$ is a constant for all securities since it contains only the market and risk-free information. This term is the slope of the security market line. The second term, security covariance, (ie Cov_{jm}) with the market line is an alternative measure of security risk. It is simply the security beta with the constant removed.

Undervalued securities will plot above the SML, and the overvalued securities will plot beneath it.

5.42 Empirical Tests of the CAPM

The ultimate test of any theory is how well it fits the facts. If the CAPM is valid then the following should be true:-

1 Systematic risk and return should be related.

2 Unsystematic risk and return should not be related.

3 The intercept term should be at R_F.

4 Risk and return relationship should be linear.

5 The slope of the regression line should be the market risk premium.

There have been many tests of the CAPM. These tests can be categorised into three types:-

(i) Testing individual securities, (Douglas, 1969).

(ii) Testing large investments and mutual funds, (Treynor, 1965; Sharpe, 1966; Jensen, 1968; Douglas, 1969) and

(iii) Testing selected portfolios, (Miller and Scholes, 1972; Black, Jensen and Scholes, 1972; Fama and MacBeth, 1973; Blume and Friend, 1973; and Blume, 1975).

Results of such tests have been somewhat inconclusive. While most tests support the hypothesis that:

1 Returns increase with the level of systematic risk, and

2 The relationship between risk and return is linear on average,

there has been evidence doubting the validity of the rest of the relationships proposed by the theory. Douglas (1969) found that ex-post realised returns were significantly positively correlated with unsystematic risk and not with systematic risk. Miller and Scholes (1972) and Black, Jensen and Scholes (1972) noted that the intercept terms do not always behave the way model predicts. For middle of the range risk the intercept term is at R_F; but with low beta securities it is consistently at a level higher than R_F, and with high beta securities it is consistently at a level lower than R_F. This gives rise to the possibility that the true underlying security market line may in fact be a curve, instead of being a straight line. (Figure 5.7 and Figure 5.8)

Figure 5.7

SML: Empirical Slope and Intercept

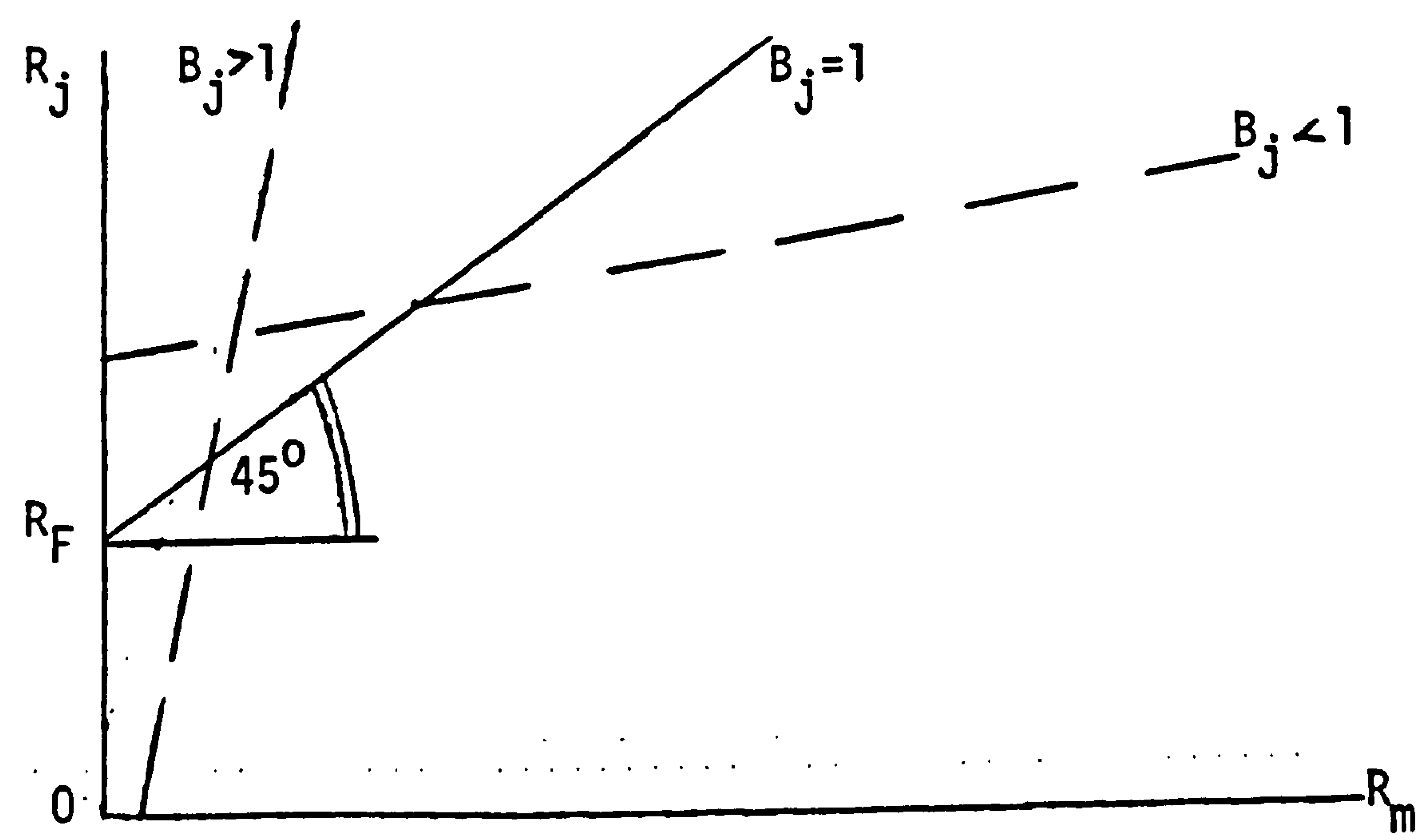
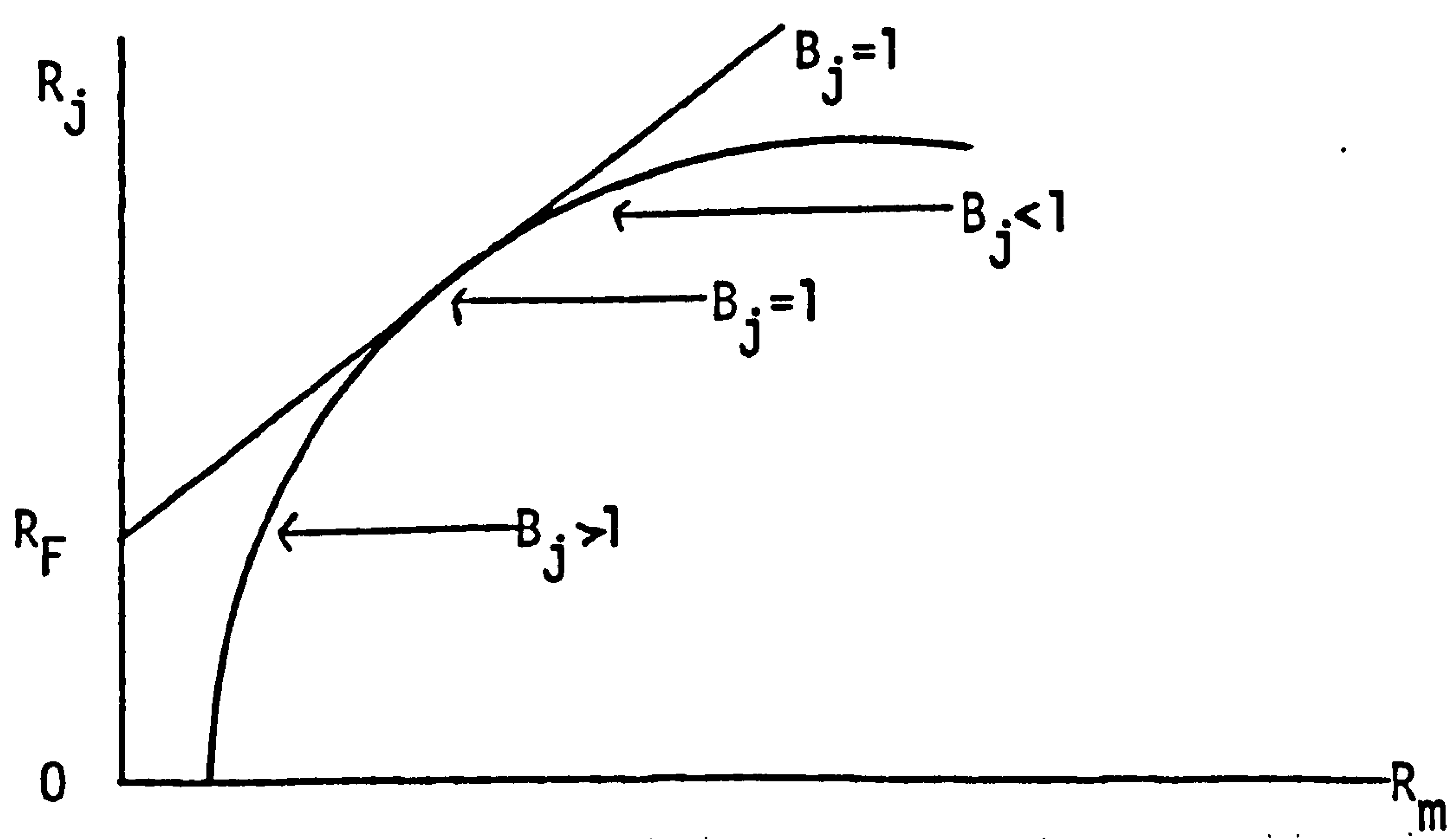


Figure 5.8

SML: Possible Theoretical Slope and Intercept



Do these anomalies make the CAPM invalid?

Since the CAPM is an expectations model it can only be tested via an ex-post model such as the market model. The relationship between ex-ante ex-post returns can be described as follows:-

The CAPM	The Market Model
$E(R_j) = R_F + \left[E(R_m) - R_F\right]\beta_j$	$E(R_j) = a_j + b_j\ E(R_m) + E(e_j)$
$= R_F + \beta_j\ E(R_m) - R_F\beta_j$	$= a_j + b_j\ E(R_m)$
$= R_F - R_F\beta_j + \beta_j\ E(R_m)$	(since $E(e_j) = 0$ by definition)
$= R_f(1 - \beta_j) + \beta_j\ E(R_m)$	

Hence $E(R_j) = R_F(1 - \beta_j) + \beta_j\ E(R_m)$ from CAPM

and $E(R_j) = a_j + b_j\ E(R_m)$ from Market Model

$$a_j = R_F(1 - \beta_j)$$

This is the ex-post - ex-ante relationship of the intercept term. Thus, if both the market model and the CAPM are valid, then the intercept term a_j of the market model is equal to $R_F(1 - \beta_j)$ of the CAPM.

If there are inaccuracies in the market model then any lack of validity of the CAPM could be due to inadequacy of the market model. One such major source of error in the market model relates to the independence of the error terms of the linear equation. King (1966) has demonstrated that these errors are correlated across securities for a given time period, and that these correlations can be due to industry effects.

Heteroscedasticity and Non-trading cause further problems in empiricaly testing the CAPM.

If the market model parameters are estimated from trade to trade using ordinary least square method, returns will be measured over periods of different length. If the variance of the residuals is approximately proportional to the length of the period, a heteroscedastic situation will arise. A weighting scheme such as dividing the log of returns by the square root of the time period will be an adequate amendment in such a situation.

When shares are traded infrequently, beta estimates can be severely biased due to the possibility that prices are recorded at the end of a time period to represent a transaction which occured earlier in the time period. Non-trading problem has been discussed in the literature by Fisher (1966) and Dimson (1979). Shares which suffer from non-trading problem have their covariance with the market substantially underestimated. Non-trading is not a serious problem in the present research since non-trading is generally a problem associated with small companies, and the companies under current investigation are large multinationals in an international context.

Another source of misfit between the ex-post - ex-ante could be in the choice of a proxy for the whole market in the form of some index. Finally, there are possible errors of measurement in individual cases. However, Ball (1978) has concluded that systematic experimental error is unlikely to be a serious enough source of misfit; hence the CAPM must be misspecified. Figure 5.9 shows the possible ways of testing CAPM.

Figure 5.9

Empirical Tests of the CAPM

(The intercept term is non-stationary; consistently positive for securities with low systematic risk, and consistently negative for securities with high systematic risk).

THIS SHOWS A LACK OF EMPIRICAL FIT

A The CAPM is a correct model, the difficulty is in measurement

B CAPM is incorrect, and should be extended to include additional variables

Any test of CAPM is also a test of market model

Some of the assumptions may have to be relaxed

Establish multi-factor models

Measurement errors resultant in the process of transition from ex-ante to an ex-post formulation

Due to errors in the variables

resulting from the errors in the estimation of individual betas

if the market factor is incorreclty specified

skewness of the distribution of the individual ex-post returns

A detailed analysis of the possible econometric difficulties involved in estimating the CAPM relationship is provided by Miller and Scholes (1972). Roll (1977) has expressed serious reservations about the CAPM. His major objections to CAPM lie on the grounds that (i) the CAPM is an ex-ante model of expectations, while all tests of CAPM have been, and can only be of ex-post data. In effect, ex-ante models are not testable; and (ii) the proxy for the market should include all assets. A true "market portfolio" would include claims on real estate, human capital, and other non-marketable assets. Stocks traded on the stock market, on which all tests of CAPM have been conducted, form only a subset of the true market.

Ryan (1982) has commented on Roll's objections, and observed that his objections are a "product of the subtle but important differences in the way individual researchers perceive the nature of theories and their empirical testing (p 443). "Of course, all economic models use proxies in one form or another and, if one insists on perfect data, few theories could be tested" (Sheffrin, 1983, p 139). The issue is thus one of testability as a criterion for scientific theory construction and development, which being beyond the scope of current research will not be pursued here.

At the practical level there are several explanations possible as to why the statistically estimated relation ex-post has a different intercept and slope from what the theory predicts:-

1 Real world investors cannot go into debt and borrow at risk-free rate. The higher rate paid by borrowers reflect the default risk.

2 Real world investors seldom hold the market portfolio, ie, because of transaction costs, and continuously changing optimum in the market, they diversify less than perfectly, resulting in the existence of a residual element in the unsystematic risk. If unsystematic risk does have a price in the market we would expect the rate of return on a zero beta risky security to be higher than the risk-free rate.

On balance we can conclude that the CAPM is a workable theory of asset pricing in the capital market. Fama and MacBeth have concluded in favour of the CAPM as follows:-

> ". . . on average there seems to be a positive trade-off between return and risk, with risk measured from the portfolio viewpoint. In addition, although there are "stochastic non-linearities" from period to period, we cannot reject the hypothesis that on average their effects are zero and unpredictably different from zero from one period to the next. Thus, we cannot reject the hypothesis that in making a portfolio selection, an investor should assume that the relationship between a security's portfolio risk and its expected return is linear, as implied by the two-parameter model. . ."
> Fama and MacBeth, (1973), p 633.

5.5 CAPM and Geographical Segment Disclosure

Multinationals are corporations which find it advantageous to have sales, manufacturing, marketing or financial activities located in a number of countries. Environments in such diverse locations can be, and often are, different between locations. If segmental geographical disclosure by multinationals results in finer information being available to market participants, and such information results in altered perceptions of risk, then it is conceivable that such altered perceptions would be evident in the reassessment of betas for multinationals. If the investor is interested in reformulating his investment strategy in the light of new information, then he would be interested not only in finding out what the systematic risk has been in the past, but also in what direction it is likely to move in the future.

Although the validity of the CAPM does not depend upon the stability of beta, a successful application of the CAPM to determine the required rate of return does require a reasonably stable beta. If beta is regarded as a random variable then mean beta alone is not a good surrogate of systematic risk. In such cases, the problem becomes one of predicting systematic risk, and of establishing beta determinants which can be used in predicting future betas. Thus the application of CAPM in segmental geographical disclosure context requires an understanding of :

(i) beta stability, and

(ii) beta determinants.

5.51 Beta Stability

The importance of testing for stationarity of systematic risk was first recognised by Blume (1971) who found that over time betas tend towards the mean value of 1.0, the market beta. Elgers, Haltinger and Hawthorne (1979) have hypothesised that this regression tendency towards the mean value is due to 'survivorship bias'. Further characteristics of betas are that at the individual level beta is more likely to be non-stationary (Sharpe and Cooper,1972). while predictive ability of betas improve, ie, betas become less volatile over time at the portfolio level (Levy, 1971; Blume, 1975). Furthermore, Goodring and O'Malley (1977) have found that betas are sensitive to market phase; ie, bull and bear markets. In an optimistic bull market betas tend to be higher than in bear markets.

These non-stationary characteristics of betas have been analysed by Klein and Bawa (1977) under the heading of 'estimation risk'.

5.511 Estimation Risk

The CAPM is based on the two parameter mean-variance model of portfolio selection. In most realistic cases, the parameters that completely characterise the return distribution of securities are unknown; yet the traditional CAPM assumes that investors know the true parameters of these return distributions. Estimation risk is this difference between the true parameters and the assumed parameters of the return distributions.

When sample information is insufficient (ie, the number of observations per security is less than the number of securities), as is the case with the empirical analyses of Blume (1970), Black, Jensen and Scholes (1972), Miller and Scholes (1972), and Fama and MacBeth (1973), estimation risk prevails (Klein and Bawa, 1977, p 90). In such cases, assuming costless information, the number of observations could be increased by one of two ways:-

(i) by extending the horizon; ie, by lengthening the observation period over which past data are collected; and

(ii) by temporal disaggregation; ie, by taking observations at more frequent intervals - for example, weekly instead of monthly; or daily, instead of weekly.

However, there are problems with both of these.

5.512 Horizon Problem

The horizon problem in segmental geographical disclosure context is the problem of deciding how long the period of observation should be over which the prices information should be collected and analysed to be able to establish realistic risk profiles of multinationals.

If the observation period is too short, then there might not be enough observations for a tenable time series as the beta estimates can be unduly influenced by unrepresentative random factors.

If the observation period is too long, then the assumption of stationary probability distributions becomes difficult to support. Too long a period might result in a situation where many of the factors that might have been relevant in the distant past might not be relevant any more in the future over the planning horizon.

On a priori grounds it would be anticipated that betas would not be stationary over periods of indefinite length of time due, for example, to changes in capital structure and asset composition of the firm (Brenner and Smidt, 1978).

The horizon decision is thus subjective. On balance, a ten year horizon could be a starting point, modified by industry characteristics, such as underlying technology which is an important influence on the asset structure of the firm. In high technology industries such as electronics and opticals the horizon could be shorter, while in low technology industries the horizon could be longer. Moreover, the horizon decision is influenced by whether one is considering portfolio beta or individual firm beta. In a portfolio context, where there might be a mixture of high and low technology industries, the impact of horizon decision is likely to be less pronounced than would be the case if firm level beta is being considered.

5.513 Temporal Disaggregation

Increasing the frequency of observations within the horizon is one of the ways of increasing the sample size (section 5.511). However, such disaggregation of the time interval can have significant influence on beta stability. A security's beta may vary very substantially depending upon whether it is estimated on the basis of daily, weekly or monthly observations. Hawawini (1983) reported that Eastman Kodak had a beta of 1.25 based on daily returns, but a beta of only 0.93 based on monthly returns for the four year period January 1970 to December 1973.

Opinions vary among researchers as to what is the optimum interval over which prices data should be collected. Cheng and Deets (1973) suggest that intervals should be as short as possible, while Bear and Gehr (1975) are of the opinion that longer intervals between observations is preferable.

An important factor in deciding an optimal degree of temporal disaggregation is serial correlation (Hawawini and Vora, 1980). If one assumes that returns are serially uncorrelated over time, then this assumption becomes unrealistic with finer partitions of the observation period; if one assumes that returns are serially correlated, then again one introduces additional unknown parameters and thereby increases the 'estimation uncertainty' (Klein and Bawa, 1977, pp 90-91).

The intervaling period and size as measured by market capitalisation are also related (Cohen, Hawawini, Maier, Schwartz and Whitcomb, 1983). In general, betas of securities with a smaller market value than the average of all securities outstanding (the market) will decrease as the return interval is shortened, whereas betas of securities with a large market value relative to the market will increase. This suggests that betas measured over return intervals of arbitrary length will tend to be biased. Hawawini (1983) suggests that this is due to the fact that securities' daily prices do not move in unison; some stocks may lag behind the general market movement, others may lead it. Fundamental cause of this intertemporal cross correlations is the friction in the trading process, which delays the response of securities' prices to new information.

On balance monthly returns seem to be desirable. The thin trading effect, (effect of non-trading) can be reduced, if not totally eliminated if one measures returns over intervals longer than a week, say a month (Hawawini, Michel and Viallet, 1983).

5.52 Beta Determinants

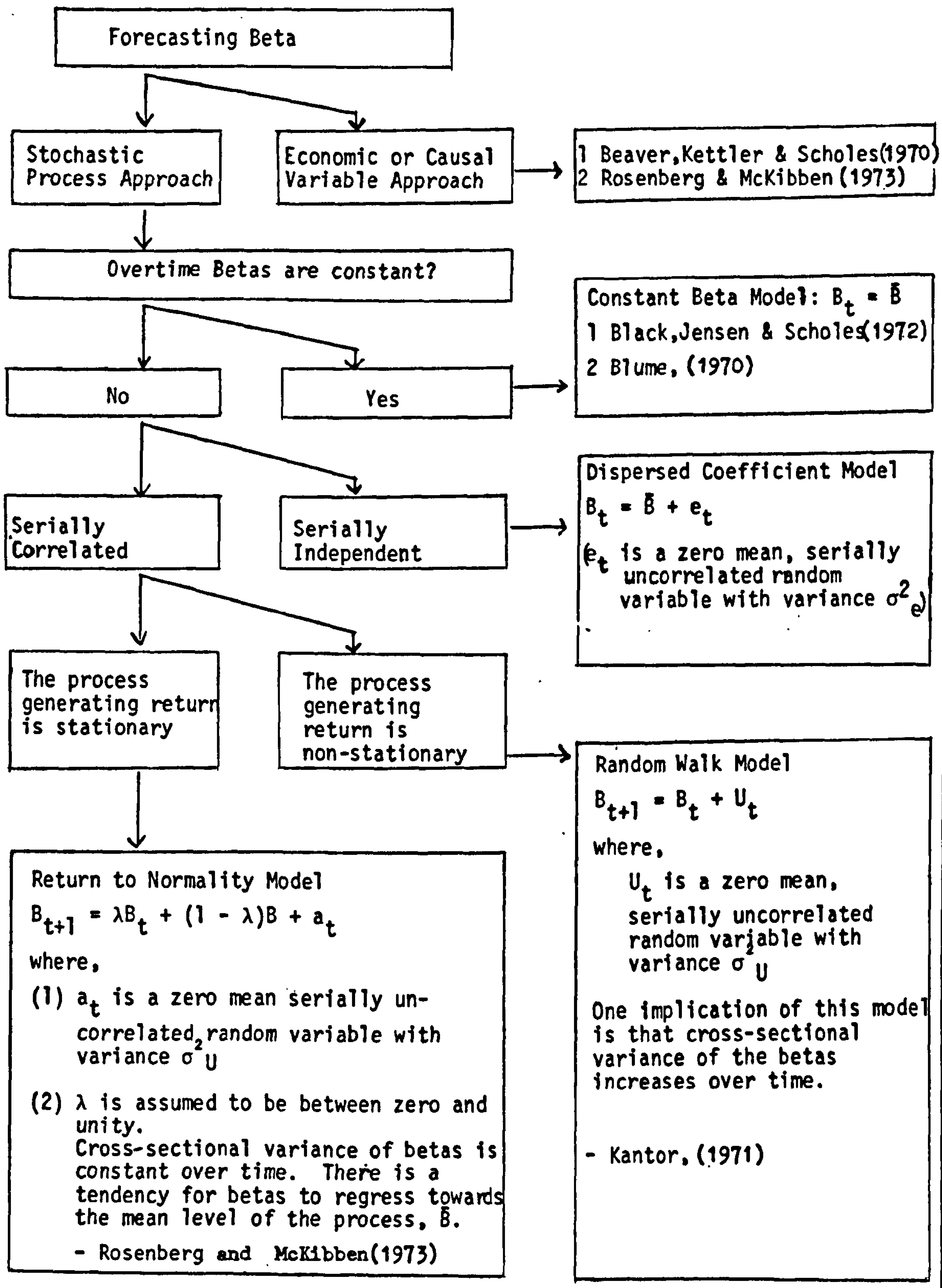
Problems in beta stability have been discussed in section 5.51 above. There still remains the question of how to predict beta over the planning horizon for a geographically diversified firm. As in any model building situation, there are two approaches to modelling systematic risk: (i) the statistical or stochastic process approach; and (ii) the economic or causal variable approach.

Stochastic process approaches are based on the time series properties of numbers, and are not concerned with what causes the numbers to be what they are. Various approaches to stochastic modelling of time series of betas are given in Figure 5.10. Schaefer, Brealey, Hodges and Thomas (1975), have tested these stochastic modelling approaches and concluded in favour of a return to normality model for forecasting systematic risk.

Like all statistical approaches, the stochastic process approach to beta determination is limited because it looks at the symptoms and not the underlying causes. To be able to predict systematic risk for multinationals over the planning horizon, it is important to understand (i) the existing state of the underlying forces; and (ii) how these underlying forces are likely to behave under alternative economic environments.

Figure 5.10

Alternative Models for Predicting Systematic Risk



The instrumental variable approach is an attempt at modelling these underlying forces.

5.521 Instrumental Variables

A pioneering attempt at modelling systematic risk based on instrumental variables was made by Beaver, Kettler, and Scholes (1970) who used accounting variables as surrogates for underlying economic variables of the firm and tested the relationship between systematic risk and some of the important accounting measures, such as net income, dividend, leverage, liquidity and assets. They suggested, and found evidence in favour of the hypothesis that accounting risk measures are predictive of future market risk levels. Similiarly, Rosenberg and McKibben (1973) used a descriptor type model where beta factors are assumed to be linear function of a number of descriptors, or explanatory variables which included accounting based variables.

Predictive ability of individual accounting variables as proxy for structural changes in the firm's investment and financing policy over time have been tested by others. For example, Hamada (1969, 1972) tested capital structure as an instrumental variable; operating leverage as an instrumental variable has been tested by Lev (1974b) and Percival (1974); Rubinstein (1973) and Bildersee (1975) have tested the relevance of line of business activity information; Brenner and Smidt (1978) have tested the association between asset characteristics of firms and beta changes. All these tests support the hypothesis that there are significant relationships between some accounting variables and systematic risk.

The instrumental variable approach to forecasting beta is preferable to stochastic modelling approaches because policy decision of firms which can affect betas (Foster, 1980b), are easier to incorporate in an instrumental variable approach. If the firm's future beta is a function of the firm's future cash flows, then policy decisions by management about investment and financing decisions affecting future cash flows, will affect the firm betas.

Collins, Rozeff and Dhaliwal (1981) have linked a firm's policy decision with estimation risk. Over time estimation risk will increase if investors become less certain about the firm's future cash flows because of increased uncertainty about, for example, investments being undertaken by the firm. If segmental geographical disclosure gives insights into the firm's investment and financing policies, estimation risk will be lower, thus affecting betas.

In addition to investment-financing policies, firm's accounting policies have been suggested as additional beta determinants. Watts and Zimmerman (1979) have suggested that lobbying behaviour related to disclosure is conditioned by size of firms; Hagerman and Zmiewski (1979) found evidence in favour of a positive relationship between accounting policy choice and a number of economic variables such as size, risk, and capital intensity. This relationship between accounting policy choice and firm beta seems rather indirect, if not tenuous. Any change in beta due to lobbying behaviour if any, is likely to be shortlived, and similar in nature to management attempts to smooth firms' income over time (Sunder, 1973; 1975).

In summary, firm level variables such as assets, profits and leverage can give insights into the firm's beta. Management policy regarding investment-financing decisions can affect the future values of assets, profits and leverage - the firm level beta determinants. If segmental geographical disclosure gives information about the existing state of the firm level beta determinants and management policies affecting their future values, such disclosure will affect firm betas.

Non-firm level environmental variables can also affect betas (Chen, 1982)

> "Generally speaking, random betas, if properly estimated can be expressed as a function of factors unique to the company and variables associated with the economy. The former may include the traditional variables such as the changes in assets, the change in dividends, and financial leverage. The latter needs more investigation. . ." (Chen, 1982, p 65)

Multifactor models, Arbitrage Pricing model and International Market model are attempts at modelling these non-firm level variables as beta determinants.

5.522 Multifactor Models

One of the earliest extensions of the Sharpe model of capital asset pricing was by Black (1972) who investigated the market equilibrium under the assumption that there is no riskless asset, hence no riskless borrowing or lending opportunities. He demonstrated that, if there are no restrictions on short selling, then in equilibrium, the portfolio of all investors will consist of a linear combination of the market portfolio and a second portfolio which, although risky, has zero co-variance with the market portfolio.

Merton (1973) introduced a three-factor model in the context of a continuous time intertemporal model of asset pricing. The three portfolios are:-
(i) the riskless asset; (ii) the market portfolio M; and (iii) a portfolio or asset N which is perfectly negatively correlated with changes in the riskless asset rate.

Fama and MacBeth (1973) have found that a four-factor random coefficient model would fit the empirical data better than the two factor model of Black, or a three factor model of Merton. An extension of this multifactor model approach is the 'k' factor model of Arbitrage Pricing.

5.523 The Arbitrage Pricing Model

Formulated by Ross (1976), the Arbitrage Pricing Theory (APT) offers a testable alternative to the CAPM. The CAPM predicts that security rates of return will be linearly related to a single common factor - the rate of return on the market portfolio. The APT is based on similar intuition, but is much more general. It assumes that the rate of return on any security is a linear function of k factors as shown below:-

$$\tilde{R}_i = E(\tilde{R}_i) + b_{i1}\tilde{F}_1 + \ldots + b_{ik}\tilde{F}_k + \tilde{e}_i$$

where $\tilde{R}_i$ = the random rate of return on the ith asset

$E(\tilde{R}_i)$ = the expected rate of return on the ith asset

b_{ik} = the sensitivity of the ith assets return to the kth factor

$\tilde{F}_k$ = the mean zero kth factor common to the returns of all assets

$\tilde{e}_i$ = the random zero mean noise term for the ith asset

The CAPM is viewed as a special case for APT when the market rate of return is assumed to be the single relevant factor.

The arbitrage pricing theory is based on the idea that in competitive markets arbitrage will assure that riskless assets provide the same expected return. The market equilibrium mechanism is driven by individuals eliminating arbitrage profits across multiple factors. This may be true, yet only of limited value in that it does not tell us what these 'k' factors are, nor does it tell us what makes these factors economically or behaviourally relevant.

A more specific multifactor model in the context of segmental geographical disclosure is the International Market Model.

5.524 The International Market Model

The Arbitrage Pricing Model described above can be seen to be extended in the area of asset pricing in an international situation. The APT is part of a general trend. King (1966) has emphasised industry factor; Beaver, Kettler and Scholes (1970) pioneered the instrumental variable approach; Black (1972) suggested two factors; Merton (1973) three factors; Fama and MacBeth (1973) four factors; Ross (1976) 'k' factors. Following the same principle, in the international capital market context there has been the development of country factors, and world factors (Lessard, 1973, 1974).

In the presence of barriers to portfolio capital flows, multinational firms (MNCs) have an advantage relative to single country firms because of their ability to diversify internationally. This financial advantage, the result of financial market imperfections, compliments the advantages MNCs derive from imperfections in real goods and factor markets and represents an additional motive for international expansion. The risk-return structure in an international scene can be modelled in the same fashion as the Sharpe (1963) market model. If one incorporates the interdependence of changes in the prices of securities in the international context, an international market model can be formulated as follows (Agmon and Lessard, 1977):-

$$\tilde{R}_{jk} = a_j + B_{1\ jk}\,\tilde{R}_k + B_{2j}\,\tilde{R}_W + \tilde{e}_j$$

where, $\tilde{R}_{jk}$ = Return on security j for country k;

$\tilde{R}_k$ = Return on country k market factor;

$\tilde{R}_W$ = Return on the world market excluding country k; (ie, the rest of the world).

If the international firm is viewed as a collection of activities in different countries, then the return on its traded shares can be viewed as:-

$$\tilde{R}_j = a_j + \sum_{i=1}^{N} W_{ij}\,B_{1\ ij}\,\tilde{R}_i + B_{2j}\,\tilde{R}_W + \tilde{e}_j$$

where, $\tilde{R}_i$ = market factors for each of the N countries in which firm j generates proportion of W_{ij} of its revenues or profits $(\Sigma_i W_i = 1)$

This equation implies a direct relationship between the international composition of the firm's activities and the pattern of price changes of its shares.

If the above relationship holds, then the return on the shares of a UK based multinational may be thought of as arising from the following relationship:-

$$\tilde{R}_{js} = a_j + B_{1\ js}\,\tilde{R}_{UK} + B_{2\ js}\tilde{R}_W + \tilde{e}_j$$

where, $\tilde{R}_{js}$ = Return on the share of the jth firm with a proportion 's' of non-UK sales or profits

$\tilde{R}_{UK}$ = Return on the FT all shares index, and

$\tilde{R}_W$ = Return on the rest of the world index, defined to be orthogonal (ie, independent) to the R_{UK}.

The testable hypothesis in the above formulation could be that $B_{1\ js}$ is a decreasing function of 's', and $B_{2\ js}$ is an increasing function of 's'.

Agmon and Lessard (1977) tested such a hypothesis on 217 US based multinationals for 168 months from January 1959 to October 1972. They obtained $\tilde{R}_W$, the rest of the world index orthogonal to the country index by regressing the Capital International world index on the New York Stock Exchange (NYSE) index, and defined the residuals as the 'rest of the world index orthogonal to the NYSE index'. Their results showed that firms with high proportions of non-US sales were highly correlated with $\tilde{R}_W$, the rest of the world index, and less with the NYSE index.

5.6 Summary

Chapter V has been concerned with risk assessment in capital markets with special reference to the segmental geographical disclosure issue. First, the notion of risk has been explained in the context of choice theory, and the two parameter mean-variance model has been chosen in preference to models incorporating higher moments. Following this, the mean-variance efficient theory of portfolio selection has been analysed, and its relevance in market model, and the equilibrium model of asset pricing has been shown.

The Capital Asset Pricing Model (CAPM) has then been described, its implications explored, its relationship with market efficiency has been explained, and problems in empirically testing the model have been mentioned. Shortcomings of the CAPM have been commented upon, and its general robustness in spite of methodological objections raised by Roll (1977) has been shown.

Attention has then been focused on the question of the application of the CAPM to the segmental geographical issue under two headings: beta stability, and beta determinants. The relevance of estimation risk in predicting beta has been shown, and problems in choosing an appropriate horizon, and in deciding upon an appropriate level of temporal disaggregation in beta measurement have been discussed. Having explained the stability problem in beta measurement, attention has been switched to the question of beta determinants. Instrumental variables approach following Beaver, Kettler and Scholes (1970) have been explained, various multi-factor models, and the concept of arbitrage pricing explained, following which the aptness of the International Market Model in the analysis of segmental geographical disclosure has been shown.

This, then concludes the theoretical discussions around the question of segmental geographical disclosure. Chapter VI will be concerned with prior research in the area of segmental disclosure, following which hypotheses will be developed, data base and methodology explained, various analyses performed and appropriate conclusions drawn in subsequent chapters.

APPENDIX V(A)

The Irrelevance of Unsystematic Risk

To show that unsystematic risk does not matter, all that matters is the systematic risk:

1 If a portfolio is comprised on N securities, then the portfolio variance consists of N individual variances, and N(N - 1)/2 covariances.

2 For a portfolio consisting of two securities, 1 and 2, of equal weight, the portfolio variance can be stated as:

$$\sigma^2_P = \sigma^2_1(\tfrac{1}{2})^2 + \sigma^2_2(\tfrac{1}{2})^2 + 2\ \mathrm{Cov}_{12}(\tfrac{1}{2})(\tfrac{1}{2})$$

3 If a portfolio is composed of three equal weighted securities, 1, 2 and 3, then the portfolio variance can be stated as:

$$\sigma^2_P = \sigma^2_1(\tfrac{1}{3})^2 + \sigma^2_2(\tfrac{1}{3})^2 + \sigma^2_2(\tfrac{1}{3})^2 + 2\ \mathrm{Cov}_{12}(\tfrac{1}{3})^2 + 2\ \mathrm{Cov}_{13}(\tfrac{1}{3})^2 + 2\ \mathrm{Cov}_{23}(\tfrac{1}{3})^2$$

4 Similarly if the portfolio consists of N securities, 1, 2, 3, ... (N - 1), N, of equal weight, then the portfolio variance can be stated as:

$$\sigma^2_P = \sigma^2_1(\tfrac{1}{N})^2 + \sigma^2_2(\tfrac{1}{N})^2 + \ldots\ldots\ \sigma^2_N(\tfrac{1}{N})^2 + 2\ \mathrm{Cov}_{12}(\tfrac{1}{N})^2 + 2\ \mathrm{Cov}_{13}(\tfrac{1}{N})^2 + \ldots\ldots\ 2\ \mathrm{Cov}_{N(N-1)}(\tfrac{1}{N})^2$$

5 For convenience we can decompose the expression in (4) into two sections: the first consisting of the individual variances, and the second of the covariances.

6 The variances of the individual securities in a portfolio, following the expression in (4) above is:

$$\sigma^2_1(\tfrac{1}{N})^2 + \sigma^2_2(\tfrac{1}{N})^2 + \ldots\ldots\ \sigma^2_N(\tfrac{1}{N})^2$$

$$= (\tfrac{1}{N})^2\ \{\sigma^2_1 + \sigma^2_2 + \ldots\ldots\ \sigma^2_N\}$$

$$= \frac{1}{N^2} \sum_{i=1}^{N} \sigma^2_i$$

As the number of securities become large, N becomes large, and $1/N^2$ tends to zero; this makes the whole expression $\frac{1}{N^2} \sum_{i=1}^{N} \sigma^2_1$ also zero.

7 Now, the covariances from our expression in (4):

$$2\,Cov_{12}\left(\frac{1}{N}\right)^2 + 2\,Cov_{13}\left(\frac{1}{N}\right)^2 + 2\,Cov_{23}\left(\frac{1}{N}\right)^2 + \ldots\ldots 2\,Cov_{(N-1)_N}\left(\frac{1}{N}\right)^2$$

$$= 2\left(\frac{1}{N}\right)^2 \{Cov_{12} + Cov_{13} + Cov_{23} + \ldots\ldots Cov_{(N-1)N}\}$$

$$= \frac{2}{N^2} \{\sigma_{12} + \sigma_{13} + \sigma_{23} + \ldots\ldots \sigma_{(N-1)N}\}$$

Let $\bar{\sigma}_{ij}$ be the average of covariances; and there are $\{N(N - 1)/2\}$ such covariances, as stated in (1).

Therefore,

$$\frac{2}{N^2} \cdot \frac{N(N-1)}{2} \cdot \bar{\sigma}_{ij}$$

$$= \frac{2N(N-1)}{2N^2} \cdot \bar{\sigma}_{ij}$$

$$= \frac{N-1}{N} \cdot \bar{\sigma}_{ij}$$

As N tends to be larger and larger, the ratio of (N - 1) and N tends to one. Hence the whole expression of covariances tends to $\bar{\sigma}_{ij}$.

8 If $\bar{\sigma}_{ij}$ is represented by any index model, where beta replaces the average covariance, then all that matters is the beta or the systematic risk, and the unsystematic risk, ie the variances of the individual securities do not matter any more.

(For notational convenience σ_{12} is used instead of Cov_{12})

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CHAPTER VI

PRIOR RESEARCH

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Sections

Figure

6.0 Introduction

Earlier chapters have introduced the topic of segmental disclosure, analysed the theory of information disclosure and explored capital market impacts of such information disclosure in general. In this chapter prior research in the area of segmental disclosure will be examined with a view to developing hypotheses of possible benefits of segmental geographical disclosure to be tested in the following chapter. Figure 6.1 is a schematic presentation of prior research.

First, descriptive studies which examine possible benefits of segmental disclosure from a user consensus viewpoint, will be cited. Cerf's (1961) consensus study will be examined in detail, and an evaluation of user behaviour studies will be made.

Next, predictive ability studies will be examined under two headings : judgmental response of the decision maker, and accuracy of forecasting models. Pioneering research of Kinney (1971) will be examined in detail under predictive accuracy of models.

Content analysis studies, which examine the extent of disclosure across companies and across countries will then be examined. Analytical aggregate market level impact studies, which explore the risk implications of segmental disclosure, will be examined in detail after that. Finally, segmental geographical disclosure will be examined primarily with the aid of studies in the area of international capital markets.

Prior Research : An Overview

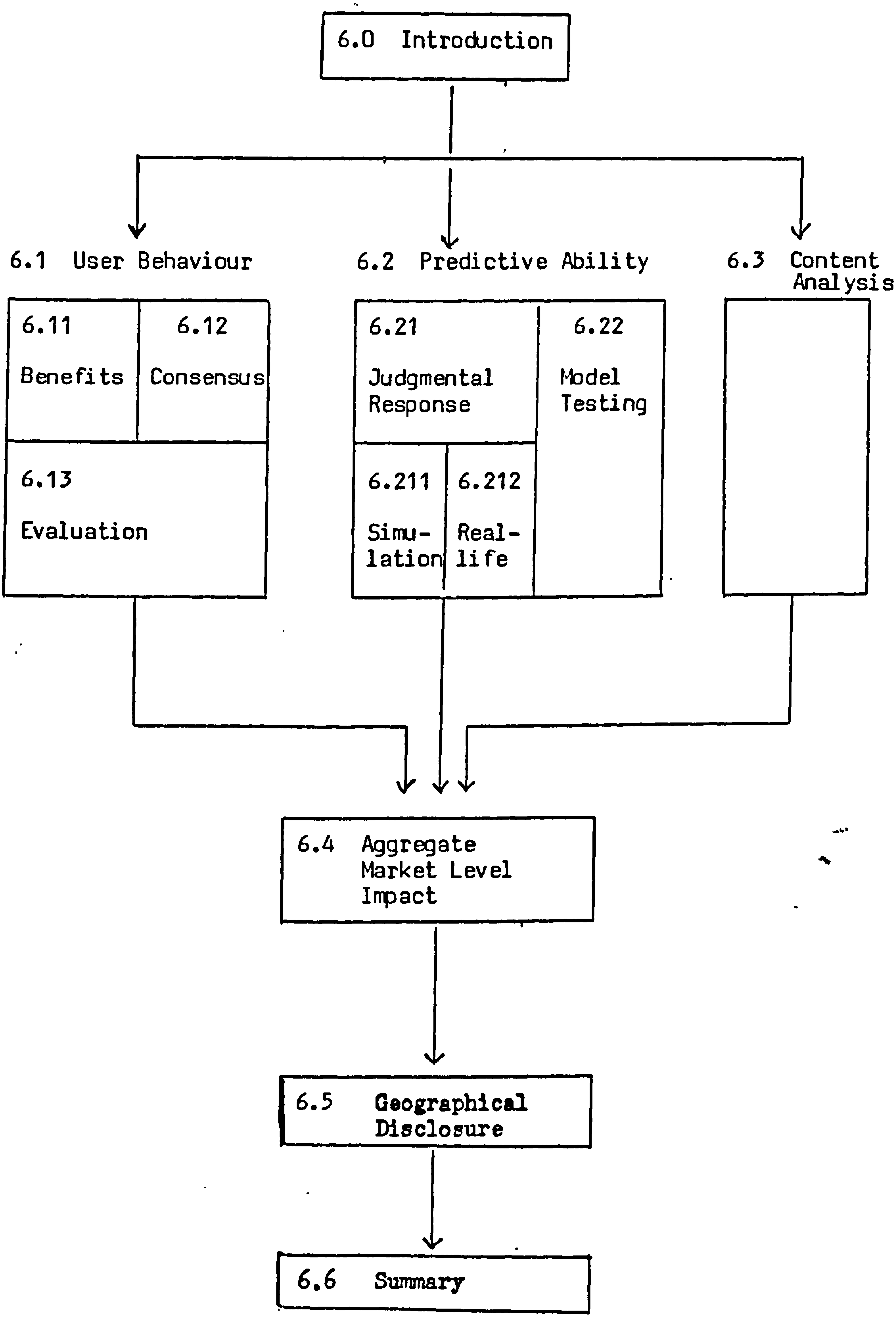

Figure 6.1

6.1 User Behaviour Studies

User behaviour studies in segmental disclosure are concerned with the way the users (consumers) respond to the disclosure of segmental information in corporate reports. This approach is very much like the marketing approach in trying to find out what the customers want, or think they want. Such studies are usually positive/descriptive type, conducted through opinion surveys such as questionnaires or interviews.

Prior research concerning user behaviour in segmental disclosure can be categorised into two broad groups : (i) disclosure benefit studies and (ii) consensus studies.

Disclosure benefit studies are attempts to establish whether users (decision makers) find segmental disclosure related information useful in decision making in general. Consensus studies are about the relative importance of individual disclosable items to the user. Assuming segmental disclosure is useful to the decision maker in principle, consensus studies are attempts to establish a consensus among users as to which items are important. From such consensus, an index of disclosure can be constructed against which 'good' or 'poor' reporters can be identified.

6.11 Disclosure Benefit Studies

Empirical research on segmental disclosure benefits started in the sixties, and were in response to the phenomenon of conglomerate mergers in western industrialsed countries. Since conglomerate mergers were not based on product market logic like horizontal or vertical mergers, analysts found it difficult to unravel the efficiency of the organization without segmental information. Various professional bodies, notably the National Association of Accountants (NAA) and the Financial Executives' Institute sponsored studies on segmental disclosure benefits to be able to recommend disclosure policies.

Bradish (1965) was the earliest example of opinion survey on disclosure benefit in which he interviewed financial analysts representing security brokers, trust and loan departments of commercial banks, and insurance companies to determine the types of information they deemed inadequately disclosed. He also sought proposed solutions from the analysts which could correct these inadequacies. His analysis showed that there was a lack of communication between the users (the analysts) and the preparers (the accountants) of financial information.

Bradish, however, did not address his enquiry to the segmental disclosure issue in particular. This was done by Mautz (1968) in a research study sponsored by the Financial Executives' Institute. The objective of Mautz's study was to define and attempt to solve the problem of segment reporting. He conducted an extensive study directly concerned with the adequacy, for investment decision purposes, of financial reports of diversified companies, to examine if segment data would be useful. Mautz sent out questionnaires to, and conducted interviews with financial controllers and financial analysts.

Among the various recommendations that resulted from this research, the two important ones are :

(i) companies that operate in more than one broadly defined industry should meet extended disclosure requirements; and

(ii) management should use its discretion in determining the segments for reporting purposes.

Among the results that Mautz obtained, it was found that 90.8% of the responding financial analysts attempt to determine operating results by segments of diversified firms. However, 87.6% of the analysts felt that the annual financial reports did not provide satisfactory clues to appropriate segmentation (p 113). It can be concluded from Mautz's study that although segmental financial data was considered desirable from an investor's point of view, many conglomerates chose not to reveal such information in a meaningful way.

Mautz's study was pathbreaking in that it established in a formal way the benefits of segmental disclosure. It has also been controversial in that it left the definition of segments to management discretion.

Accountants were equally concerned with the segmental issue like the financial analysts. Backer and McFarland (1968) produced a study sponsored by the National Association of Accountants (NAA) in which questionnaires were used to survey the opinion of financial analysts, bankers and corporate executives. Analysis showed that participants were almost unanimously in favour of segmental disclosure. Segment identification problems, however, remained unresolved by being left to the discretion of management. They however have recommended that such segment information should be audited since audited segment information will increase the users' confidence in such information.

Rappaport and Lerner (1969) was a follow up research study also sponsored by NAA in which the concepts explored by Backer and McFarland (1968) was further developed. The objective of this study was to develop a framework for financial reporting by diversified companies that would be useful to the shareholders and investors. The authors presented alternative investor valuation models, and based on these models presented a case for segment reporting. Since this study has wider implications for model building, it will be formally discussed in section 6.2, on 'Predictive Ability Studies'.

6.12 Consensus Studies

If there are benefits from additional disclosure, then to be able to reap these benefits any haphazard method of disclosure is clearly undesirable because the cost of disclosure may be larger than the benefits. Items to be disclosed have to be carefully chosen in such a way that the benefits exceed the costs. Consensus studies of disclosure, sometimes called research measure of disclosure, aim to establish this by assessing the information content of individual items disclosed.

The first comprehensive effort to measure the information content of individual items disclosed was made by Cerf (1961). Cerf believed that the differences in disclosure between firms could be shown to be related to certain firm characteristics (variables). Knowing what variables were associated with disclosure would point to the areas where educational or other methods to improve disclosure should be concentrated.

Cerf considered the possible influence on disclosure of the following variables :

1 Method of trading shares of stock.

2 Size.

3 Profitability.

4 Frequency of external financing.

5 Stability of growth in earnings and dividends.

6 Product of firm.

7 Degree of competition.

8 Industry.

9 Stage of development.

10 Associated outside auditor.

11 Characteristics of management.

Cerf chose to test the association between disclosure and three of these variables, ie Nos 1, 2 and 3; method of trading; size, measured both by asset size and by ownership distribution; and profitability. His criterion for choosing these three were primarily quantifiability.

In order to test the association between disclosure and the three variables, Cerf had to develop a measure or index of disclosure (IOD). The development of the IOD involved three major steps :

1 Items of information which were thought to be important in making investment decisions were chosen. Selection of these items were based on :

   (a) a review of literature on how investment decisions are made or should be made;

   (b) interviews with financial analysts;

   (c) an examination of analysts reports; and

   (d) a list of items most frequently used by financial services (eg Moody's, Standard and Poors).

2 Members of the National Federation of Financial Analysts' Societies (NFFAS) were interviewed and a questionnaire was sent to other members at random. In this step the analysts were asked to weight the information items to their relative importance.

3 Cerf examined 527 annual reports. When an item appeared, the annual report received the number of points indicated. The sum of the points received, divided by the total points possible became the firm's index of disclosure.

Cerf concluded that, on the basis of differences in means (arithmetic averages) high disclosure firms -

(i) had more stockholders;

(ii) were larger in total assets;

(iii) were more profitable, ie the ratio of net profit to net worth were greater; and

(iv) were more likely to be registered on the NYSE than on a regional exchange or over the counter.

Cerf's pioneering work on consensus of disclosure improvement has been replicated by Singhvi and Desai (1971), Buzby (1974b and 1975), Chandra (1974), Barrett (1976), and Firth (1978) in various contexts.

Singhvi and Desai (1971) developed an index of disclosure. The index consisted of 34 items of information which were used as the basis for a composite measure of the extent of disclosure of these items in annual reports. Weights were assigned to these items in order to note distinctions in their relative importance as indicated by the security analysts who were interviewed. The extent of a company's disclosure was measured by adding weights assigned to items included in its annual report. Using this approach they identified companies which had inadequate disclosure. They concluded corporations which disclose inadequate information are likely to be :

(a) small in size as measured by total assets

(b) small in size as measured by number of stockholders

(c) free from listing requirements

(d) audited by small CPA firms, and

(e) less profitable as measured by earnings margin.

Buzby (1974b) surveyed professional financial analysts to construct a detailed set of weighted disclosure criteria for each of 38 items or types of financial and non-financial information which might appear in an annual report. The set of disclosure criteria was then applied to a sample of annual reports to determine, among other things, the relationship between the importance of an item and its extent of disclosure. He concluded that there is room for improvement by disclosing those items for which this relationship is low.

Buzby (1975) studied the relationship between the extent to which selected items of information are presented in corporate annual reports and two company characteristics - the size of the company and its listing status. The extent of disclosure of these items in the annual reports was measured by a disclosure index similar to that used by Singhvi and Desai (1971). The results of Buzby's study indicate that 'the extent of disclosure in annual reports is positively associated with the size of a company's assets and not affected by listing status'(p 30). The implication of this result is that disclosure improvement efforts should be focused on smaller firms.

Chandra (1974) conducted questionnaire studies to test the consensus on disclosure in published reports among public accountants and security analysts. 58 items from balance sheets, income statements, and other published financial information were given to accountants and financial analysts. The relative importance given by each group were compared. Results showed a marked difference between the preferences of accountants and financial analysts so far as information required for share valuation was concerned.

Barrett (1976) measured the extent of disclosure in published reports by an index constructed of seventeen categories of information for a ten year period (1963-72) to test the segmental disclosure practices of multinational firms across seven industrialised countries. He found that in spite of the regulatory environment, US companies were not the best performers so far as segmental disclosure was concerned. In some cases, the Swedish and UK firms performed better as measured by his disclosure index.

Firth (1978) studied the consensus of perceived importance of disclosure of individual items in corporate annual reports. Questionnaires containing seventy-five items that are or could be disclosed in a firm's annual report were sent to 750 individuals in the United Kingdom. These individuals consisted of 250 directors of companies in the Times 1000 largest firms in UK; 250 qualified accountants employed by auditing firms; 120 financial analysts working for stockbrokers and investment institutions, and 130 loan officers of major banks and finance houses in the city of London.

These individuals were asked to state their views as to how important they perceived each individual item in the list so far as including such items in the annual reports were concerned. Results showed similarities and differences. Similarities were found in that company directors agreed with auditors as to relative rankings of individual items; and financial analysts agreed with bank loan officers; but the rankings given by loan officers and analysts differed from those perceived by directors and auditors.

The importance of Firth's study is twofold; first, it emphasises the multiperson approach to user behaviour; second it gives substance to the view that there is need for better communication between preparers and users of financial statements.

6.13 Evaluation

All the research using an index of disclosure (IOD) are based upon the argument that improved disclosure is useful if it adds to the satisfaction of the users' needs. Consumer sovereignty rules (Peasnell, 1981). It is held that management of a corporation can benefit from responding to the needs of the user through improved disclosure. Once the information needs of the user have been established, one can measure the quality of existing financial disclosure by investigating the extent to which users' needs are being satisfied.

Implicit in the reasoning employed above are the following assumptions:

(i) Users are assumed to possess a high degree of insight concerning their own use of information.

(ii) The relative importance of an item of information to the user is the same regardless of what other items of information are available to him.

and

(iii) The relative importance of a disclosure item does not change over time (Dhaliwal, 1980, b, p.386)

Each of the three above assumptions are questionable.

1 Research had indicated that individuals (even experts) have poor insights into their own judgment process as described by mathematical models. Decision makers, in general, lack insight concerning their own use of information (Ashton 1976). Further, there is a great deal of variation in the relative importance assigned to different items of information by different sets of analysts in designing an index of disclosure.

2 The second assumption implies that the relative importance of a

disclosure item to the user is the same regardless of what other items of information are available to him. This relates to the concept of substitute signals of information. Two items of information are substitute items if elimination (or absence) of one of them does not result in loss of information to the user. Which means that as long as one of the two items is available, the disclosure of the second item does not provide any more information. This concept of substitute items of information has been ignored in the construction of disclosure indices, and redundant data seem to have been included.

Moreover, there is the consideration of information overload. It is conceivable that the inclusion of numerous items of data might reduce the validity of the resulting prediction, even though each one of them might be relevant in isolation.

3 The third assumption is about the stability of importance of the items over time. Relative importance of an information item is dependent upon economic conditions and the objective of the user, and thus not stable over time.

A new methodology of disclosure improvement is therefore needed which will provide a programme for obtaining maximum improvement in financial disclosure through a minimum number of additional disclosure items. Perhaps the use of multivariate factor analysis will be an appropriate technique to apply here (Hair, Anderson et al, 1979).

The information content of a new disclosure item can be viewed as having two components. The first component is that information which is already being provided by one or more items; the second component is the additional information which this new item will provide. A new disclosure item may have no second component. However, disclosure of this item will be desirable if the cost of providing this item is less than the cost of providing the items that will no longer be needed (Dhaliwal, 1980b, p 388).

6.2 Predictive Ability Studies

User oriented studies described in section 6.1 assume consumer sovereignty. In such studies it is the behaviour or opinion of decision makers which has been the object of enquiry.

There is another approach to the empirical investigation of decision-usefulness of published financial statements. This places emphasis on determing what are better methods of financial reporting. Attention is shifted from the accounting data to determining which accounting data and methods give the best predictions of the events in the future of relevance to particular type decision. (Peasnell 1981). This is the predictive ability criterion and has been discussed in the literature extensively (Beaver, Kennely and Voss, 1968; Ashton, 1976). Predictive ability studies in the context of segmental disclosure is about the extent to which consolidated sales and profits can be better forecast with the aid of segmental information than without such segmental information.

Based on the conceptual framework of Rappaport and Lerner (1969), Kinney (1971) was the pioneer in testing forecasting ability of segmental information in the financial reporting context. But such predictive ability tests of segmental information of a model testing variety is only a partial test of predictive ability because the so called "predictive ability model does not explicitly consider the decision maker" (Libby, 1975, p 476). Strictly speaking, most forms of accounting data do not give predictions; predictions are obtained by putting data into a model. Therefore 'predictive ability' tests of accounting data are tests of a joint hypothesis, that the data and the model combined have predictive value. It is necessary, therefore, to consider (i) studies relating to judgmental response of the fore-caster facing additional segmental information, and (ii) studies of the model testing variety separately to obtain a fuller understanding of predictive ability studies in segmental disclosure context.

6.21 Judgmental Response

Predictive ability models have two components : (i) the judge, or the decision maker with his perceptional strengths and limitations and his response to environmental changes in the face of new information; and (ii) the model used by the decision maker to make the prediction.

Judgmental response studies recognize that "information is not useful if it cannot be utilized effectively by the decision maker because of his limitations as an information processor"(Libby, 1975, p 477).

Judgmental response studies in the context of segmental information disclosure have been of two types : (i) simulation studies - studies of judgmental response in controlled environment and (ii) real life studies of decision makers in real life'open'environment.

6.211 Simulation Studies

Simulation studies are studies of judgmental response of simulated decision makers in the context of segmental disclosure of information against nondisclosure of such segmental information. Judgmental response studies using simulated decision makers in the context of segmental disclosure were conducted by Barefield (1972) and Porcano (1976).

Barefield (1972) conducted a simulation study with a student group at Purdue University. Students played the role of managers responsible for controlling labour costs, and were provided with simulated data. One group was provided with information on labour cost and material costs, while the other group was given data on labour costs only. Data analysis showed that the subjects receiving detailed disaggregated material and labour costs were slightly better performers. The importance of this study is rather limited however, since the participants were students, role playing, and in an obviously experimental setting.

Porcano (1976) conducted an experiment similar to that of Barefield on a student sample of forty, to examine users' predictive ability changes under segmental disclosure against nondisclosure of segmental information. The emphasis here was on unsophisticated users and on the interaction effects of segmental disclosure and other moderator variables. Results indicated that disclosure of segmental data, by itself, did not affect (i) subject's predictions of corporate earnings, (ii) prediction consensus among subjects, and (iii) the confidence subjects placed in their predictions of corporate earnings. However, the disclosure of segmental data (when interacting with similarity in segments) does affect subjects' average predictions and prediction consensus among subjects.

Simulation studies such as those conducted by Barefield and Porcano have limitations in that they are concerned with simulated (hence unreal) decision makers role playing. There is no way of saying how the real decision makers will behave in real life situations. Hence external validity (ie generalization) is a real problem with simulation studies. However, since simulation studies are conducted in a controlled environment, its internal validity (ie, ability to control for confounding factors) is enhanced. "Properly done, this method has potential value in throwing light on users' reactions to accounting alternatives." (Peasnell, 1981, pp 110-111).

6.212 Real Life Studies

Predictive ability of any forecasting model has two components : the forecaster and the model that the forecaster is using. At the individual forecaster level there are perceptual or judgmental factors involved. The judgmental ability of the forecaster can be evaluated in a controlled environment via simulation studies which give good internal validity at the expense of external validity of the model. If real life decision makers, users or forecasters are used then external validity is likely to improve at the expense of internal validity.

Real life studies with actual forecaster or users of financial information were made by Stallman (1969), Buzby (1974a), Ortman (1975) and Benjamin and Stanga (1977), to test whether additional disclosure represented an improvement in judgmental ability in the sense of satisfying users' information needs.

Stallman (1969) used questionnaire method to study the effects of additional disclosure of segmental income data on financial analysts' confidence in their own judgment. The data used in the experiment were obtained by combining the actual reported financial data of real single industry companies to construct financial statements of two hypothetical multi-industry companies. Questionnaire packets containing condensed annual reports and price data for each of the two companies were mailed to a representative sample of 1068 members of Financial Analysts' Federation, and the Institute of Chartered Financial Analysts. The analysts were asked to judge the 'intrinsic' or long term investment value of a share of stock for each of the two companies.

The analysis of stock valuation estimates made by responding analysts showed that the valuations differed between the two companies. The valuations differed because of the level of past stock price performance data whichwere supplied to the analysts. These differences in valuations due to the price performance factor were affected by the additional disclosure. "Those analysts receiving the additional disclosure of divisional income data were influenced less by the difference between the high and low price-performance data than those who did not receive it" (p 41).

Disclosure of segmental information had apparently put historical price performance data in perspective; hence segmental information proved useful to investors.

Buzby (1974a) used questionnaire study on financial analysts and concluded that financial analysts found segment reporting of income and sales relatively important items of information in investment decision making.

Ortman (1975) tested the impact of segmental financial information on judgemental improvement of sophisticated users (chartered financial analysts). A stratified sample of just over three hundred was drawn from the complete membership list of about two thousand six hundred chartered financial analysts. Two sets of financial statements were generated for ten years. One set presented segmented information and ratios, while the second set generated aggregated information alone. Subjects in each of the groups were asked to assign a per share offering price to each of the two diversified firms, both of which were expected to go public in the near future. Without knowledge of what the market is currently paying for each of the company's stock, the subjects were forced to rely on the financial information given for their estimates of the stock value of each company. With segmental data, the value of each firm's stock was in accordance with the present value of its expected returns as reflected by industry average price earnings ratios. Without segmental data the reverse was experienced. The decrease in the variance with regard to the distributions of per share values of the diversified firm's stocks in this study may mean that segmental disclosure by all such firms could result in greater stability in the movement of prices of these stocks. The results of this study strongly suggest that diversified firms should include segmental data in their financial reports.

Benjamin and Stanga (1977) surveyed the opinion of commercial bank loan officers and professional financial analysts to compare the informational needs of the two groups who are primary users of external accounting information. The questionnaire encompassed 79 items of information. The sample consisted of 600 commercial bank loan officers and 600 chartered financial analysts. It was hypothesised that there was no difference between the perceived importance of information to commercial bank loan officers making a term loan decision and the perceived importance of information to CFAs making a common stock investment decision. A series of null hypotheses for each of the 79 information items included in the questionnaire was formulated, and each hypothesis was tested at the 5 per cent significance level using a chi-square test.

Results showed that the perceived informational needs of the two groups were different. For instance bankers perceived comparative statement of retained earnings for the past two years as of primary importance, and ranked this as number one, while analysts ranked retained earnings information as only number 11.

6.22 Model Testing

Predictive ability tests of segmental disclosure has two components: the information processing ability of the decision-maker, and the inherent accuracy of the model to forecast consolidated numbers with the disaggregated numbers assuming no information processing constraint exists. Tests of predictive accuracy of segmental information have been made by Kinney (1971), Collins (1976a, and 1976b), and Emmanuel and Pick (1980).

Kinney (1971) used a framework that was developed by Rappaport and Lerner (1969). The Rappaport and Lerner study developed a framework for financial reporting designed to be useful to the shareholders and investors. This study presented alternative investor valuation models, and based on these models presented a case for segment reporting. They identified two ways investors might try to estimate earnings:
(i) forecast returns through industry analysis, and (ii) forecast returns from company data.

The first method involves estimating future industry conditions and determining the company's relationship to the industry. If the company being evaluated operates in several industries then it follows that knowledge of the different products and/or markets in which the company operates is essential. To use the industry analysis model the investor must receive sales and income data from each segment.

The second method is to use the past consolidated data and extrapolate. A linear extrapolation based on consolidated data may be in error if the segments are growing at different rates or experiencing different trends in growth.

The Rappaport and Lerner study presents the first ever theoretical evidence in favour of segment reporting. They also implicitly define the two variables which might influence the need for segment data:

(i) the nature of the segments (ie are they in similar industries or dissimilar industries?), and

(ii) the earnings history (variability) of the segments.

If the segments are in similar industries then apparently segment data will contain less information than would be the case if the segments were in dissimilar industries.

Kinney (1971) used Rappaport and Lerner framework to test the improved forecasting ability of segment data when compared with consolidated data alone.

Kinney was motivated by SEC segmental disclosure requirements by Line of Business (LOB) in 1969. He wanted to test the usefulness of this new requirement by the SEC, and designed a test as to the predictive ability improvement following LOB disclosure rule. Predictive ability was defined as the ability to determine next period's consolidated earnings. Kinney used four prediction models and compared earnings forecasts based on consolidated earnings only, with those based on segment data, for a sample of 24 US companies which had voluntarily reported sales and earnings data by subentity for the years 1968 and 1969. He employed only relatively simple prediction models in order to assess whether the reporting of this data adds to the investor's capability to predict earnings of the diversified company.

Kinney used four prediction models, two based on consolidated earning, and two based on segment earnings. Kinney's models are described below, first the two consolidated earnings based models, then the segment based models.

1 For a company which is a single product company, or which is diversified in the same manner as the gross national product is composed of, the consolidated earnings forecast for this year will be equal to consolidated earnings of last year multiplied by change in GNP forecast for this year over last year.

In symbols,

$$\boxed{\hat{E}_i \quad = \quad (1 + \Delta\widehat{GNP}_i) \qquad E_{i-1}}$$

Predicted consolidated earnings for year i	=	Predicted change in GNP from year i - 1 to year i	x	Consolidated earnings in year i - 1

2 For a company that is <u>less diversified</u> than in situation 1 above, but the fluctuations among divisions are offset by each other, implying that covariances among divisions are large and negative, consolidated earnings forecasts can be made from an analysis of trend in consolidated earnings.

$$\hat{E}_i \quad = \quad f(E_{i-1}, E_{i-2}, \ldots\ldots E_{i-t})$$

Predicted consolidated earnings	=	A function of past consolidated earnings

Kinney used an extension of this linear trend of consolidated earnings by applying double exponential smoothing of the following type:

$$\hat{E}_i = aE_{i-1} + (1-a)\,\bar{E}_{i-2} + (\bar{E}_{i-1} - \bar{\bar{E}}_{i-1})$$

which is essentially a weighted moving average forecasting process, where a is a smoothing constant, $0 \leqslant a \leqslant 1$;

$\bar{E}_{i-1}$ is the first order smoothed average earnings through period i - 1;

and $\bar{\bar{E}}_{i-1}$ is the second order smoothed averages obtained by smoothing the first order averages.

3 If the firms provide information on segments, using segment revenues the investor could predict future revenues by segment by using predictions of industry revenues and applying the rates of change in industry revenues (and possibly an expected change or trend in market share) to the past revenues of the segment. The sum of subentity sales could be multiplied by consolidated earnings rate to predict consolidated earnings.

$$\boxed{\hat{E}_i = \left[\sum_j (1 + \widehat{\Delta IS}_{i,j}) \quad s_{i-1,j}\right] \frac{\bar{E}}{\bar{S}}}$$

Predicted consolidated earnings	=	Predicted % change in segment sales	x	Actual segment sales of past year	x	Average consolidated profit rates

4 If subentity earnings data are also reported, then the procedure in 3 above can be amended by replacing average consolidated profit rates by respective segment profit rates.

$$\boxed{\hat{E}_i = \sum_j (1 + \widehat{\Delta IS}_{i,j}) \quad s_{i-1,j} \quad \frac{\bar{e}_j}{\bar{s}_j}}$$

Predicted consolidated earnings	=	Predicted % change in segment sales	x	Actual segment sales of past year	x	Average rate of profit of segment sales

Where the symbols are as follows:-

		Consolidated	Segment
Sales	Actual Average Predicted	S $\bar{S}$ $\hat{S}$	s $\bar{s}$
Earnings	Actual Average Predicted	E $\bar{E}$ $\hat{E}$	e $\bar{e}$
Year Industry		i j	

In more simple terms the four models are:

1 Last year's actual consolidated profit x forecast change in GNP.

2 Last year's actual consolidated profit x simple extrapolation.

3 Forecast segment sales x Average consolidated profit rates.

4 Forecast segment sales x Average segment profit rates.

For 24 companies which disclosed segmental data, consolidated earnings forecasts were made using each of the four above prediction models to see if segmental data were better predictors. Despite the size of his sample, the short study period, and the limited number of models employed, Kinney still reached the conclusion that 'predictions based on segment sales and earnings data and industry predictions are on average more accurate than predictions based on models using consolidated performance data alone' (p 136).

Kinney investigated the predictive ability of segmental line of business information for companies that disclosed such information voluntarily.

However, there may be something peculiar to the reporting firms which might explain their willingness to disclose voluntarily their segment sales and profits. Collins (1976a, and 1976b) wanted "to extend and update the preliminary work of Kinney using data disclosed under the line of business reporting requirements ... initiated by the SEC" (1976b, p 164).

Beginning with fiscal years ending on or after December 31, 1970, the SEC required all registrants engaged in more than one "line of business" to report sales and profits before taxes and extraordinary items by product lines in their annual 10-K report. In addition for each line of business the registrant is required to disclose sales and profits for each of the last five years. (Securities Act Release No 34-9000, October, 1970).

Collins used 96 firms that did not disclose segmental earnings voluntarily prior to 1970 10-K requirement, but did so subsequent to 1970 when such disclosures became mandatory. He extended Kinney's work by using a larger number of models: seven consolidated based and two segment based. In the consolidated based models he included five models which were specifically appropriate for testing time series properties of numbers. Moreover he included three years, 1968, 1969 and 1970 in his investigation.

The consolidated sales and earnings figures were obtained from the Standard and Poors' COMPUSTAT tapes. The choice of accounting variables that were predicted was dictated by the availability of segment information on the 10-K reports.

The extensions to Kinney's models that Collins made can be summarised as follows:

	Kinney	Collins
Sample size	24 companies	96 companies
Nature of disclosure	voluntary	mandatory
No of years tested	two	three
No of models: consolidated based	two	seven
segment-based	two	two
Nature of models	simple	includes those which test time-series properties of accounting numbers

Collins argued that Kinney's models were chosen without any explicit reference to empirical research concerning the time series properties of accounting numbers such as those conducted by Beaver (1970) and Ball and Watts (1972).

Collins argued that it is entirely possible that observed superior predictive ability of segment vis-a-vis consolidated data could be explained by the inappropriateness or misspecification of the consolidated-based forecasting procedures that were tested. Appropriateness of the earnings prediction model is greatly dependent on the form of earnings variable used in the model. Level of earnings have been found to exhibit high serial correlation and to be well specified by a strict martingale or submartingale prediction model. First differences in the earnings series, however, possess very little serial correlation and are well specified by a simple linear regression model. First differences in earnings also have been found to be well approximated by simple mean reversion or mean reversion with drift prediction models.

Market association studies (Ball & Brown, 1968, Beaver & Dukes, 1972) have shown that several time-series models are consistent with the earnings expectations of securities market participants. Thus the models should be tested in conjunction with consolidated data when evaluating the relative predictive usefulness of segment versus consolidated data.

Further, that the observed superiority of segment-based models in predicting future income could be explained by the weakness of the consolidated-based models due to their inappropriateness or mis-specification.

To improve the reliability of the consolidated-based models Collins tested seven models for predictive ability of consolidated data.

Consolidated-based prediction models which Collins used included the two that Kinney used, but in addition he included the following five:

Linear regression

Strict martingale

Submartingale

Pure mean reversion - no drift

Moving average of a pure mean reverting process

C.1 Linear Regression Model

$E\ (X_{it}) = a_i + b_i\ X_{mt}$

It is assumed in this model that there is a strong association between the earnings of the firm and the general trend of earnings throughout the economy; (Ball and Brown, 1967). Here $E\ (X_{it})$

represents the expected value of earnings in period t from firm i; the intercept and slope of a linear regression are represented by a_i and b_i respectively, and the general market wide index of earnings is represented by X_{mt}.

C.2 Strict Martingale

$$E\,(X_{it}) = X_{it-1}$$

This model assumes that the earnings for the coming year will be the same as the previous year.

C.3 Submartingale

$$E\,(X_{it}) = X_{it-1} + \frac{1}{N}\sum_{j=1}^{N}\,(X_{it-j} - X_{it-j-1})$$

Earnings were assumed to be the same as for the previous year plus a drift factor which was estimated to be the average yearly change in earnings since 1951.

C.4 Pure mean reversion - no drift

$$E\,(X_{it}) = \frac{1}{N}\sum_{j=1}^{N}\,X_{it-j}$$

Average earnings for the firm from 1951 to the year prior to the year of prediction was used as an estimate of future earnings in this model.

C.5 Moving average of a pure mean reverting process

$$E\,(X_{it}) = X_{it-1} - \frac{1}{N}\sum_{j=1}^{N}\,(X_{it-j} - X_{it-j-1})$$

In this model earnings were estimated to be the same as for the previous year minus the average annual change since 1951.

Model C.6 and C.7 of the consolidated-based prediction, and the two segment-based models were identical to that of Kinney's.

Collins carried out two different tests of predictability:

(i) prediction of consolidated sales and earnings, and

(ii) prediction of first differences of consolidated sales and earnings.

With regard to the prediction of consolidated sales and earnings Collins found the following:

1 Forecasts of consolidated sales based on previous years' segment sales models were more useful (being better predictors) than models based on consolidated sales only.

2 Forecasts of consolidated profits based on segment sales x consolidated earnings rate were better than consolidated sales x consolidated earnings.

3 When segment earnings rates were introduced in addition to segment sales, consolidated profits forecasts did not improve significantly. This may be due to the amount of discretion available to management in cost allocations in determining segment earnings rate.

The above findings were confirmed when prediction of first differences were carried out, and confirmed Kinney's (1971) findings.

In the United Kingdom, Emmanuel and Pick (1980) replicated the research of Collins (1976b) with UK data in an environment of voluntary disclosure. A sample of 50 UK firms was randomly selected from the top 100 of 'The Time 1,000' for the year 1977-78. Predictions of consolidated profits and sales were made for the years 1973-77 using the data for 1972 as base. Consolidated based models for sales and profits were strict martingales, (where this year's forecast is the same as last year's actual). Seven segment-based models were used: three for forecasting sales and four for forecasting profits. These segment-based models are as follows:

A For forecasting consolidated sales:

(i) (a) x (b)

(ii) (a) x (b) x (c)

(iii) (a) x (d)

where: a = Last year's segment sales.

b = National Institute Economic Review (NIER) growth forecast of industrial output.

c = Consumer price index change forecast made by NIER.

d = A trend factor derived from NIER forecasts.

B For forecasting consolidated profits:

(iv) (e) x (f)

(v) (e) x (f) x (g)

(vi) (e) x (h)

(vii) (e) x (h) x (g)

where: e = Estimated segment sales.

f = Previous year's consolidated profit margin.

g = A trend factor in segment sales.

h = Previous year's segment profit margin.

Emmanuel and Pick tested the accuracy of each of the seven models by computing the mean absolute error (MAE) in predicting sales or profits for the years 1973-77 as follows:

$$\text{MAE} = \sum_{t=73}^{77} \left| e_{it} \right|$$

where $\left| e_{it} \right| = \left[(\text{predicted} - \text{actual})/\text{actual} \right]$, ignoring signs.

For consolidated-based strict martingale model for sales prediction, Emmanuel and Pick had an average error of 17.27% compared with only 11.43% of Collins. Similarly for sales prediction using segment-based models, Emmanuel and Pick found greater error than Collins. These differences according to the authors could have been caused by differences in the quality of published statistics in UK compared with USA, and the differential levels of price changes in the years studied.

For predicting consolidated earnings, the conclusions of Emmanuel and Pick are similar to that of Collins. They found that segment sales had additional information content for predicting consolidated profits. But further sophistication in forecasting using segment profits rate did not improve consolidated profits forecasts significantly.

6.3 Content Analysis

Research on content analysis of disclosure has been concerned with (i) the extent to which disclosure practices between companies are different, and (ii) possible reasons for the existence of such differences.

The extent of the differences in disclosure practices between companies have been examined by Choi and Bavishi (1982), Gray and Radebaugh (1981) and Arnold, Holder and Mann (1980).

Choi and Bavishi (1982) have conducted a comprehensive empirical analysis of disclosure practices for one thousand companies of international standing, across twenty four countries, for thirty two reporting categories. Not surprisingly, they found wide differences in disclosure practices regarding pensions accounting, tax, goodwill, inventory valuation, lease capitalization methods and others.

While the Choi and Bavishi study was comprehensive, it was not specifically related to segmental disclosure. A specific segmental disclosure related UK-US comparative study was conducted by Gray and Radebaugh (1981) who found significant differences in segmental disclosure practice in companies between these two countries.

The Gray and Radebaugh study consisted of an examination of the 1979 annual reports of 103 multinational companies (44 UK based and 59 US based) for segmental disclosure practices. Companies were selected in the sample only if at least 30 per cent of revenues, profits, assets or number of employees of the consolidated report arose from foreign operations. Results showed that although the qualitative narrative for UK companies were more meaningful, US companies in general provided more detailed quantitative information on segments.

A geographical segmental disclosure study was conducted by Arnold, Holder and Mann (1980) who analysed 10-K reports for the year 1978 filed by US companies with the Securities and Exchange Commission (SEC) and concluded that a great deal of divergency exists in practice in regard to disclosure of foreign activities. SFAS No 14 has not resulted in an adequate narrow definition of geographical area. The existence of such diversity makes it difficult for investors to assess at least two different kinds of risk : political risk of expropriation, and economic risk arising from foreign currency translation and exchange.

Disclosure studies conducted earlier in the seventies were not as comprehensive as that of Choi and Bavishi, but were nonetheless significant because of their implications. Barrett (1976 and 1977) examined financial disclosure practices across seven industrialized countries for 103 large companies selected by market capitalization rankings.

Barrett measured the extent of financial disclosure by an index constructed of seventeen categories of information, on principles similar to that pioneered by Cerf (1961), and subsequently used by Singhvi and Desai (1971) and Buzby (1974). He examined annual accounts for a ten year period (1963-1972), and found that US companies were not necessarily the best disclosing companies so far as segmental disclosure was concerned. For the year 1972, Swedish and UK firms disclosed better information measured by his index of disclosure.

But what is more significant is that he found discernible groupings in disclosure practices. The United Kingdom and the USA belonged to one group; West Germany and France belonged to another group; Japan belonged to yet another group. Barrett hypothesized that "there is a link between the quality of financial reporting practice and the degree of efficiency of national equity market" (Barrett, 1976, p 24).

Solnik (1973) and MacDonald (1973) had also come to conclusions similar to that of Barrett. They observed that equity markets in the continental Europe were less efficient than those of the UK and the USA; that financial reporting practice and loose requirements for the disclosure of information were among the possible explanations for apparent inefficiencies of the continental European markets. A similar view of the relative inefficiencies of the continental European stock markets has been expressed by Gray(1978a) in a comparative analysis of disclosure of statistical information by companies. Gray observed that the UK disclosure was more detailed than on the continent of Europe, and that this difference in the extent of disclosure was related to the development of the national capital markets.

A further implication of Barrett's findings lie in the possible influence of cultural factors in explaining differences in disclosure practices across countries and continents. Jaggi (1975), McComb (1979) and Choi (1980) also have examined the impact of cultural difference on disclosure practice. Nair and Frank (1980) and Nobes (1983) have attempted to classify financial disclosure differences across countries, and such differences could also have been influenced by cultural differences, and by the differences in the history of economic developments of those countries.

6.4 Aggregate Market Level Impact

Studies on aggregate market level impact of segmental disclosures bring together the impact of user behaviour, predictive ability, and content analysis studies described earlier, but focus on one specific kind of user - investors. Although aggregate market behaviour can be seen as an extension of the individual action, there are significant differences. These are influences of factors that are difficult to simulate in individual level research, such as competing sources of information, incentives, and user reactions, which are important in the study of groups (AAA, 1977, p 19). For these reasons, it is important to study the behaviour of the market in response to segmental information disclosure separate from the reaction of the individual user.

Prior studies of aggregate market level impact of segmental information disclosure have been made primarily in the context of the information efficiency of capital markets. These studies test the impact of new information in the framework of Sharpe's (1963) market model, and apply the results to the evaluation of disclosure policy.

Kinney (1972) was the first to produce evidence which indicated that segmental earnings data contained information relevant to the estimation of systematic risk. He attempted an integration of portfolio theory and the reporting of segmental financial data by large multisegment corporations by examining the relationship between :

(i) the covariability of segment earnings of a sample of multi-segment firms, and (ii) the covariability of the returns of these shares with the market.

Kinney's sample consisted of 51 firms from Accounting Trends and Techniques published annually by the American Institute of Certified Public Accountants. These firms had voluntarily disclosed some type of segment earnings continuously for the years 1965-1969. Twenty-five of the firms reported on a geographic basis, while the remaining twenty-six reported on a line of business basis.

Kinney argued that a multisegment firm can be considered as a portfolio of investments. One possible motive for establishing a multisegment firm could thus be to obtain the advantages of diversification. Following Markowitz (1952), a measure of success of a firm in diversifying would be the ratio of the variance of the returns of the firm as a whole to the sum of the variances of the individual segment returns. For a firm with N segments, this ratio can be expressed as :

$$\sigma^2 \Big/ \sum_{j=1}^{N} \sigma_j^2$$

Kinney called this ratio, the covariance ratio (CR).

Following a Markowitz approach to diversification, a firm would select investment which, other things being equal, have negative covariances of returns with existing investments in order to obtain an efficient portfolio, which can diversify away the unsystematic risk. For positively correlated segment returns, on the average, the variance of the returns of the firm is increased over the sum of the variances of the individual segments, since the segment returns tend to vary together. Conversely, if the firm had selected segments which have negatively correlated returns, then the variance of the consolidated return is less than the sum of the parts, since the segment returns would not be varying together.

Kinney applied the covariance ratio of earnings instead of returns since the capital employed figures for the segments were not available. Kinney's covariance of earnings ratio is as follows :

$$\sigma^2_E \Big/ \sum_{j=1}^{N} \sigma^2_{E_j}$$

where, σ^2_E is the variance of consolidated earnings, and

σ^2_{Ej} is the variance of the segment earnings.

The smaller this covariance of earnings ratio is the more successful the firm is seen to be so far as its efforts in diversifying is concerned.

To relate this expost measure of diversification to the market determined risk measure, B, Kinney regressed the monthly stock price data for the five year period, December 1964 to December 1969 for each of these 51 stocks with the Standard and Poor's Composite Index (500 stocks) using ordinary least squares.

Correlation measures were then computed between the betas and the covariance ratios. Results showed that for line of business reporters, the association between betas and covariance ratios were significant at 5% level. For geographic reporters this association was not significant. Kinney concluded that segment earnings on a line of business (LOB) basis had information content which can be used to predict market determined risk.

Barefield and Comiskey (1973) examined the degree of association between market beta, earnings variability, and errors in forecasting firm's earnings as reflected in analysts' forecasts. A one-hundred company sample was drawn from the Standard and Poor's Earnings Forecaster service. These companies satisfied the following constraints simultaneously : (i) a December 31 year end, (ii) continuous listing on the New York Stock Exchange for the years 1967 to 1972, and (iii) continuous inclusion in the Earnings Forecaster as published by Standard and Poor during 1967-1972. Forecast error and earnings variability were computed from the sample data while the market beta was drawn from the Value Line Investment Survey. Forecast error was defined as the mean of the absolute value of the percentage difference between the actual and forecasted earnings for the six years, 1967-1972. A positive association was observed between the three risk measures : market beta, earnings variability, as well as forecasting error of the analysts in predicting firms' earnings, although the degree of association was strongest between forecast errors and earnings variability. This positive association between market beta and forecast earnings error suggest that the observed decline in market beta, on average, may be a consequence of improvements in earnings forecastability which can result from segmental disclosures.

Choi (1973b) examined the problem of financial disclosure and its impact on the firm's cost of capital in the eurobond market. He examined 18 multinational companies which entered the eurobond market prior to 1971, and compared their disclosure index (following Cerf 1961) with that of similar companies matched by asset size, period studied, and approximate industry category. He conducted a Wilcoxon matched pairs test, and found that new entrants' disclosure practices were significantly better at the 5% level of significance. Since the new entrants' ability to raise capital is dependent upon the investing community's perception of the uncertainties about new entrants, Choi concluded that increased corporate disclosure (including segmental disclosure) reduces investor perceived uncertainties, and consequently reduces equity cost of capital.

Kochanek (1974) investigated the impact of segmental disclosure on stock prices for 37 multisegment firms for the four year period 1966-1969. His a priori hypotheses were (i) investors with segmental data are better able to predict future earnings changes of the firm, than without; and (ii) security price fluctuations of the firm are dampened where such segmental data are available. Using a disclosure index (following the methodology of Cerf, 1961; and Singhvi and Desai, 1971) he categorized firms into 'good' and 'poor' reporters, and used Spearman's Rank Correlation method to compute the association between 'good' reporting practice, earnings predictability and weekly stock price changes.

Tests confirmed his a priori hypotheses. Good reporters exhibited higher positive correlations between current period stock price changes and subsequent period earnings changes than poor reporters, indicating that segmental disclosures help in the prediction of future earnings changes. Testing the association between stock price volatility and reporting practice, he also found that the weekly stock price volatility ratio was smaller for good reporters than for poor reporters.

The results of Kochanek's empirical tests suggest that not only future earnings predictions are facilitated by segmental reports, but that voluntary disclosure of subentity data reduces stock price volatility over time as well.

Horowitz and Kolodny (1977) study of market level impact of segmental disclosure is in marked contrast from all other market level impact studies conducted previously. They included post 10-K requirement data and reported the first evidence against the information content of segmental data in their study of two sets of 50 firms covering the period 1965-1973. They divided their investigation period into three subperiods : predisclosure, 1965-1970; disclosure, 1971; and post disclosure, 1972-1973.

Their treatment group consisted of 50 firms which were required to disclose segmental earnings in the 10-K reports filed with the SEC for the first time in 1971, while the control group of 50 firms were not required to make any disclosure of segmental earnings. Using ordinary leastsquares method, beta values were computed for each firm in the sample, for predisclosure and post disclosure periods; and averaged for each of the two groups.

A difference of means test was conducted assuming normal distribution properties. The Z-statistic obtained showed that the two means were not different at .05 significance level.

The significance of Horowitz and Kolodny's findings are, however, limited since they tested only two year data for the post disclosure period which is in marked contrast to the six year period studied for the pre disclosure period. To construct a time series with some reliable parameters, a larger number of observations is warranted.

Initiated by the negative findings of Horowitz and Kolodny cited above, Collins and Simonds (1979) carried out one of the most substantive piece of research in the area of aggregate market level impact of segmental disclosure.

Collins and Simonds formalised the arguments supporting the use of segment data for evaluating the riskiness of a firm by linking segment operating characteristics to some measure of firm riskiness. They argued that since the operating characteristics of the firm are determinants of risk, it would be reasonable to assume that segment reporting of contribution margin, asset, and revenue would contribute to the accuracy of risk assessment. Borrowing from Rubinstein (1973), the authors showed that beta for the pure equity firm is a function of operating variables that define operating risk. Rubinstein's formulation of the determinants of risk for the multiproduct firm provided the theoretical support for the assumed importance of information on a firm's segments. It is of interest to note that the Rubinstein model includes segment variable cost as an operating risk factor which is related to the concept of operating leverage which Lev (1974b) has shown to be an important factor in explaining differences in betas in cross-sectional studies.

They analysed 215 firms : 137 identified as the control group of companies which did not change their disclosure practice throughout the period of investigation, 1963-1974; and 78 identified as treatment group - companies which disclosed very little or none at all so far as segmental data was concerned before the initiation of line of business reporting by the SEC in 1970 in 10-K reports, but did disclose both segment revenue and profits data after 1970.

They used the familiar market model of Sharpe (1963) variety, but defined the systematic risk, B, in terms of the operating characteristics of the firm as follows :

$$B_{im} = \frac{Cov(\tilde{R}_i \tilde{R}_m)}{Var(\tilde{R}_m)} = \sum_{j=1}^{n(i)} \left[\delta_{ij}\, E(\tilde{P}_j - \tilde{V}c_j)\, P(\tilde{q}_{ij}, \tilde{R}_m)\, \frac{\sigma(\tilde{q}_{ij}/\delta_{ij}V_{i1}}{(\tilde{R}_m)} \right]$$

where,

δ_{ij} = Proportion of the i th firm's wealth at period 1, invested in segment j, where $\Sigma_j\ \delta_{ij} = 1$

$E(\tilde{P}_j - \tilde{V}c_j)$ = Expected unit contribution margin from segment j's output

$P(\tilde{q}_{ij}, \tilde{R}_m)$ = The coefficient of correlation between the quantity of segment j's output produced by firm i and the rate of return on market portfolio $\tilde{R}_m$

$\sigma(\tilde{q}_{ij}/\delta_{ij}V_{ij})$ = A measure of uncertainty of the output level of segment j per unit of wealth invested in segment j

The constancy of beta coefficients was tested by employing the analysis of variance procedure as described by Johnston (1972), which involved splitting the overall time series of monthly observations into two non-overlapping subperiods differentiated by the critical event (the time period associated with the initiation of the SEC LOB reporting requirement in 1970).

Sums of squared residuals obtained by applying separate regressions to subperiod 1 (pre-disclosure) and subperiod 2 (post-disclosure) data were compared against the sum of squared residuals from a pooled regression (subperiod 1 and subperiod 2 combined) to test whether a statistically significant shift in beta parameter had occurred.

Analysis of covariance test was applied to monthly portfolio level return data for each of the sample groups. Separate regression estimates were computed over the forty observations on either side of the period July 1969 to March 1971 during which changes in beta values may have occurred.

Results showed a significant negative change in beta over the critical period (July 1969 to March 1971) for the treatment group. There was no significant change in the beta for the control group. Collins and Simonds concluded that the observed change in beta was caused by the new requirement of segmental disclosure.

Location of beta shift was examined by two methods : (i) moving beta estimates over forty month regression periods calculated monthly from January 1967 to December 1974, and (ii) calculation of Quandt log-likelihood ratios over the period May 1966 to August 1975. Both these techniques indicated that beta shift occurred during March/April 1970.

Negative change in beta for the treatment group following segmental disclosure showed that segmental data had information content, and that the disclosure of such information has altered the market's perception of the riskiness of the disclosing firms which were previously not disclosing such finer information. So far as the timing of the beta change around April 1970 is concerned Collins and Simonds observed that :

"the market was anticipating the effects which expanded segmental disclosure would have on management's tendency to take on less risky projects in an attempt to minimize the agency cost to them (management) of disclosing marginal or unprofitable operations or that LOB disclosure reflected reduced investor uncertainty about operations of multi-segment firms brought about by early dissemination of LOB data prior to disclosure in 1970 10-K reports." (p 380)

There are two minor shortcomings of Collins and Simmonds' most elegant theoretical exposition of segmental disclosure and risk. (i) They disregarded the effects of changes in leverage in the estimation of betas; and (ii) Control groups are, in theory, to differ from the treatment group only in terms of the variable under investigation. The authors do not make clear if any matching as to the characteristics other than the one under investigation have taken place.

Nevertheless, in a most exhaustive analysis Collins and Simonds have provided fairly convincing evidence that the observed decline in beta for the treatment group, on average, is a consequence of improvements in earnings forecastability, which results from segmental disclosure and a reflection of reduced investor uncertainty about the future prospects of multisegment firms.

Using a modified version of Collins and Simonds' sample Ajinkya (1980) tested the aggregate level impact of LOB after a relatively longer period of experience on the part of both preparers and users of such data. In order to do this, he tested changes in consensus at the aggregate market level as an effect of mandatory disclosure policies.

Ajinkya examined 172 companies; 108 in the treatment group category and 64 in the control group, for a ten year period, 1966-1975. Treatment group companies were multiproduct firms which had changed segmental disclosure practice from non or partial disclosure to 'full' disclosure of segmental earnings following the SEC 10-K requirements in 1970. Control group companies were either multiproduct firms which had voluntarily disclosed segmental earnings prior to 10-K requirements or single product firms for whom the 10-K requirements were not applicable.

'Market risk equalized' mean returns for portfolios based on varying disclosure requirements for the pre, and post 10-K requirement periods were computed. For the period before the 10-K requirements were initiated Ajinkya found no significant difference (at .05 level, using F test) in the mean returns between the portfolios. However, when covariance of returns structure among groups in the pre Vs post 10-K requirement period was examined using Box's x^2 test, results suggest a consensus of risk-return assessment following disclosure.

Ajinkya concluded that risk equalized mean portfolio returns were not significantly different because the direction of beta change at the individual firm level were not predictable following the disclosure of finer information. Hence at the portfolio level, the individual beta changes may have been neutralized. But when the aggregate consensus was examined the usefulness of finer information was substantiated.

"The results suggest that the uniformity and greater fineness of disclosure for multiproduct firms (as mandated by the SEC) appear to have increased the consensus in the risk-return assessments of securities of multiproduct firms at the aggregate level". (p 360)

All the aggregate market level impact studies mentioned above, Kinney (1972), Barefield and Comiskey (1973), Choi (1973b), Kochanek (1974), Collins and Simonds (1979), and Ajinkya (1980) found evidence in favour of increased information content in segmental disclosure. There has been only one exception to this consensus : Horowitz and Kolodny (1977), whose post disclosure observations were rather limited.

There have been many other studies exploring aggregate market level impacts : Benston (1973), Collins (1975), Tanju (1977), Dhaliwal (1978), Foster and Vickrey (1978), Dhaliwal, Spicer and Vickrey (1979), and Garsombke (1979) to name but a few. Results of all these studies also are not too dissimilar to those that have been mentioned in detail in this section. With the exception of Benston (1973), and Garsombke (1979), all these studies found increased information content in segmental disclosure.

Apart from consensus on information content of segmental data, these studies have something else in common. With the exception of Kinney (1972) none of the above mentioned studies have even considered segmental geographical disclosure, being entirely concerned with line of business disclosure. Even Kinney made only a halfhearted attempt at exploring geographical disclosure and concentrated primarily on line of business.

6.5 Geographical Disclosure

In the previous sections in this chapter an appraisal has been made of prior research in segmental disclosure. Evidence gathered from prior studies seem to favour the notion that segmental disclosure has information content. However, this information content of segmental disclosure is based on line of business data. Research on geographical disclosure is scarce to the point of being almost non-existent compared with the plethora of studies on LOB. Yet, there is wide support in the literature for segmental disclosure research although actual studies are rather scarce. For instance :

"With the increased consistency in reporting segmental operations across firms afforded by FASB Statement No 14, the opportunity exists to test whether different bases of segmentation (eg, product-line, customer, or geographical breakdown) .... have differential market consequences. Such research could suggest the specific form of segmental disclosure that investors find most useful in assessing the risk and return prospects of multisegment firms."

(Collins and Simonds, 1979, p 381)

and

"Segmentation on a geographical basis is not an alternative to segmentation on the basis of business activity. It is distinctly and significantly different, as foreign countries often exhibit different risk and return profiles as a consequence of foreign exchange, inflation, and interest rate differentials - quite apart from the differing impact of environmental factors, including political risk and the possibility of expropriation.

Whilst geographical segmentation is a widely used basis, it is not well developed." (Gray, 1981, pp 39-40)

Kinney (1972) conducted an analysis of segmental geographical disclosure as a byproduct of his line of business investigation cited earlier. Twenty five of his sample of fifty one companies had reported geographical earnings for two or three segments for the years 1965-1969 voluntarily. Geographic segment categories were domestic or foreign, and eastern and western hemisphere. Although these categorizations were very general, Kinney proceeded to analyse the segment earnings with the aid of the ratio of covariance defined as :

$$\sigma^2_E \Big/ \sum_{j=1}^{N} \sigma^2_{(Ej)}$$

where Ej is the earnings of segment j, and

E is the consolidated earnings of the firm.

The measure of consolidated earnings used paralleled the ones reported for the segments. Thus consolidated earnings measure varied from consolidated net income after taxes to consolidated net income before common cost allocations.

Kinney found that three of the 25 geographic data firms had covariance ratios of less than one, meaning that only in three cases out of 25 were there benefits of geographical diversification so far as diversifying away the unsystematic risk was concerned.

To examine the information content of geographical segmental disclosure Kinney used least square regression between the Standard and Poor's Composite Index (500 stocks) and the monthly stock price data for six years, 1964-1969. Product moment and rank correlation tests were conducted between the covariance ratios and betas. Kinney found no evidence of information content in geographical segmental disclosure. Kinney's results for geographic firms were as follows :

Sample size	25 firms
Beta :	
average	1.01
standard deviation	0.35
Covariance Ratio :	
average	1.32
standard deviation	0.38
Correlation Coefficient	
(Covariance ratio and B)	
Product Moment	- .054
Rank (Spearman)	- .047

Having thus found no evidence of information content in geographic segmental disclosure, Kinney observed :
"The geographic data firms cannot be considered as multisegment firms in the same sense as those reporting on a product line or divisional basis. Firms reporting on a geographic basis are likely to be in the same industries in both the foreign and domestic markets and thus have a smaller incidence of covariance ratio less than one due to worldwide industry effects." (p 342)

Kinney's conclusions may have been premature. Firstly, his segments were not identified in detail, being simply 'domestic or foreign, and eastern and western hemisphere'. Such classifications do not give adequate room for identifying and grouping segments into suitable risk categories. Secondly, as he himself stated subsequently, his sample size of 25 companies was hardly exhaustive. Finally, given that the western world has seen a large number of conglomerate mergers during the nineteen sixties and seventies, it is no longer true that "firms reporting on a geographical basis are likely to be in the same industries in both foreign and domestic markets".

Regrettably however, Kinney's is the only study ever conducted as yet on information content of segmental geographical disclosure at the aggregate market level. There have been other studies such as Gray (1978b), Arnold, Holder and Mann (1980), and Gray and Radebaugh (1981), but none of these have been in the area of aggregate market level impact of geographical segmental disclosure.

Regulatory and other authorities such as the FASB in the USA, the UK Companies Act 1981, and the London Stock Exchange have left the segment identification problem entirely to the discretion of reporting companies. Yet, without some tightening up of the segment identification, any empirical analysis of benefits of geographical disclosure is going to be difficult (Gray, 1978b; Gray, Shaw and McSweeney, 1981; Emmanuel and Gray 1977, and 1978).

An adequately narrow operational definition of geographical segments is necessary. Such data is important due to political (for example expropriation) and economic (for example, currency exchange and translation) implications. (Arnold, Holder and Mann, 1980, p 135).

Because of varying economic, political and other risks in overseas countries, arguments about geographical segmental disclosure benefits overflow into the area of studies in international capital markets where a continuing debate is whether the international capital market is segmented or unified.(Grubel, 1968).
A segmented market hypothesis will support international diversification for risk reduction purposes at the corporate level while an unified market may make international diversification superfluous since there may be no additional benefit from diversifying into overseas territories over and above those to be derived from product diversification.

Grubel (1968) demonstrated that international diversification can lead to new gains in world welfare apart from the traditional gains from trade and migrational factors of production, thus supporting the segmented market hypothesis. Agmon (1972) on the other hand in a study of share price comovement supported the one market hypothesis.

To demonstrate possible gains from geographical diversification, Grubel (1968) collected monthly information on common stock market averages for 11 industrialized countries (10 NATO countries and South Africa) for January 1959 to December 1966, calculated expost returns, variances of returns, and regressed each country index with the US index (Moody's Industrial Average of US common stocks).

His results indicated that diversification among 11 countries had allowed investors a superior risk-return trade off compared to the portfolio consisting of Moody's Industrial Average of US common stocks.

Levy and Sarnat (1970) extended Grubel's study by including Less Developed Countries (LDCs) and found additional risk adjusted gains in diversifying businesses to LDCs. They concluded that such advantage in diversification to LDCs is possible because of inefficiencies in international capital markets due to barriers in international capital flows. Therefore, the lifting of restrictions on international capital movements would produce greater benefits from geographical diversification.

Agmon (1972) disputed Grubel and Levy and Sarnat's findings, in a study of benefits in diversifying between US, UK, Germany and Japan. He observed no benefit in diversifying between these countries, and concluded that the international capital market is unified and not segmented. Hence geographical diversification is superfluous. However, his was a very small sample of only four countries. It is not surprising that four industrially developed countries of the west with similar economies would present little advantage in geographical diversification among them. These four countries may have characteristics of a unified market, but there are many more countries in the developed and underdeveloped world where opportunities for geographical diversification would exist. Agmon (1973) in a further study admitted this and found "the existence of some unique country factors".

Solnik (1974) developed an equilibrium model of the international capital market that integrates exchange risks and different interest rates across the world, and called this the International Asset Pricing Model (IAPM). The IAPM states that the risk premium of any security over the international risk free rate is proportional to its international systematic risk, where the proportionality is the return on the world market less a world interest rate.

He also developed a Multinational Index Model where security returns are influenced by both world factor and purely national factor, which can be seen as a resolution of the Grubel-Agmon debate.

Solnik's IAPM is a novel idea though it has two drawbacks. First, his 'world' consisted of Europe and USA. He used 234 stocks of eight European stock exchanges, and 65 US stocks for the period of March 1966 to April 1971. Second, his risk parameter consisted entirely of exchange risk to the exclusion of all other risks.

Lessard (1974) extended Solnik's research by testing the relationship between 16 national stock price indices (including 4 from Latin America) for 15 years, January 1959 - October 1973. He used multivariate analysis (principal component), and analysed world, national and industry factors in equity returns. He found that the influence of a common world factor was very small in explaining stock price variances, and that national factor was the most dominant over the other two; world factor and industry factor. There was

> "less to be gained by diversifying across industries given diversification across countries than by diversifying across countries given industrial diversification within a single country" (p 382).

This shows that where cultural, political and other factors are predominantly different, (as is the case between Latin America and Western Europe), geographical diversifications has greater benefits than line of business diversification, and is in marked contrast to Kinney's observation :

> "... firms reporting on a geographic basis are likely to be in the same industries in both foreign and domestic markets and thus have a smaller incidence of the covariance ratio less than one due to world-wide industry effects" (Kinney, 1972, p 342)

Rugman (1978) extended the frontier of international capital market studies further by linking accounting beta (Beaver, Kettler and Scholes, 1970) studies with geographical diversification. He concluded that accounting beta for multinational firms can explain the risk characteristics better than purely market betas following Sharpe-Lintner capital asset pricing model.

To conclude, unlike LOB disclosure benefit studies, studies of benefits from geographical segmental disclosure are scarce. Evidence from international capital markets literature cited above suggest that in the absence of barriers to international capital flows, and imperfections in factor markets and goods markets, there might not be advantages in diversifying geographically. But the real world is different.

The notion of a perfect economy and perfect competition requires the assumption that prices everywhere are adjusted to bring supply and demand into equilibrium. It may well be that because of segmentation in world markets, rates of return are not equalized internationally. Such segmentation can be due to currency overvaluation, inefficiencies in security markets such as thin trading or lack of disclosure, and disequilibrium in technology markets. (Calvet, 1981, pp 317-318).

It is possible, therefore, that there are benefits to geographical diversification. If such benefits exist , it may well be that disclosure of geographical segmental data will result in a better appreciation of risk characteristics of disclosing entities.

6.6 Summary

In this chapter prior research in segmental disclosure and related studies have been cited and analysed. User behaviour studies have examined ways in which the consumers of segmental reports respond to segmental disclosure. Cerf's (1961) consensus study is a landmark in user behaviour studies where he established a disclosure index. Cerf's methodology has been used by many in different contexts. Predictive ability studies have been discussed after user behaviour studies. There are two components in predictive ability tests : the judgmental response or the perceptual aspects, and the models with which predictions are made. Kinney's (1971) model testing study based on voluntary disclosure is the pathbreaking one, although Collins (1976b) is an enlargement of Kinney's. Content analysis studies have been described next following which are the aggregate market level impact studies which integrate all other prior studies in segmental disclosure area. Again, as in model testing studies, Kinney (1972) produced the pathbreaking study while Collins along with Simonds produced a bigger and more sophisticated study. All these studies have been concerned primarily with line of business disclosure. Studies of benefits of geographical segmental disclosure have been scarce, and Kinney (1972) is the only exception.

Studies in the international capital markets have been examined next. Some evidence exist that the international capital market is segmented due to various market imperfections. Thus there will be benefits from corporate geographical diversification.

In the following chapter, hypotheses will be developed for the testing of the possible effects of segmental geographical disclosure on stock market risk assessments, and the data base will be described upon which such hypotheses will be tested.

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CHAPTER VII

HYPOTHESES, DATABASE AND EXPERIMENTAL DESIGN

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CHAPTER VII

Hypotheses, Database and Experimental Design

7.0 Introduction

In earlier chapters, segmental geographical disclosure issues, information theory perspectives, capital market theories, and prior research have been discussed. The purpose of this chapter is to set the scene for empirically testing the concepts and issues explored in earlier chapters.

First, hypotheses will be formulated drawing upon the theoretical framework earlier cited. There are two specific hypotheses in this thesis: one concerns the information content of segmental geographical data, and the other is related to the benefits accruing to one specific user group, the investors.

Second, the database, upon which the hypotheses can be tested empirically, will be explained. The rationale behind the choice of companies and the time period studied will be discussed and the categorization of companies between the control group and the treatment group will be explained.

Finally, the design of the experiment will be examined. In this connection, various alternative methods of experimental design will be cited, and the rationale for choosing the moving regression method in preference to others will be explained.

7.1 Hypotheses

A system of financial disclosure should take into account user needs and the user environment (sections 2.11 and 2.12). User needs and environment have changed in the sixties and seventies in the wake of conglomerate diversification across national boundaries (section 3.1). Conglomerate merger and diversification have resulted in a loss of finer information to investors.

Finer disaggregated information can help in uncertainty reduction (section 2.211). Segmental geographical disclosure results in finer information on segment trading profits, sales and other relevant information being available to users (section 3.2). Since such segmental geographical disclosure has costs as well as benefits, segmental geographical disclosure is desirable if benefits exceed costs (section 3.3).

One of the possible benefits of segmental geographical disclosure is reduction in the uncertainty of the rates of return from investments. It is possible to examine the risk reduction benefits in the context of the capital market. If segmental geographical data have information content, then in an efficient market finer information about the entity should be reflected in the stock prices of the entity (section 4.14).

For a well diversified investor company specific volatility does not matter, all that matters is systematic risk (section 5.4). Therefore if segmental disclosure benefits exceed costs, then over time, there will be a reduction in systematic risk of such disclosing companies when compared with nondisclosing companies as a group although this may not be true for each individual company.

Benefits of segmental disclosure of a line of business variety in the stock market context have been examined by researchers, and evidence has been found to substantiate the notion that an average segmental line of business disclosure results in a reduction of systematic risk for disclosing entities as a group.(Section 6.4)

Tests of risk reduction benefits resulting from segmental geographical disclosure have been scarce in general, and none in the UK context (section 6.5) in particular.

Current research is based on segmental geographical data disclosed by UK based multinationals. If it can be shown that other things being unchanged, segmental geographical disclosure and systematic risk are associated then it is possible to conclude that segmental geographical data have information content. If it can be further shown that the direction of beta change favours disclosure behaviour, ie segmental geographical disclosure has resulted in a lower beta then it can be concluded that segmental geographical disclosure reduces systematic risk for disclosing companies.

Thus, the two hypotheses of this thesis are :

(1) Regarding information content :

Segmental geographical disclosure affects systematic risk.

(2) Regarding disclosure benefits :

Segmental geographical disclosure is associated with a lower systematic risk for the disclosing companies as a group.

The next section will describe the data base upon which the above hypotheses can be tested.

7.2 The Database

Earlier studies on segmental disclosure cited in chapter VI were mostly based on US data, and primarily on the effectiveness of line of business (LOB) disclosure. The objective of this study is to investigate UK based companies and the effectiveness of geographical segmental disclosure. For this reason companies selected will be required to have substantial overseas sales disclosed in their financial reports. Moreover, since our purpose is to examine the risk characteristics of these companies there has to be a reasonable length of time over which the geographical segmental data, and the listings for ordinary shares on the London Stock Exchange, are available continuously throughout the period under investigation.

To be more specific, the following were seen as required criteria for an adequate database for current investigation :

(i) Substantial overseas sales

(ii) A common year end to avoid seasonality

(iii) Continuous stock price listing on the London Stock Exchange

(iv) An adequate horizon and an appropriate interval over which stock prices are to be measured

(v) An examinable point of impact; and adequate differentiation between the control group and the treatment group of companies

(vi) A justifiable proxy for the 'market'

(vii) Avoidance of 'estimation risk'

To ensure that each of the above criterion is met, the following measures were taken :

(i) The starting point of this data base is "The Times 1000 Largest UK Industrial Companies (1981/82) by Turnover". Since size is an important criterion in investigating multinational conglomerates, only the first 500 of this 1000 companies was investigated.

To ensure substantial overseas sales, it was decided that at least 10% of total third party sales must be in overseas territories since any smaller percentage is unlikely to induce companies to disclose segmental geographical sales. The figure which is required to be disclosed for exports was taken as a reliable indicator in this regard. This choice of 10% cut off was also influenced by FAS 14, and the London Stock Exchange Listing Agreement discussed earlier (section 3.2).

An exception was made in the case of British Petroleum, the number one company in the Times Listing, because of its overwhelming size. For the year 1981/82, British Petroleum's export sales from UK was just over 9% of its turnover.

(ii) The companies must have a common year end. This common year end is important because the violation of this condition can cause distortions due to seasonality.

December 31 was the choice, since 52% of all companies listed in the Times Top 1000 companies have their financial year end on December 31.

The application of criteria (i) and (ii) simultaneously resulted in 101 surviving companies as shown in Appendix VII(A).

(iii) To be able to investigate the risk characteristics of these companies disclosing geographical segmental data, stock prices are required. Of the 101 surviving companies only 55 were listed on the London Stock Exchange in June 1982, the rest were either unquoted companies, or quoted in overseas exchanges.

(iv) Next, stock prices at the beginning of each month were obtained from Data Stream for 109 months : June 1973 to June 1982.

The choice of Data Stream for stock prices is justified as follows : unlike the USA, stock price data base for UK companies are scarce; there are two major sources for stock prices data in existence at this time point : the London Business School (LBS) and Data Stream International. The data base available from LBS could not ensure an adequate horizon as it did not go as far back as 1973. This was possible with Data Stream.

Justification for monthly stock prices being used instead of weekly or daily prices has been given earlier (section 5.513). Eight of the fifty-five companies mentioned in (iii) above dropped out, either because there were newer companies which have come to the market since June 1973, or because their listings were discontinuous. This resulted in 47 companies with a continuous listing for the 109 months which disclosed segmental geographical financial data consistently.

(v) Having established continuous stock price listings on the London Exchange for 109 months, a common financial year end on 31 December, and substantial overseas sales, the disclosure practice of these companies was examined with the aid of their annual reports, company records from The Exchange Telegraph Company (EXTEL) such as the EXTEL cards and EXTEL Handbook of Market Leaders for appropriate years. Since the objective of this research is to investigate the risk impact of differential disclosure practices, a point of impact was decided as being December 1977 for two reasons: (i) this is approximately in the middle of the period under investigation, hence will result in a reasonable sample size for the period after as well as before the point of intervention; and (ii) secondly, because these multinational conglomerates are likely to be influenced by changes in disclosure requirements by the FASB, the IAS, and the UN around this time (see figure 3.1). Of the forty-seven companies disclosing geographical segmental data mentioned in (iv) above, (a) 15 had continuously disclosed segmental geographical data throughout the nine year period, (b) 21 had changed from nondisclosure to geographical segmental disclosure in December 1977, and (c) 11 had changed from nondisclosure to disclosure at a time point other than end of December 1977.

To ensure a point of impact, companies in category (c) were withdrawn from further investigation, leaving a final sample of 36 surviving companies. Category (a), the 15 continuously disclosing companies were designated as the Control Group, and category (b), the 21 companies which changed their disclosure practice on 31 December 1977 were considered as the Treatment Group.

Appendix VII(B) is a list of treatment group companies, and Appendix VII(C) is a list of control group companies.

(vi) To be able to analyse the systematic risk characteristic of the companies surviving the selection process in (v) above, a proxy for the market portfolio is required. For this purpose, the Financial Times Actuaries Index (FTA 500) was chosen. According to Financial Times (1982, p 12), the FT Actuaries share indices are joint compilation of the Financial Times, London, the Institute of Actuaries, London, and the Faculty of Actuaries, Edinburgh. These indices are based on the London Stock Exchanges' share prices for quoted companies, and are adjusted for capitalization issues retrospectively.

The FTA 500 share index consists of 487 industrial group companies and 13 companies in the oil sector, but excludes the financial group companies such as banks and discount houses. As none of the companies in the final sample of 36 mentioned in (v) above were in the financial group, the FTA 500 index was chosen as an appropriate proxy for the market.

To generate the market return, R_{mt}, price relatives were computed as follows :

$$R_{mt} = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Price indices for the beginning of the month were used to conform with the individual stock prices data mentioned in (iv) above. Using 109 months' price indices, (109-1) = 108 market returns were obtained.

(vii) For each of the 36 companies mentioned in (v) above, Data Stream beginning of the month stock prices (which are already adjusted retrospectively for capitalisation issues) were used. Interim and final dividend information were obtained from annual reports and EXTEL cards, to adjust the market prices, prior to computing monthly returns in a fashion similar to that in (vi) above.

(viii) The selection process outlined in (i) to (vii) above results in approximately four thousand price relatives as follows :

for the market	:	1(108)	=	108
for treatment group	:	21(108)	=	2268
for control group	:	15(108)	=	1620
		total		3996

Systematic risk indicators, betas, can now be computed by regressing the market returns with company returns for companies in the treatment and control group categories.

The sample selected above ensures an adequate sample size of companies, is consistent to be able to minimise seasonality due to the choice of financial year end, provides an adequate number of observations, being 109 months long, ensuring a long enough time span to be able to examine the changes in systematic risk, if any, and is manageable for computational purposes.

Furthermore, 'estimation risk' is avoided as the number of observations per security is larger than the number of securities investigated (section 5.511).

7.3 Experimental Design

In the choice of an experimental design the researcher has to consider (i) internal validity and (ii) external validity. Internal validity refers to the consistency of the model and its applicability to the research question in hand in a particular instance, and external validity refers to the generalisability of the research. While internal validity is essential for model validation, external validity can never be proved unquestionably. It is desirable to have both.

"Internal validity is the basic minimum without which any experiment is uninterpretable: Did in fact the experimental treatments make a difference in this specific experimental instance? External validity asks the question of generalisability: To what populations, settings, treatment variables, and measurement variables can this effect be generalised? Both types of criteria are obviously important, even though they are frequently at odds in that features increasing one may jeopardize the other. While internal validity is the sine qua non, and while the question of external validity, like the question of inductive inference, is never completely answerable, the selection of designs strong in both types of validity is obviously our ideal".

Campbell and Stanley, 1963, p 5

The research question in hand is the testing of changes in systematic risk, B, in response to changes in segmental geographical disclosure practice over time. Such questions are answered via the time series models, and the testing here is essentially one of stationarity over time. In such a setting it is worthwhile considering that :

"A weak model reduces the power of the test, while a model correlated with extraneous signals can lead to false rejection of the null hypothesis of no information content".

Patell, 1979, p 546

Bearing in mind the question of trade-off between internal validity and external validity discussed above, in the following sections the cumulative average residuals, the most popular research method in the finance literature, will be described; other possible designs will be mentioned; and a simple technique, a moving beta estimate which is being used will be explained.

7.31 Cumulative Average Residual (CAR) Method

One of the most commonly used methodology in capital market literature is the cumulative average residual (CAR), pioneered by Ball and Brown (1968), and Fama, Fisher, Jensen and Roll (1969). This CAR methodology consists of : (i) estimating the parameter of the market model based in a time period prior (and sometimes subsequent) to an announcement, and (ii) analysing the residuals derived from applying this model to a time period which includes the announcement date.

A step by step approach to cumulative average residual methodology can be stated as follows :

(1) A sample is chosen from the population of companies engaged in the event of interest.

(2) For each company the date when the event of interest occurs is called t_o.

(3) An estimation period is decided upon which does not include the announcement date, or any date immediately before or after the announcement date to avoid any contamination.

(4) For each security the parameters of the ordinary least squares are estimated using the one factor market model, as follows :

$$\tilde{R}_{jt} = a_j + B_j \tilde{R}_{mt} + \tilde{e}_{jt}$$

where tildes denote random variables, and e_{jt} denotes the error term satisfying the assumptions of a linear regression model regarding means, variances and covariances.

(5) For each security, and for each period, forecast returns are now computed using the intercept, a_j, the slope B_j, and the corresponding market return $\tilde{R}_{mt}$.

(6) Actual returns for each security for each period are subtracted from the forecast return to obtain 'Abnormal Returns' or residuals.

$$\tilde{AR}_{jt} = \tilde{R}_{jt} - (a_j + B_j \tilde{R}_{mt})$$

(7) These abnormal returns around the time of the event of interest are then :

(a) calculated for each security in the sample

(b) cumulated over time, and

(c) averaged across securities

to test for the information content in the event of interest around t_o. The assumption here is that any drift in the cumulative average residuals (CARs) is caused by excess risk-adjusted returns in anticipation or as a result of the announcement. The behaviour of the cumulative average residual is examined by visual inspection or statistical testing.

While the CAR methodology described above is by far the most popular method used in the capital market literature, there are many problems with using this method. Firstly, it does not allow for changes in beta over time. In many cases there are a priori reasons to expect systematic risk to change during an announcement test. Such changes in systematic risk have been cited in the literature extensively. (Boness, Chen and Jatusipitak, 1974; Sunder, 1973; and Brenner and Smidt, 1977). Further, in CAR methodology it is assumed that beta for each company is independent across securities. This may not always be so when the securities being investigated are influenced by the same external factor such as changes in segmental disclosure practice.

Discussing the pitfalls of this CAR methodology, Sunder (1973, p 36) states that :

"(1) .. such analysis may indicate abnormal price changes when in fact none exist;

(2) even when abnormal price changes are present, this analysis may not be able to detect them due to the presence of changes in the relative risk; and

(3) in the presence of risk changes, estimated abnormal returns on stocks are dependent on the time series data used for estimation of the relative risk; and to the extent that this choice is made arbitrary, estimated abnormal performance is also arbitrary."

Similar reservations on CAR methodology have been expressed by Marshall (1975), Deakin (1976), AAA (1977), Larcker, Gordon and Pinches (1980), and Peasnell (1981). For instance, Larcker, Gordon and Pinches (1980, p 270) state :

"The average residual (AR_{t+1}) is unbiased if changes in B_{jt} are independent across securities. However, in an announcement test it is likely that changes in B_{jt} will be associated with that event. Hence averaging across the securities is of no benefit and the estimated average (AR_{t+1}) and cumulative average residuals (CAR_L) are biased; accordingly, any statement about market efficiency or the information content of the announcement may be incorrect. In effect the traditional methodology confounds the results so that patterns in the CAR's caused by shifting B's cannot be disentangled from shifts which appear to be associated with new information."

It is concluded that in spite of its popularity, the ubiquitous cumulative average residual method is not appropriate for investigating the relationship between segmental geographical disclosure and systematic risk because of its stationarity and independence assumptions. In the following section other possible methods for testing the relationship between segmental geographical disclosure and systematic risk will be explored.

7.32 Other Possible Methods

Other possible methods for testing changes in beta over time include (i) Dummy Variables and (ii) Box-Jenkins Method. While dummy variables have rarely been used in capital market studies*, the use of Box-Jenkins method** is fairly common, though used in a different context (improved forecasting ability).

7.321 <u>Dummy Variables</u>

"Dummy variables may be used as proxies for qualitative factors when no observations on these factors are available, or when it is inconvenient to do so". (Koutsoyiannis, 1977, p 281.)

A typical relationship using dummy variable may be described as follows :

$$C = a_1 x_1 + a_2 x_2 + BY + e$$

where C refers to the amount consumed by the community of a product, and the X's are dummy variables such that :

X_1 = 1 in each wartime years, and 0 in each peace-time years;

X_2 = 1 in each peace-time years, and 0 in each wartime years.

However, in using this method one has to be aware of 'The Dummy Variable Trap'. If explanatory variables such as those mentioned above in the equation are used in conjunction with a regression programme that automatically produces an intercept term, then the estimating procedure breaks down. (Johnston, 1972, p 179.)

A more popular method, though usually in a different context is the Box-Jenkins Auto Regressive Integrated Moving Average (ARIMA) method.

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* Exceptions being Wippern (1966) and Collins and Simonds (1979).

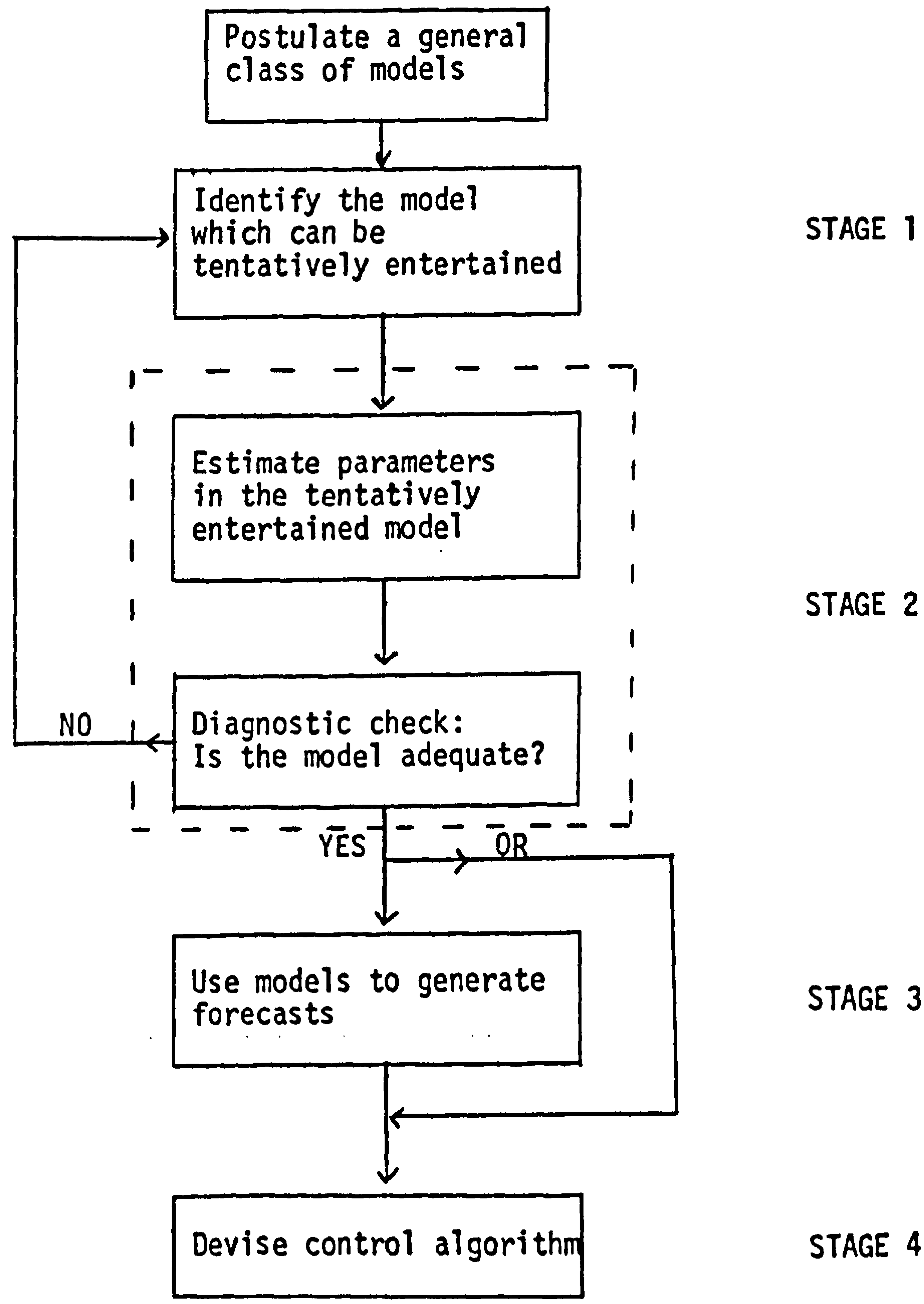
** Albrecht, Lookabill and McKeown (1977), Ang (1979), Foster (1977), Lorek, McDonald and Patz (1976), Mabert and Radcliffe (1974), and Umstead and Bergstrom (1979).

7.322 The Box-Jenkins Method

Data describing real life phenomena are more complicated than one which can be described by a straight line relationship. Therefore, in all forecasting we make an initial assumption as to the pattern that best fits the data (linear, logarithmic, exponential, multinomial etc) based upon which we produce a model that best fits the data. Box and Jenkins(1970, p.19) describe forecasting as a four stage process as in figure 7.1.

Figure 7.1

The Box-Jenkins Method



The Box-Jenkins method postulates three general classes of models which can describe any type or pattern of data: (1) Auto-Regressive (AR), (2) Moving Average (MA), and (3) mixed Auto-Regressive Moving Average (ARMA), which is also known as Auto-Regressive Integrated Moving Average (ARIMA). Identification of the correct model type is made by examining the auto-correlation coefficients. If the correct model is fitted into the data the residuals must be randomly distributed around the model, therefore their auto-correlation should be small with no pattern in them. This has to be achieved in stage 2, before one can proceed to stage 3, in figure 7.1.

An ARIMA model has three structural parameters, p, d and q. The structural parameter p indicates an auto-regressive relationship, that is the number of past observations used to predict the current observation. The structural parameter q denotes the number of moving average structures in the model; and finally, the structural parameter d indicates that the time series was differenced, ie, the first observation is subtracted from the second, the second observation is subtracted from the third, and so on. Model identification referred to in stage one of figure 7.1 refers to the empirical procedures by which the most appropriate set of structural parameters (p, d and q) are selected from a given time series. This means that the researcher will have to know how many times to difference the data (d), how many auto-regressive (p) and/or moving average parameters (q) to estimate for a set of data. This model identification is a cumbersome task. However, once a correct model has been developed it can be quite easily and in a routine manner, used to generate additional forecasts.

7.33 Quasi-Experimentation

In earlier sections it has been suggested that Dummy Variables are appropriate for qualitative factors when no observations on these factors are available. The Box-Jenkins ARIMA method though powerful is cumbersome, and is appropriate for forecasting purposes. Cumulative Average Residuals (CAR) is inappropriate when there is the likelihood of changes in relative risk. The nature of our sample is such that perfect matching is difficult, if not impossible. The purpose of our research is to investigate changes in systematic risk in the event of an interruption. For these two reasons quasi-experimentation of a regression discontinuity type is appropriate.

A genuine comparative experiment requires that the experimentor manipulate two or more experimental conditions by assigning them at random - either simply or restrictedly - to the experimental units (or, what is the same, he assigns the experimental units at random to the experimental conditions). Randomization guarantees that before the experiment begins, the means of the various conditions for any variable will differ only randomly. Such randomization forms the basis for tests of statistical significance.

If the experimentor cannot or does not assign his experimental units at random to his experimental treatments, he performs something other than a "true" experiment.

Using the analysis of variance or 't' test does not change a status study into an experiment; the design of an investigation, rather than the analysis, distinguishes experiments from non-experiments.

Campbell and Stanley(1963), p 34 describe quasi-experimental designs as follows:-

"There are many natural social settings in which the research person can introduce something like experimental design into his scheduling of data collection procedures (eg, the when and to whom of measurement), even though he lacks full control over the scheduling of experimental stimuli (the when and to whom of exposure and the ability to randomize exposures) which makes a true experiment possible. Collectively, such situations can be regarded as quasi-experimental designs".

7.331 Regression Discontinuity Analysis

In a quasi-experimental setting, regression discontinuity analysis is an appropriate method where perfect matching of the treatment and control group samples is difficult, if not impossible. Thistlethwaite and Campbell (1960), p309 - 310, explain regression discontinuity analysis as follows:-

"While the term "ex-post facto experiment" could refer to any analysis of records which provides a quasi-experimental test of a causal hypothesis, ... it has come to indicate more specifically the mode of analysis in which two groups - an experimental and a control group - are selected through matching to yield a quasi-experimental comparison. In such studies the groups are presumed, as a result of matching, to have been equivalent prior to the exposure of the experimental group to some potentially change inducing event (the "experimental treatment"). If the groups differ on subsequent measures and if there are no plausible rival hypothesis which might account for the differences, it is inferred that the experimental treatment has caused the observed differences. . . . . .

In situations . . . . where exposure to an experimental treatment . . . . is determined by the subject's standing on a single, measured variable, and where the expected effects of the treatment are of much the same nature as would be produced by increasing magnitudes of that variable, examinations of the details of the regression may be used to assess experimental effects. The experimental treatment should provide an additional elevation to the regression of dependent variables on the exposure determiner, providing a steplike discontinuity at the cutting score".

Regression discontinuity analysis does not rely upon matching to equate experimental and control groups, hence it avoids the difficulties of (a) differential regression-toward-the-mean effects, and (b) incomplete matching due to failure to identify and include all relevant antecedent characteristics in the matching process.

The value of the regression-discontinuity analysis is that it provides a more stringent test of causal hypotheses than is provided by the ex-post facto design.

7.332 Time Series Experimental Design

"The 'pretest - posttest' experimental design has never been highly regarded as an experimental technique in the behavioural and social sciences, and for good reasons. The simple pattern of 'observation-treatment-observation of change' which worked so well in the physical sciences is seldom equal to the difficult task of demonstration of causal relationships in the system of human behaviour. In such systems observations must be made repeatedly both before and after the intervention, ie, introduction of the 'treatment' or assumed cause. The change from immediately before to immediately after intervention can then be judged as either the effect of the intervention or merely the progression of an evolving and dynamic process unaffected by the intervention. The assessment of a causal claim can be made more reliably by an extension of the pretest-posttest design known as the 'time series experimental design'".

Glass, Willson and Gottman (1975) p 1

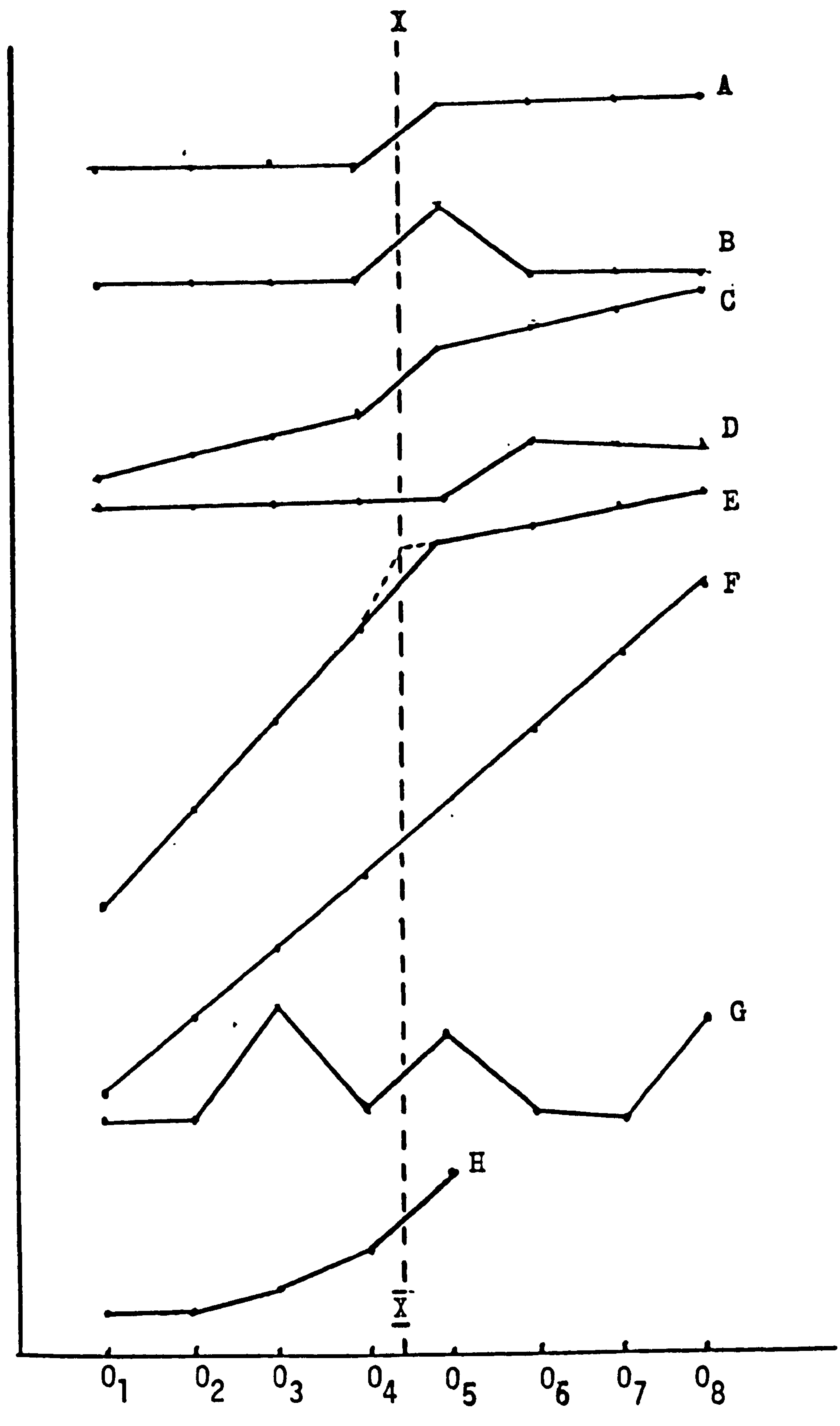
The essence of the time-series design is the presence of a periodic measurement process on some group or individual and the introduction of an experimental change into this time series of measurements, the results of which are indicated by a discontinuity in the measurements recorded in the time series. It can be diagramed thus:

$O_1\ O_2\ O_3\ O_4\ X\ O_5\ O_6\ O_7\ O_8$

Figure 7.2 shows some possible patterns from the introduction of an experimental variable into a time series of measurements.

Figure 7.2

Time Series Measurements



Some Possible Outcome Patterns from the introduction of an Experimental Variable at Point X into a Time Series of Measurements, O_1 - O_8. Except for D, the O_4 - O_5 gain is the same for all time series, while the legitimacy of inferring an effect varies widely.

7.333 Interrupted Time Series Analysis

Analysis of the time series quasi-experiment is a statistical comparison of the pre and post intervention time series segments. This analysis requires a statistical model which might be

$$Y_i = B_{pre} + B_{post} + e_i$$

where,

Y_i = the ith observation of a time series

B_{pre} = the pre-intervention series level

B_{post} = the post-intervention series level

e_i = an error term associated with Y_i

The null hypothesis for this model,

$$H_0 \; : \; B_{pre} - B_{post} = 0$$

states that there is no statistically significant difference between the pre-intervention and post-intervention series levels, that the intervention had no statistically significant impact on the series levels.

7.334 The Moving Regression Method

Having established a hypothesis to be tested in an interrupted time series framework in a quasi-experimental setting, to be able to test this possible discontinuity of systematic risk, a plausible time series will have to be generated. A simple pre-test, post-test series of betas would be inappropriate. Instead a moving regression will be used following Brown, Durbin and Evans (1975), and Collins and Simonds (1979). Brown, Durbin and Evans have described a moving regression as follows :

> "... Another useful way of investigating the time variation of B_t is to fit the regression on a short segment of n successive observations and to move this segment along the series. The graphs of the resulting coefficients against time provide further evidence of departures from constancy ..."
> p 155

The quantities required for each new segment are computed by first adding a new segment to the observation and dropping one from the beginning of the series similar to the moving average process.

A 30 item moving regression programme has been developed following Brown, Durbin and Evans (1975) which will be used in analysing the data. This moving regression programme appears in Appendix VII(D). A 'thirty item' series has been chosen because (i) a series of much smaller number of items will not produce a reliable beta; it will be a very volatile beta likely to be influenced by random items; and (ii) to be able to measure the change in the regression slope over time, and to be able to judge the intervention (change in disclosure practice) effect, there has to be enough data points on either side of the intervention point; a thirty item regression results in approximately 40 items on either side of the intervention time point.

Assuming normal distribution, statistical tests of significance will be performed using Z tests. Pre-intervention and post-intervention betas will be examined to test for significant differences in average betas between the two segments for both the control group and the treatment group.

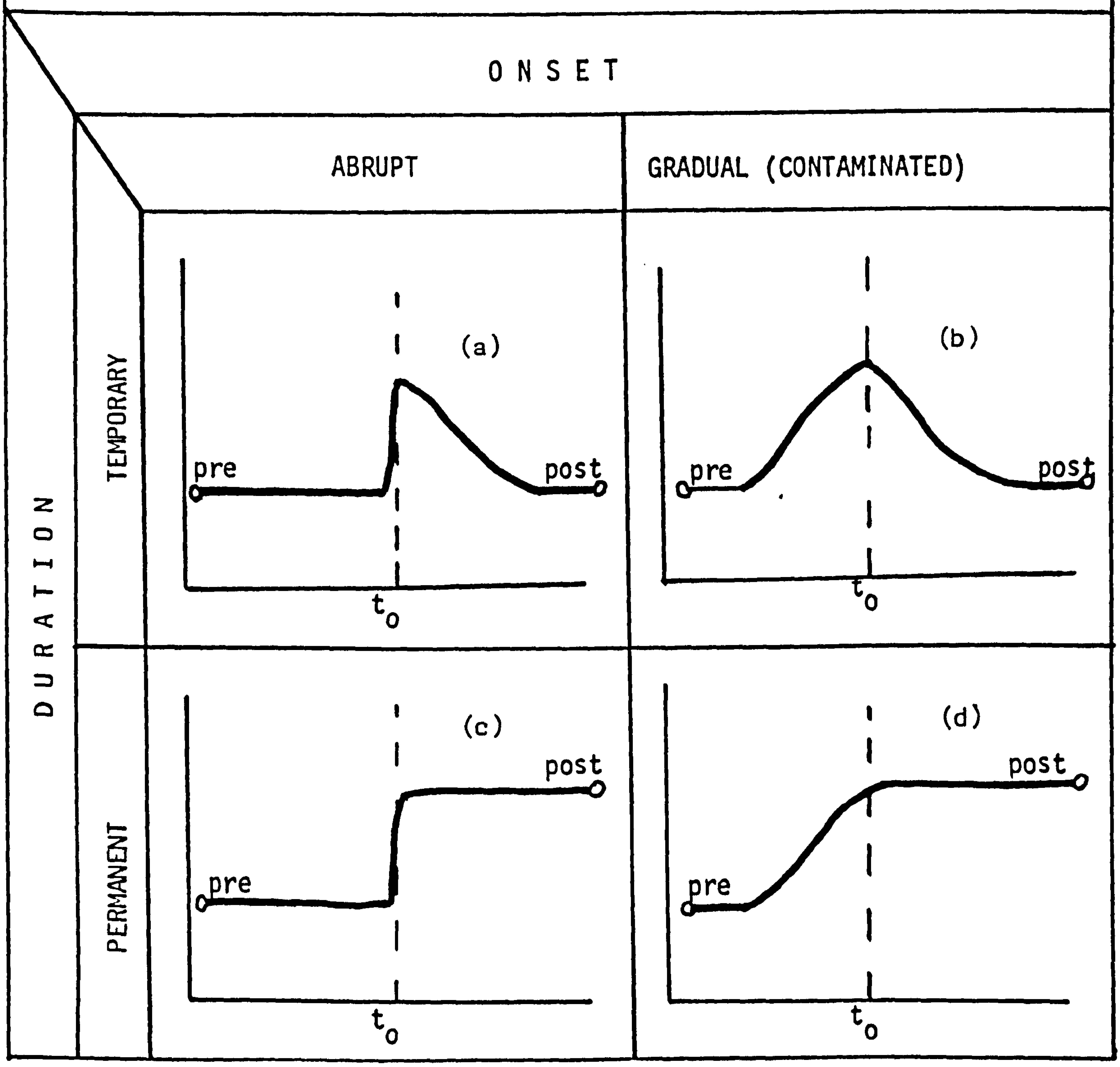
If geographical segmental disclosure is a significant influence on betas, it is envisaged that pre-intervention betas for the treatment group will be significantly different from the control group betas for the pre-intervention period; but post-intervention betas for the treatment and control groups will have no significant differences. This will be a test of the first hypothesis : "segmental geographical disclosure affects systematic risk".

Further, if segmental geographical disclosure is beneficial to the investors, post intervention betas for the treatment group will be significantly smaller than pre-intervention betas for the treatment group. This will be a test of the second hypothesis : "segmental geographical disclosure results in a lower systematic risk".

Having examined the change, if any, in the direction and magnitude of the treatment group moving beta in response to intervention (change in disclosure practice), against the norm of the control group, the duration and onset of such changes will be further explored to see if the duration of the change in beta is temporary or permanent, and if

Figure 7.3

Duration-Onset Analysis



(a) Duration temporary, onset abrupt;

(b) Duration temporary, onset gradual;

(c) Duration permanent, onset abrupt;

(d) Duration permanent, onset gradual.

the onset is abrupt or gradual. Figure 7.3 illustrates the duration-onset analysis of regression slope following McDowall, McCleary, Meidinger and Hay (1980).

Finally, to ensure that such changes, if any, in moving beta are not unduly influenced by confounding variables such as leverage or return on equity, the relationships between these possible confounding variables and betas will be analysed.

7.335 Location of structural change

Structural change in a linear equation can be located with the method of maximum likelihood tests (Mood and Graybill 1963). A more specific measure of structural change in the context of regression analysis is the Quandt's Log-Likelihood Ratio Technique (Quandt, 1958, 1960). This ratio is appropriate when it is believed that the regression relationship may have changed abruptly at an unknown time point $t = r$ from one constant relationship specified by $B^{(1)}$, σ_1^2 to another constant relationship specified by $B^{(2)}$, σ_2^2

If $B^{(1)}$ is the regression slope corresponding to H_0, and $B^{(2)}$ is the regression corresponding to H_1, then this likelihood ratio is computed as follows :

$$\lambda r = \log_{10}\left(\frac{\text{maximum likelihood of the observation given } H_0}{\text{maximum likelihood of the observation given } H_1}\right)$$

Such a ratio has been used by Collins and Simonds (1979) and Brown, Durbin and Evans (1975). The point at which this ratio achieves its minimum is the most likely location of a structural shift in the linear time series relation. However, although maximum likelihood estimates have the desired properties of consistency and efficiency they are biased for small samples (Koutsoyiannis, 1977; Fogler and Ganapathy, 1982). Since the final sample size in this research is 15 in the control group, and 21 in the treatment group, the use of the maximum likelihood test may result in biased results. Maximum likelihood ratios will therefore not be used to locate the structural shift in beta. Visual observation will be used instead.

7.4 Summary

Chapter VII has been concerned with hypotheses, data base and experimental design. First hypotheses have been formulated and stated. The two hypotheses of this thesis are (i) segmental geographical disclosure affects systematic risk; and (ii) segmental geographical disclosure is associated with a lower systematic risk for the disclosing group as a whole.

The database upon which the hypotheses can be tested have then been described. In describing the database selection criteria have been explained prior to describing the companies, the treatment and control groups, the choice of index, and the interval over which observations have been taken.

The design of the experiment has been explained next, where the cumulative average residuals, dummy variables, and Box-Jenkins methods have been explained, and the reasons for their not being selected have been stated. The nature of quasi-experimentation, regression discontinuity analysis and interrupted time series analysis have been explained and their relevance in the measurement of changes in systematic risk in the context of geographical segmental disclosure have been explained. A moving regression method has been explained, a fortran programme for moving regression has been developed, and methods for location of structural change in beta have been explained.

Having thus set the scene for hypotheses testing, such tests will be performed in the next chapter from which results will be obtained and commented upon.

Appendix VII(E) is a summary of data base and experimental design.

7.5 References

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APPENDIX VII(A)

Possible List of Companies

From The Times 1000 largest industrial companies (1981/82) by turnover included are the first 500 companies with the year end December, and export , at least 10% of total sales (except for BP where 9% is accepted because of its overwhelming size). December year end is the most common, 52% of the first 500 had December year end. (Origins are mentioned for non-UK parentage).

Origin if not U.K.	Rank 81/2	Company Name	Activity	Sales £ million Total	Export	%
	1	British Petroleum	Oil	25,347	2,289	9
	4	ICI	Chemicals	5,715	1,173	21
	5	Unilever	Food	4,345	455	10
Holland	7	Shell (UK)	Oil	3,263	666	20
USA	8	Esso Petroleum	Oil	3,219	650	20
USA	10	Ford Motor Co	Vehicle	2,924	852	29
	20	Guest Keen & Nettlefold	Engineering	1,923	193	10
USA	35	C T Bowring	Ins Brokers	1,458	688	47
	37	British Aerospace	Aircraft	1,423	789	55
	39	Dunlop Holdings	Rubber	1,386	149	11
	45	BICC Holdings	Cable	1,281	244	19
	48	Hawker Siddeley	Engineering	1,205	289	24
USA	49	Mobil Oil	Oil	1,201	163	14
	53	Tube Investments	Engineering	1,158	235	20
USA	56	Conoco	Oil	1,102	343	31
USA	66	IBM (UK) Holdings	Computers	954	452	47
	71	Babcock International	Engineering	873	146	17
USA	75	Vauxhall Motors	Vehicles	819	209	26
Holland	76	Phillips Electronics	Electronics	800	177	22
	88	Coats Paton	Yarn	689	71	10
	97	Blue Circle Industries	Cement	637	65	10
	98	Turner & Newall	Asbestos	635	112	18
	102	IMI	Metals	629	139	22
	104	Northern Engineering	Electricals	610	127	21
	110	S Pearson & Son	Newspaper	591	124	21

Origin if not UK	Rank 81/2	Company Name	Activity	Sales £ million Total	Export	%
France	112	Talbot Motor Co	Vehicle	588	189	32
	115	Standard Telephones	Telecom	538	95	18
USA	125	Gulf Oil	Oil	496	89	18
	126	Vickers	Engineering	493	142	29
USA	127	Food Manufacturers (GB)	Food	493	48	10
France	129	Michelin Tyre	Tyre	474	148	31
Belgium	133	Petrofina (UK)	Oil	454	83	18
USA	141	Albright Wilson	Chemicals	412	103	25
Switz	143	Ciba-Geigy (UK)	Chemicals	401	148	37
	144	Fisons	Chemicals	399	47	12
USA	150	Amoco (UK)	Oil	374	105	28
Canada	164	Alcan (UK)	Aluminium	336	92	27
	170	Phillips Imperial Petroleum	Oil	329	63	19
Canada	173	INCO Europe	Nickel Refin	325	191	59
	175	Simon Engineering	Engineering	324	113	35
	186	Guthrie Corporation	Plantation	301	34	11
	188	Carrington Viyella	Textiles	297	40	13
	194	APV Holdings	Engineering	282	43	15
	198	Tricentrol	Exploration	276	66	24
	199	Croda International	Chemicals	276	44	16
	206	Hepworth Ceramic Holding	Clay Pipes	263	35	13
USA	210	Monsanto	Chemicals	256	80	31
USA	220	Foster Wheeler	Engineering	236	73	31
USA	226	General Motors	Automobiles	229	45	20
USA	229	Dupont (UK)	Chemicals	227	78	34
	239	Cape Industries	Bldg Matl	219	26	12
USA	250	Hoover	Appliances	207	29	14
USA	251	Goodyear Tyres	Tyres	206	41	20
	252	Automotive Products	Components	206	55	27
USA	254	Teneco Int Holdings	Agr Equip	204	86	42
	255	Arthur Bell	Whiskey	203	23	11
	263	Laird Group	Metal Ind	194	40	21
	264	Stone Platt	Machinery	193	75	39
	268	London and Northern	Contracting	191	28	15
	286	Bunzl Paper Group	Paper	170	19	11
Canada	287	Tioxide Group	Chemical	168	44	26
	295	Bridon	Wire Ropes	159	33	21

Origin if not UK	Rank 81/2	Company Name	Activity	Sales £ million Total	Export	%
	299	Hunting Assoc Ind	Aviation Supp	155	29	19
	301	Davies & Newman	Shipbrokers	154	29	19
USA	303	Engelhard Industries	Precision Met	153	35	23
	308	Charterhouse Group	Merchant Bank	151	22	15
France	323	May & Baker	Chemicals	141	45	32
USA	328	Dow Chemicals	Chemicals	159	29	18
Sweden	329	Electrolux	Appliances	139	24	17
USA	330	USMC International	Machinery	138	43	31
	331	Aurora Holdings	Engineers	136	22	16
	335	BBA Group	Insulation	135	16	12
USA	337	Cummings Engineering	Diesel Eng	134	101	75
	342	La Porte Industries	Chemicals	128	40	31
	346	Coutinho, Card & Co	Steel, Chemic	127	16	13
	349	Portals Holdings	Papermaking	127	47	37
USA	350	Honeywell	Computers	126	23	18
	351	Twil	Wire Manuf	124	17	14
Italy	352	Pirrelli General Cable	Wire & Cable	124	33	27
	354	Morgan Crucible	Misc, Matl	124	35	28.
	356	Molins	Machinery	123	71	58
USA	368	Borg-Warner	Eng/Chemicals	119	66	55
USA	387	Texas Instruments	Electronic	110	45	41
	394	London & Scottish Marine	Exploration	108	36	33
	398	Andrew Weir	Shipping	106	11	10
	405	Coates Bros & Co	Print/Ink	103	18	17
Switz	415	European Grain & Shipping	Brokers	100	25	25
USA	427	Merck, Sharpe & Dohme	Chemists	96	35	36
Italy	428	Pirelli	Tyres	95	21	22
	432	Central & Sheerwood	Fin Service	94	26	28
USA	441	Ingersoll-Rand Holdings	Engineers	92	48	52
	454	Brown Boveri Kent	Instruments	89	28	31
	463	International Synthetic Rubber	Rubber	88	24	27
	464	M Golodetz	Brokers	87	26	30
	465	Tenants Consolidated	Chemical	87	9	10
USA	471	Lummus & Co	Refinery Eng	86	14	16
Sweden	475	Sandvik	Steel Product	85	12	14
USA	479	Alcoa (GB)	Aluminium	85	16	.19
	491	Frank Fehr & Co	Merchants	82	32	39

Origin if not UK	Rank 81/2	Company Name	Activity	Sales £ million Total	Exp	%
USA	494	Rohm & Haas (UK)	Chemical Manuf	81	53	65
	498	Amalgamated Power Eng	Turbines	81	32	40

Total, 101 companies with December year end in the first 500 of The Times 1,000 largest UK industrial companies (1981/2) by turnover and export sales at least 10% of total.

APPENDIX VII(B).

Treatment Group (21 companies)

Company Number	Name
T1	APV Holdings
T2	Aurora Holdings
T3	Automotive Products
T4	Babcock International
T5	BBA Group
T6	British Petroleum
T7	Bunzl
T8	Cape Industries
T9	Carrington Viyella
T10	Croda International
T11	Dunlop
T12	Fisons
T13	Hepworth Ceramic
T14	Imperial Chemical Industries
T15	Laird Group
T16	La Porte Industries
T17	S Pearson
T18	T I Group
T19	Tricentrol
T20	Unilever
T21	Vickers

(All these companies changed their disclosure practice starting December 1977; from non-disclosure of geographical sales and trading profit to disclosure of geographical sales and trading profit).

APPENDIX VII(C)

Control Group (15 companies)

Company Number	Name
C1	Arthur Bell
C2	BICC
C3	Blue Circle
C4	Bridon
C5	Central and Sheerwood
C6	Coates Brothers
C7	Coats Paton
C8	Davies and Newman
C9	Guthrie Corporation
C10	Hawker Siddley
C11	Hunting Associates
C12	London and Northern
C13	Morgan Crucible
C14	Portals Holdings
C15	Simon Engineering

(All these companies made no change in their disclosure practice during the whole of the period under investigation, ie 1 June 1973 to 1 June 1982).

Appendix VII (D)

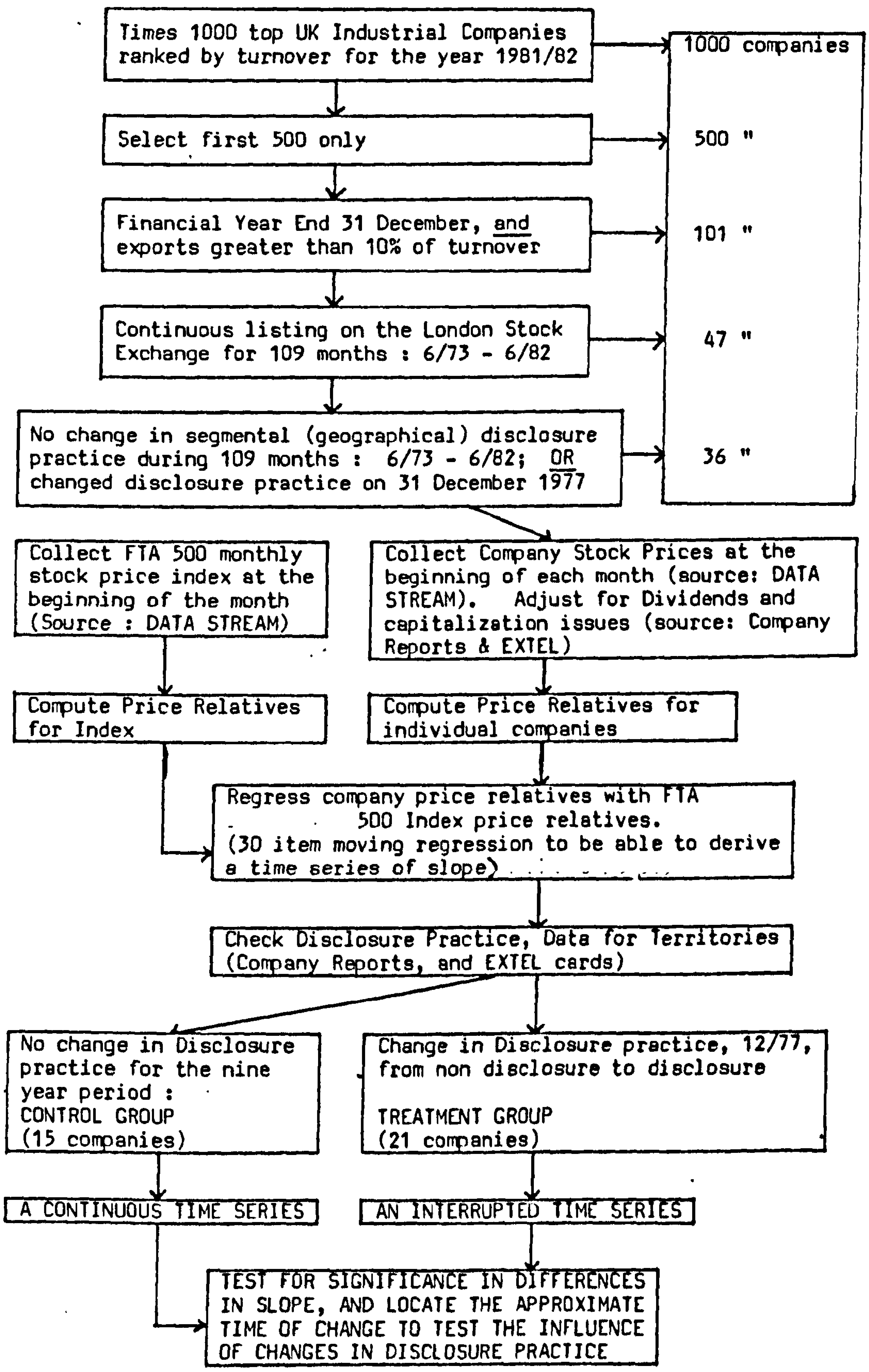
Fortran Programme for Moving Regression

```
Command:LIST BPHOLD
      CHARACTER*80 BUF,BLK
      DIMENSION A(108),B(108)
      DOUBLE PRECISION RES(20),X(30),Y(30),BEES(79),TIME(79)
      DATA BLK/80*' '/
C
C     SET UP TIME AS AN INDEX
C
      DO 21 I=1,79
21    TIME(I)=DBLE(I)
C
C     OPEN UP SEGONE AND READ THE INDEX
C
      OPEN(UNIT=1,FILE='SEGONE')
      DO 1 I=1,108
1     READ(1,101)A(I)
C
C     FOR EACH COMPANY IN THE FIRST FILE
C     READ INTO B
C
      DO 10 IC=1,21
      DO 2 I=1,108
2     READ(1,101)B(I)
C
C     EXTRACT 30 LONG SEGMENTS AND PASS TO NAG
C
      DO 3 IS=1,79
      IOFF=IS-1
      DO 4 I=1,30
      X(I)=A(IOFF+I)
4     Y(I)=B(IOFF+I)
C
C     DO THE REGRESSION (FIRST ORDER)
C
      CALL G02CAF(30,X,Y,RES,IF)
      BEES(IS)=RES(6)
      BUF=BLK
      IX=1+INT(((RES(6)+3)/7)*80)
      BUF(IX:IX)='*'
      WRITE(6,102) IC,BUF
3     CONTINUE
      CALL G02CAF(79,TIME,BEES,RES,IF)
      WRITE(6,103) IC,RES(6),RES(8),RES(10),RES(13),RES(2),RES(4)
10    CONTINUE
      CLOSE(1)
      OPEN(UNIT=1,FILE='SEGTWO')
C
C     FOR EACH COMPANY IN THE SECOND FILE
C     READ INTO B
C
      DO 50 IC=1,15
      DO 42 I=1,108
42    READ(1,101)B(I)
```

```
42    READ(1,101)B(I)
C
C     EXTRACT 30 LONG SEGMENTS AND PASS TO NAG
C
      DO 43 IS=1,79
      IOFF=IS-1
      DO 44 I=1,30
      X(I)=A(IOFF+I)
44    Y(I)=B(IOFF+I)
C
C     DO THE REGRESSION (FIRST ORDER)
C
      CALL G02CAF(30,X,Y,RES,IF)
      BUF=BLK
      IX=1+INT(((RES(6)+3)/7)*80)
      BUF(IX:IX)='*'
      BEES(IS)=RES(6)
      WRITE(6,102) IC,BUF
43    CONTINUE
      CALL G02CAF(79,TIME,BEES,RES,IF)
      WRITE(6,103) IC,RES(6),RES(8),RES(10),RES(13),RES(2),RES(4)
50    CONTINUE
101   FORMAT(10X,F7.0)
102   FORMAT(' COMP',I5,' B PLOT :',A80)
103   FORMAT(' COMP',I5,' B=',F10.5,' STDERR',F10.5,' T=',6F10.5)
      STOP
      END
```

APPENDIX VII(E)

DATA BASE AND EXPERIMENTAL DESIGN - A SUMMARY



CHAPTER VIII

ANALYSES AND RESULTS

CHAPTER VIII

ANALYSES AND RESULTS

Sections

Tables

Figures

8.0 Introduction

Chapter VII has been concerned with hypotheses, database, and experimental design. In chapter VIII analyses will be performed using the database and experimental design explained in chapter VII to test the two hypotheses of this thesis: (i) segmental geographical disclosure affects systematic risk; and (ii) segmental geographical disclosure results in a lower systematic risk than would have been the case without such segmental geographical disclosure. This chapter proceeds as follows:

1. First, individual company moving betas will be computed using the fortran programme earlier cited (section 7.334, and appendix VII(D)). These moving betas will be used to perform cross sectional as well as time series analyses.
2. Moving betas will be examined using nonparametric as well as parametric tests. First nonparametric tests will be performed to see if the treatment group and the control group belong to the same population, assuming no underlying distribution of the moving betas.
3. Parametric tests will then be formed to examine (i) independence (ii) stability and (iii) the impact of intervention on the treatment and control group betas.
4. The time series will be redefined for intervention analysis purposes, and the two hypotheses of this thesis will be examined in the light of intervention analysis.
5. Having tested the hypotheses, a duration-onset analysis will be performed on the beta changes in response to intervention to see if the duration is permanent or

or temporary, and whether the onset is abrupt or gradual.

6. Finally, impact of possible confounding variables will be tested in an attempt to improve the external validity of our results.

First, the moving betas.

8.1 Moving Betas

One of the objectives of this research is to examine the degree of association, if any, between changes in disclosure practices and the systematic risk profiles of UK based multinationals. To be able to examine systematic risk, over time, a time series of betas needs to be generated. Using the database described in section 7.2, and methods described in section 7.334, moving betas were first generated for treatment group companies listed in appendix VII(B), and control group companies listed in appendix VII(C). These moving beta procedure resulted in seventy-nine data points for each of the companies in the treatment group and the control group. Table 8.1 shows the moving betas for the treatment group companies, and table 8.2 shows the moving betas for control group companies. In the generation of these moving betas, the fortran programme listed in appendix VII(D) has been used.

Table 8.1

Moving Betas for Treatment Group Companies.... (i)

Co. / Obs.	1	2	3	4	5	6	7	8	9	10	11	12
1	.86	.04	.91	1.26	.92	.87	.64	.98	.85	.82	.67	.62
2	.86	.03	.91	1.26	.92	.87	.64	.98	.85	.82	.66	.63
3	.86	.04	.92	1.26	.91	.87	.63	.99	.85	.82	.67	.63
4	.86	.04	.91	1.26	.92	.86	.64	1.01	.84	.82	.66	.63
5	.86	.05	.92	1.27	.92	.86	.64	1.01	.84	.82	.66	.63
6	.87	.06	.92	1.27	.92	.86	.65	1.00	.83	.82	.67	.63
7	.94	.06	.97	1.40	1.01	.88	.73	1.07	.89	.90	.77	.68
8	.91	.04	.93	1.41	.99	.88	.71	1.04	.87	.90	.76	.68
9	.90	.01	.91	1.41	.97	.90	.73	1.05	.86	.88	.73	.69
10	.89	.03	.91	1.41	.98	.89	.74	1.04	.88	.90	.73	.70
11	.91	.01	.94	1.36	.96	.92	.75	1.07	.90	.92	.74	.73
12	.90	.00	.93	1.29	.97	.93	.74	1.12	.88	.90	.69	.73
13	.93	-.03	.94	1.27	.98	.91	.76	1.12	.86	.91	.61	.78
14	.95	-.07	.90	1.27	.95	.89	.74	1.11	.90	.90	.60	.78
15	.95	-.03	.92	1.27	.96	.87	.77	1.06	.93	.93	.61	.77
16	.93	-.07	.88	1.31	.96	.85	.77	1.07	.90	.90	.67	.79
17	.91	-.02	.90	1.29	.91	.91	.78	1.05	.94	.97	.65	.79
18	.92	-.03	.90	1.29	.91	.90	.77	1.05	.92	.96	.66	.79
19	.94	-.08	.91	1.28	1.01	.88	.82	1.08	.96	.96	.64	.74
20	.92	-.08	.87	1.30	.98	.88	.82	1.09	.94	.95	.61	.77
21	1.03	.09	1.00	1.88	.75	.67	.88	.94	.90	1.03	1.29	.64
22	.90	.09	1.25	1.77	.87	.51	.84	.94	.83	.97	.92	.35
23	.89	.19	1.36	1.76	.88	.47	.83	.97	.86	1.11	.97	.36
24	.94	.27	1.45	1.49	.67	.43	.82	.81	.99	1.06	.99	.86
25	.93	.28	1.49	1.48	.65	.37	.88	.87	1.05	1.03	1.00	.90
26	.92	.26	1.52	1.54	.87	.43	.93	.92	1.04	.98	1.10	.98
27	.90	.39	1.47	1.49	.97	.42	.80	.87	1.06	1.10	1.02	.90
28	1.09	.38	1.36	1.36	1.03	.36	.76	.79	1.19	1.21	.93	.86
29	1.09	.42	1.39	1.35	1.03	.37	.76	.80	1.16	1.22	.90	.82
30	1.07	.46	1.36	1.39	1.01	.40	.77	.77	1.18	1.15	.87	.84
31	1.03	.42	1.38	1.37	1.01	.40	.75	.77	1.14	1.19	.83	.84
32	1.01	.50	1.38	1.37	1.05	.41	.73	.74	1.15	1.19	.84	.84
33	.93	.50	1.34	1.37	1.11	.42	.70	.70	1.13	1.21	.74	.80
34	.94	.48	1.37	1.35	1.11	.42	.69	.65	1.15	1.22	.79	.81
35	.94	.47	1.38	1.35	1.13	.41	.70	.66	1.15	1.20	.79	.81
36	.92	.45	1.37	1.30	1.12	.45	.63	.65	1.23	1.19	.78	.81
37	.88	.50	1.41	1.30	1.05	.48	.54	.70	1.26	1.14	.67	.82
38	.88	.51	1.40	1.31	1.07	.49	.54	.68	1.28	1.13	.68	.83
39	.89	.58	1.40	1.29	1.13	.46	.50	.69	1.29	1.18	.75	.80
40	.91	.51	1.42	1.19	1.10	.47	.43	.70	1.30	1.13	.76	.77
41	.66	.46	1.12	1.13	1.04	.77	.44	.73	1.16	.89	.77	.57
42	.60	.47	1.09	1.10	1.11	.92	.53	.60	1.07	.80	.83	.57
43	.60	.47	1.00	1.19	1.13	.94	.52	.61	1.12	.76	.82	.58
44	.36	.74	1.27	1.09	1.23	1.04	.51	.43	1.10	.88	.87	.50
45	.32	.59	1.15	1.11	1.25	1.04	.26	.51	1.06	.68	.81	.39
46	.31	.57	1.14	1.11	1.26	1.04	.26	.54	1.02	.69	.79	.40
47	.33	.60	1.10	1.06	1.27	1.01	.27	.55	1.02	.71	.78	.41
48	.27	.55	1.12	1.06	1.23	.99	.34	.44	1.08	.72	.74	.38
49	.22	.42	1.07	1.00	1.18	.98	.32	.45	1.06	.66	.74	.36
50	.19	.39	1.04	1.01	1.17	1.01	.29	.44	1.06	.66	.71	.33
51	.12	.41	1.04	.92	1.21	.98	.35	.44	.95	.63	.78	.35
52	.09	.41	.87	.74	1.11	1.14	.31	.55	.78	.67	.91	.27
53	.09	.45	.52	.81	1.23	1.14	.44	.58	.80	.86	1.07	.34
54	.06	.46	.55	.79	1.22	1.19	.47	.51	.85	.85	1.09	.45
55	.11	.43	.60	.92	1.19	1.20	.42	.53	.90	.83	.97	.54
56	.05	.35	.71	1.04	.97	1.20	.41	.56	.85	.79	1.00	.50
57	- .02	.35	.62	1.03	1.00	1.14	.55	.56	.96	.79	.94	.49
58	- .17	.47	.68	1.07	.93	1.14	.58	.54	.96	.83	.96	.48
59	- .22	.34	.59	1.10	.92	1.16	.61	.48	.97	.82	1.01	.50
60	- .13	.26	.53	1.05	.86	1.21	.65	.51	1.02	.84	.92	.54
61	- .11	.31	.46	1.08	.83	1.22	.64	.52	1.03	.75	.99	.55
62	- .19	.51	.49	1.14	.85	1.26	.60	.49	1.02	.78	.94	.67
63	- .13	.44	.48	1.15	.73	1.32	.61	.47	.88	.70	1.04	.75
64	- .17	.47	.45	1.18	.80	1.30	.63	.47	.97	.75	1.04	.75
65	- .20	.53	.49	1.25	.81	1.32	.65	.46	.99	.78	1.06	.78
66	- .17	.56	.74	1.37	1.25	1.24	.62	.54	1.17	.99	1.04	.84
67	- .01	.64	.79	1.43	1.30	1.17	.69	.59	1.15	1.04	.87	.85
68	- .02	.66	.81	1.43	1.30	1.16	.69	.62	1.14	1.05	.87	.86
69	.02	.67	.84	1.46	1.26	1.16	.70	.66	1.11	1.05	.89	.85
70	.03	.66	.92	1.49	1.26	1.04	.76	.63	1.05	1.07	.89	.88
71	.13	.77	1.18	1.82	1.51	.87	.90	.67	1.28	1.43	.81	1.14
72	.12	.60	1.04	1.64	1.46	.95	.92	.63	1.32	1.47	.77	1.10
73	.19	.85	1.42	1.69	1.54	1.00	.97	.56	1.30	1.36	1.04	1.20
74	.23	.79	1.40	1.69	1.63	.98	.98	.66	1.25	1.29	.97	1.20
75	.26	1.05	1.44	1.79	1.58	.91	1.03	.77	1.23	1.18	.95	1.47
76	.23	1.23	1.38	1.77	1.58	.91	.98	.75	1.27	1.10	.95	1.24
77	.23	1.35	1.41	1.90	1.55	.95	.97	.55	1.32	1.11	1.00	1.32
78	.22	1.58	1.39	1.97	1.61	.97	.98	.66	1.33	1.15	.97	1.43
79	.25	1.68	1.38	1.99	1.65	.97	.99	.65	1.34	1.19	.94	1.43

Table 8.1

Moving Betas for Treatment Group Companies.... (ii)

Co. / Obs.	13	14	15	16	17	18	19	20	21	Ave
1	.90	.81	.85	.82	1.34	.84	1.20	.84	.91	.85
2	.90	.81	.85	.82	1.34	.84	1.22	.84	.91	.86
3	.90	.81	.86	.86	1.35	.84	1.21	.84	.92	.86
4	.90	.81	.87	.85	1.35	.84	1.21	.84	.92	.86
5	.90	.81	.87	.86	1.35	.84	1.20	.84	.93	.86
6	.90	.81	.88	.86	1.34	.84	1.21	.84	.93	.86
7	1.01	.90	.99	.92	1.42	.92	1.33	.90	1.05	.94
8	.99	.89	.98	.92	1.41	.91	1.34	.90	1.04	.93
9	.99	.90	.96	.92	1.40	.90	1.33	.91	1.04	.92
10	.98	.91	.97	.92	1.40	.90	1.32	.92	1.03	.93
11	1.02	.93	1.01	.97	1.52	.93	1.30	.92	1.03	.94
12	1.04	.93	.97	.94	1.52	.96	1.26	.92	.95	.93
13	1.05	.96	.99	.93	1.51	.98	1.23	.93	.99	.94
14	1.07	.97	1.04	.95	1.52	.94	1.26	.92	.99	.94
15	1.09	.96	1.05	.97	1.51	.95	1.27	.91	.99	.94
16	1.09	.95	1.04	.95	1.49	.98	1.22	.89	.98	.93
17	.99	.99	1.06	.98	1.52	.97	1.19	.86	1.02	.94
18	.99	.98	1.07	.99	1.52	.96	1.17	.85	1.02	.93
19	1.01	.95	1.05	.95	1.52	.96	1.20	.91	1.05	.94
20	1.00	.95	1.04	.94	1.51	.95	1.17	.93	1.02	.93
21	1.13	.88	1.40	1.15	.95	1.13	1.20	.75	1.06	1.02
22	1.03	.86	1.33	1.06	.75	.92	.74	.77	.96	.89
23	1.19	.86	1.27	1.01	.74	.89	.71	.80	.93	.91
24	1.29	.97	1.46	.99	.80	.81	.71	.78	.94	.93
25	1.36	.95	1.53	1.03	.84	.85	.87	.81	.98	.96
26	1.45	.97	1.46	1.00	.91	.83	.80	.87	1.02	.99
27	1.41	.97	1.45	.96	.97	.77	.85	.82	.98	.98
28	1.46	1.00	1.46	.97	.92	.87	1.12	.76	1.04	1.00
29	1.45	1.00	1.46	.95	.94	.84	1.15	.73	1.00	.99
30	1.49	.99	1.48	.97	.94	.85	1.18	.75	1.01	1.00
31	1.49	1.02	1.46	1.00	.99	.83	1.19	.74	1.00	.99
32	1.51	1.02	1.52	.98	1.01	.85	1.22	.72	1.02	1.00
33	1.53	.96	1.54	.89	.96	.87	1.25	.69	1.00	.98
34	1.54	.98	1.54	.90	.96	.87	1.30	.69	1.01	.99
35	1.54	.98	1.53	.91	.95	.89	1.30	.69	1.02	.99
36	1.58	1.01	1.44	.90	.95	.90	1.30	.68	.93	.98
37	1.60	.99	1.40	.93	1.02	.88	1.07	.67	.93	.96
38	1.59	1.00	1.39	.94	1.01	.89	1.14	.68	.94	.97
39	1.58	1.01	1.45	.94	1.04	.89	1.22	.66	.90	.98
40	1.59	1.02	1.39	.92	1.02	.92	1.30	.66	.88	.97
41	1.68	.92	1.23	.78	1.08	.89	1.23	.56	.80	.90
42	1.63	.89	1.27	.77	1.08	.83	1.39	.59	.69	.96
43	1.69	.91	1.41	.73	1.07	.84	1.37	.62	.66	.91
44	1.84	.80	1.26	.64	1.13	1.00	.96	.57	.67	.90
45	1.70	.88	1.31	.52	1.24	.97	.89	.72	.66	.86
46	1.72	.91	1.32	.52	1.25	.94	.87	.72	.65	.86
47	1.72	.92	1.32	.53	1.24	.93	.84	.74	.65	.86
48	1.68	.96	1.31	.65	1.24	.98	.65	.77	.83	.86
49	1.62	.96	1.18	.62	1.18	.97	.65	.76	.80	.82
50	1.60	.95	1.17	.62	1.18	.97	.66	.77	.79	.81
51	1.56	.95	1.34	.73	1.19	.99	.68	.74	.94	.82
52	1.44	.98	1.22	.73	1.25	1.11	1.08	.68	1.02	.83
53	1.34	.93	1.20	.86	1.22	1.14	1.21	.63	1.14	.86
54	1.39	.86	1.16	.91	1.30	1.16	1.29	.65	1.15	.87
55	1.40	.85	1.13	.89	1.27	1.14	1.25	.64	1.22	.88
56	1.27	.86	1.04	.83	1.22	1.09	1.28	.62	1.33	.86
57	1.33	.85	1.14	.81	1.22	1.13	1.08	.61	1.40	.86
58	1.37	.89	1.18	.82	1.23	1.19	1.01	.60	1.47	.87
59	1.35	.88	1.17	.84	1.19	1.21	.90	.63	1.53	.86
60	1.33	.85	1.13	.80	1.16	1.15	.99	.59	1.56	.84
61	1.28	.79	1.12	.74	1.08	1.17	.93	.62	1.57	.84
62	1.20	.77	1.02	.78	1.05	1.19	.96	.70	1.52	.85
63	1.17	.78	.88	.72	1.00	1.13	1.01	.71	1.52	.83
64	1.21	.71	.91	.73	.99	1.21	.96	.74	1.55	.84
65	1.23	.71	.95	.75	.98	1.22	.95	.75	1.56	.86
66	1.18	.93	1.01	.98	1.02	1.26	.75	.78	1.74	.94
67	1.22	.96	.99	.94	.98	1.37	.84	.75	1.71	.97
68	1.24	.97	.99	.92	1.00	1.39	.76	.72	1.74	.97
69	1.24	.96	1.01	.93	1.01	1.41	.73	.73	1.74	.97
70	1.27	.91	1.07	.96	1.03	1.46	.61	.75	1.86	.98
71	1.14	1.11	1.08	1.18	.96	1.63	.80	.96	2.20	1.12
72	1.01	1.13	1.04	1.20	.92	1.51	.93	.99	2.14	1.09
73	1.09	1.13	1.08	1.33	.97	1.52	.89	.98	2.19	1.16
74	1.06	1.13	1.09	1.40	.98	1.49	1.03	1.04	2.21	1.17
75	1.17	1.18	1.09	1.48	.96	1.59	.92	.99	2.27	1.21
76	1.15	1.11	1.15	1.47	.83	1.66	1.05	.92	2.20	1.19
77	1.20	1.09	1.13	1.47	.83	1.70	1.11	.86	2.18	1.20
78	1.25	1.07	1.12	1.34	.79	1.72	1.36	.81	2.09	1.23
79	1.29	1.06	1.11	1.34	.81	1.75	1.34	.79	2.11	1.24

Table 8.2

Moving Betas for Control Group Companies

Observation No.	COMPANY NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Average
1	.87	.90	1.12	.96	.93	1.03	.87	.58	.55	1.03	.82	.95	1.12	.64	1.00	.89
2	.88	.90	1.12	.96	.95	1.03	.87	.58	.55	1.03	.82	.85	1.12	.64	1.00	.89
3	.88	.90	1.11	.95	.94	1.05	.86	.56	.57	1.04	.82	.95	1.11	.63	1.00	.89
4	.89	.91	1.11	.96	.95	1.05	.87	.54	.56	1.03	.83	.86	1.11	.63	1.01	.89
5	.89	.91	1.11	.95	.94	1.05	.87	.55	.56	1.03	.83	.96	1.10	.63	1.01	.89
6	.89	.91	1.12	.94	.95	1.04	.87	.54	.57	1.04	.83	.96	1.11	.62	1.01	.89
7	.96	.98	1.21	1.05	1.01	1.09	.87	.61	.63	1.13	.89	1.05	1.18	.70	1.12	.97
8	.96	.97	1.19	1.04	.99	1.09	.89	.56	.63	1.13	.86	1.02	1.17	.70	1.11	.95
9	.97	.96	1.19	1.04	.95	1.09	.90	.56	.63	1.12	.86	1.01	1.16	.68	1.11	.95
10	.97	.97	1.19	1.04	.97	1.09	.91	.55	.65	1.13	.85	1.01	1.15	.68	1.09	.95
11	.93	1.00	1.22	1.05	.90	1.12	.94	.53	.68	1.15	.87	1.01	1.21	.67	1.12	.95
12	.86	1.01	1.21	1.05	.80	1.13	.96	.45	.71	1.12	.84	.93	1.17	.70	1.09	.93
13	.83	1.01	1.20	1.08	.79	1.14	.97	.46	.73	1.13	.88	.97	1.18	.73	1.11	.95
14	.81	.98	1.25	1.07	.72	1.11	.98	.42	.67	1.08	.86	1.00	1.16	.70	1.11	.93
15	.82	.99	1.26	1.05	.74	1.12	.98	.36	.67	1.11	.92	1.00	1.17	.73	1.13	.94
16	.78	.99	1.25	1.05	.74	1.12	.97	.32	.67	1.11	.90	.99	1.16	.71	1.11	.92
17	.74	1.02	1.28	1.11	.69	1.11	.96	.31	.69	1.13	.86	1.02	1.16	.71	1.16	.93
18	.75	1.02	1.28	1.11	.70	1.11	.96	.33	.70	1.14	.85	1.02	1.17	.71	1.17	.93
19	.74	1.02	1.26	1.15	.60	1.09	.93	.29	.71	1.09	.82	1.04	1.15	.69	1.17	.92
20	.74	1.02	1.27	1.13	.62	1.08	.92	.29	.71	1.08	.80	1.05	1.15	.70	1.15	.91
21	.72	1.07	1.23	0.89	.47	.74	.85	.60	.97	.94	.76	1.34	1.32	.65	1.04	.91
22	.88	.91	1.43	.87	.44	.66	.94	.14	.65	.89	.85	1.26	1.08	.65	1.01	.84
23	.82	.82	1.43	.96	.50	.65	.92	.17	.70	.85	.84	1.24	1.02	.65	1.02	.84
24	.56	.76	1.42	.96	.64	.62	.86	.43	.68	.94	1.14	1.23	.94	.69	1.09	.86
25	.68	.81	1.49	.86	.77	.63	.91	.42	.73	.97	.97	1.30	.92	.61	1.12	.88
26	.66	.87	1.55	.80	.71	.68	.99	.46	.61	.85	1.01	1.33	.80	.54	1.13	.87
27	.73	.85	1.58	.78	.65	.59	.98	.46	.57	.93	.98	1.27	.77	.52	1.10	.85
28	.71	.88	1.54	.75	.74	.58	.86	.38	.56	.87	1.12	1.31	.84	.69	1.11	.86
29	.73	.87	1.50	.77	.74	.53	.87	.42	.60	.91	1.08	1.28	.87	.67	1.08	.86
30	.72	.88	1.52	.70	.69	.48	.84	.42	.65	.89	1.11	1.28	.89	.66	1.10	.85
31	.70	.84	1.50	.72	.74	.47	.82	.41	.71	.91	1.10	1.25	.86	.63	1.11	.85
32	.71	.81	1.50	.73	.72	.43	.82	.40	.76	.94	1.16	1.17	.84	.66	1.13	.85
33	.75	.78	1.59	.79	.77	.36	.77	.38	.81	.90	1.18	1.24	.82	.68	1.10	.86
34	.73	.75	1.60	.80	.75	.36	.78	.42	.81	.91	1.16	1.20	.82	.68	1.11	.86
35	.74	.74	1.60	.79	.74	.36	.77	.42	.82	.91	1.12	1.19	.83	.70	1.11	.86
36	.82	.70	1.60	.79	.77	.38	.82	.41	.78	.90	1.25	1.14	.78	.75	1.13	.87
37	.85	.68	1.57	.78	.85	.35	.87	.53	.69	.94	1.33	1.10	.74	.74	1.08	.87
38	.86	.68	1.55	.80	.83	.34	.84	.53	.70	.94	1.34	1.13	.75	.76	1.09	.88
39	.89	.70	1.54	.84	.89	.32	.82	.48	.65	.93	1.34	1.03	.75	.78	1.09	.87
40	.84	.67	1.59	.76	.84	.22	.80	.48	.68	.87	1.34	1.01	.75	.75	1.08	.85
41	.63	.73	1.67	.69	.70	.43	.75	.33	.55	.89	1.25	.93	.63	.87	1.15	.81
42	.94	.65	1.71	.62	.61	.41	.73	.31	.49	1.11	1.23	1.19	.66	.80	1.20	.84
43	1.04	.69	1.74	.56	.45	.43	.65	.22	.40	1.19	1.26	1.19	.62	.78	1.21	.83
44	1.03	.83	1.65	.47	.83	.48	.65	.54	.56	1.37	1.54	1.18	.63	.86	1.33	.93
45	1.21	.82	1.67	.70	.81	.49	.62	.60	.64	1.39	1.18	1.04	.61	.73	1.28	.92
46	1.21	.82	1.68	.69	.80	.50	.61	.61	.63	1.37	1.19	1.05	.61	.74	1.26	.92
47	1.22	.81	1.66	.65	.78	.51	.62	.62	.63	1.36	1.21	1.06	.61	.73	1.23	.91
48	1.17	.78	1.75	.40	.85	.58	.65	.57	.63	1.34	1.24	.99	.61	.66	1.19	.89
49	1.15	.72	1.71	.34	.81	.55	.61	.52	.62	1.34	1.20	.99	.62	.61	1.15	.86
50	1.16	.71	1.70	.23	.85	.55	.55	.53	.60	1.28	1.20	1.00	.57	.61	1.14	.85
51	1.07	.75	1.79	.29	.80	.61	.61	.43	.64	1.24	1.37	.98	.56	.66	1.11	.86
52	.93	.92	1.50	.39	.78	.54	.36	.11	.80	1.20	1.36	.98	.58	.63	1.18	.82
53	.80	.92	1.42	.57	.81	.57	.47	.21	.53	1.19	1.63	.93	.63	.60	1.12	.83
54	.86	.94	1.44	.51	.96	.62	.49	.23	.49	1.20	1.76	.93	.62	.69	1.07	.85
55	.86	.96	1.44	.68	.86	.55	.41	.22	.45	1.26	1.70	.77	.66	.63	1.04	.83
56	.78	.93	1.40	.77	.92	.55	.56	.32	.37	1.41	1.52	.64	.80	.75	0.94	.84
57	.78	.95	1.41	.89	.91	.53	.50	.28	.30	1.45	1.47	.64	.80	.84	0.96	.85
58	.76	.97	1.45	.93	.85	.65	.54	.32	.22	1.49	1.40	.63	.72	.84	1.04	.85
59	.69	1.02	1.49	.89	.80	.72	.51	.25	.19	1.45	1.47	.64	.66	.88	1.09	.85
60	.65	1.06	1.43	.81	.80	.73	.54	.21	.16	1.45	1.40	.63	.65	.87	1.08	.83
61	.67	1.11	1.46	.79	.70	.72	.57	.19	.08	1.45	1.39	.64	.67	.90	1.05	.83
62	.75	1.11	1.41	.80	.74	.88	.56	.26	.28	1.43	1.35	.75	.78	.93	1.02	.87
63	.66	1.11	1.36	.61	.65	.82	.58	.31	.19	1.42	1.42	.64	.80	.89	0.99	.83
64	.68	1.16	1.38	.54	.77	.81	.67	.50	.27	1.47	1.38	.73	.81	.86	1.01	.87
65	.68	1.19	1.38	.61	.76	.83	.67	.54	.25	1.49	1.48	.73	.83	.86	1.02	.89
66	.77	1.15	1.46	.80	.57	1.08	.66	.42	.28	1.48	1.27	.84	.81	.84	1.19	.91
67	.77	1.15	1.48	.78	.57	1.11	.63	.55	.26	1.52	1.42	.78	.83	.81	1.15	.92
68	.76	1.15	1.49	.73	.62	1.14	.65	.55	.26	1.49	1.39	.78	.84	.80	1.14	.92
69	.75	1.16	1.51	.74	.60	1.14	.65	.55	.27	1.51	1.41	.80	.84	.81	1.16	.93
70	.74	1.23	1.58	.84	.54	1.17	.69	.50	.14	1.58	1.36	.80	.85	.83	1.17	.93
71	.88	1.31	1.56	1.09	.77	1.07	.85	.71	-.03	1.71	1.56	.91	1.08	.80	1.09	1.02
72	.85	1.30	1.51	1.05	.85	1.10	.82	.66	-.02	1.72	1.52	.97	1.04	.84	1.10	1.02
73	.95	1.40	1.53	1.05	.89	.98	.84	.65	.03	1.66	1.30	.94	1.20	.87	1.07	1.02
74	1.00	1.37	1.46	1.19	.98	1.00	.77	.40	.00	1.55	1.35	.89	1.14	.87	1.06	1.00
75	.95	1.33	1.49	.95	.95	1.17	.75	.47	-.11	1.60	1.43	.92	1.15	.86	1.16	1.00
76	.88	1.32	1.55	1.05	1.02	1.10	.79	.41	-.07	1.61	1.37	.90	1.07	.89	1.20	1.01
77	.94	1.35	1.50	1.17	1.05	1.10	.79	.41	-.10	1.56	1.34	.98	1.06	.87	1.17	1.01
78	.99	1.44	1.47	1.39	.95	.99	.72	.42	-.12	1.51	1.51	1.02	1.07	.96	1.12	1.03
79	1.00	1.50	1.46	1.39	1.01	1.03	.74	.44	-.12	1.51	1.62	1.03	1.05	1.02	1.12	1.05

8.2 Testing for Differences in Moving Betas

There are two ways in which differences in betas can be tested: (i) assuming the underlying distributions of betas are known, and is normal; and (ii) assuming that the underlying distribution is not known. In the first case normal distribution tests will be appropriate. If the underlying distribution is not known and no underlying distribution is assumed then 'distribution free', non-parametric tests will be appropriate (Siegel, 1956).

For non-parametric testing, we shall use Kolmogorov-Smirnov two sample test, and for parametric tests 't', tests will be used.

8.21 Nonparametric Test

According to Siegel (1956) the Kolmogorov-Smirnov two-sample test is a test of whether two independent samples have been drawn from the same population. The two-tailed test is sensitive to any kind of difference in the distributions from which the two samples were drawn - differences in location (central tendency), in dispersion, in skewness, in kurtosis, etc.

The two sample test is concerned with the agreement between two cumulative distributions. If the two samples have in fact been drawn from the same population distribution, then the cumulative distributions of both samples may be expected to be fairly close to each other, in as much as they both should show only random deviations from the population distribution. If the two sample cumulative distributions are too far apart at any point, this suggests that the samples come from different populations. Thus, a large enough deviation between the two sample cumulative distributions is evidence for rejecting H_o.

Moving betas for treatment group companies have been averaged across companies over time, and are shown in table 8.1. Similarly, moving betas for control group companies have been averaged across companies and have been shown in table 8.2.

Cumulative frequency percentages of these average betas across companies over time have been compared between treatment and control groups in Kolmogorov-Smirnov test as shown in table 8.3.

Results show that the differences between treatment and control group betas are significant at the 5% level. Figure 8.1 shows the cumulative frequencies for treatment and control group moving betas used in Kolmogorov-Smirnov two sample test.

Table 8.3

Kolmogorov-Smirnov Two Sample Test

Beta values' class intervals	Treatment group cumulative frequency %	Control group cumulative frequency %	Treatment-Control $B_T - B_C$
	$(F_0\ (X))$	$(S_N\ (X))$	(D)
.80 - .84	10	15	- 5
.85 - .89	35	58	-23
.90 - .94	61	81	-20
.95 - .99	84	89	- 5
1.00 - 1.04	89	99	-10
1.05 - 1.09	90	100	-10
1.10 - 1.14	91	100	- 9
1.15 - 1.19	95	100	- 5
1.20 - 1.24	100	100	0

D = maximum $[F_0(X) - S_N(X)]$ = 35-58 = 23% or .23

Critical value of D at 5% level of significance for large samples is given by:-

$$1.36 \left[(n_1 + n_2)/n_1\ n_2\right]^{\frac{1}{2}}$$

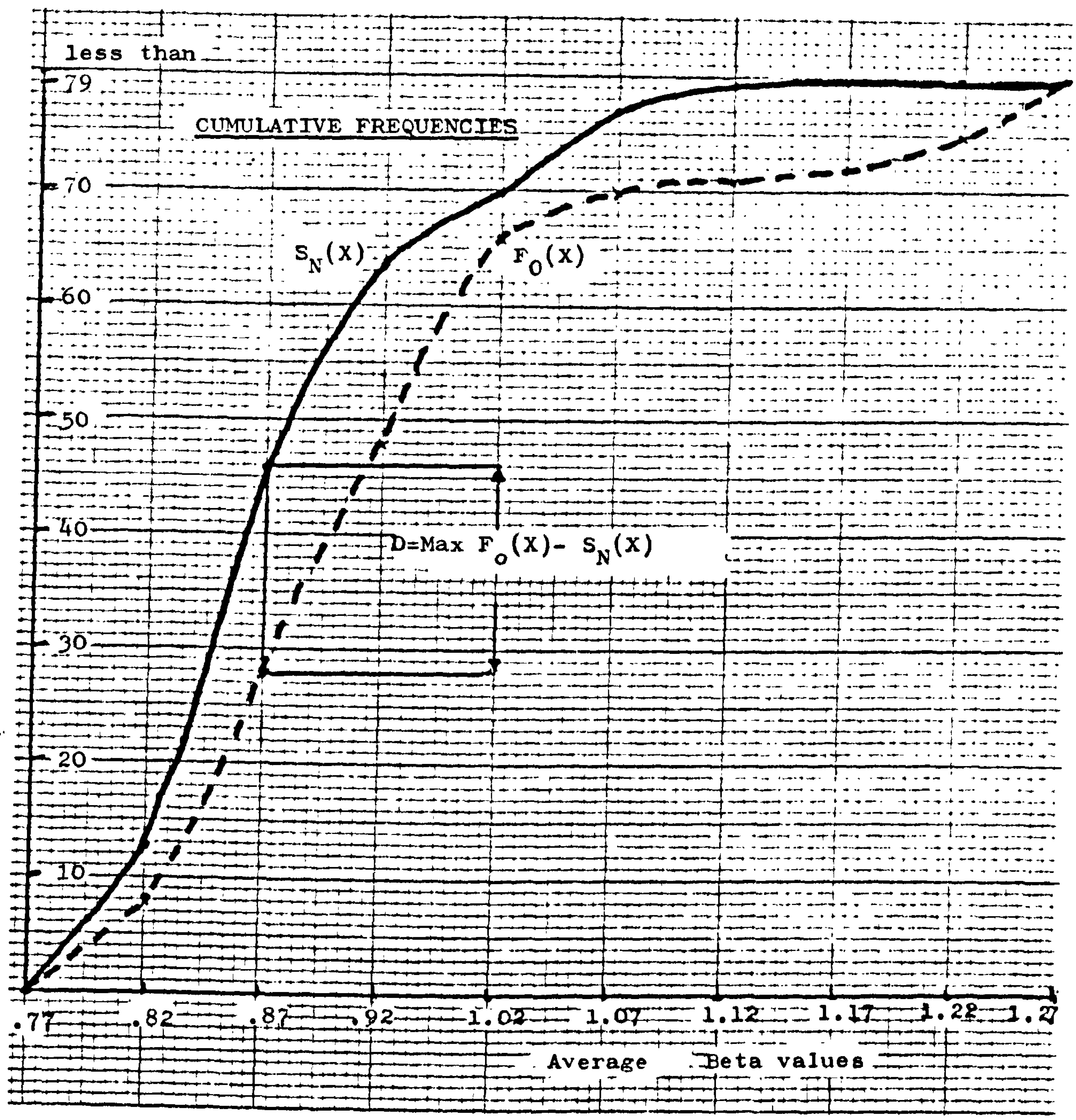
For $n_1 = n_2 = 79$, we get:-

$$1.36\ (158/6241)^{\frac{1}{2}} = .216;$$

Our observed value of D is .23; this is in excess of the critical value of .216; hence H_0 is rejected, at 5% level of significance. The differences between the control and treatment group betas are significant at 5% level. That is there is 95% chance that the differences are real and not random.

Figure 8.1

KOLMOGOROV-SMIRNOV TWO SAMPLE TEST



Since the maximum number of observations in the moving beta is seventynine, the maximum value in less than cumulative frequencies is also seventynine.

D = maximum $F_o(X)$ - $S_N(X)$ = 18/79 = .23, appears at beta value .87, the mid point of the class interval .85 - .89, corresponding to table 8.3.

8.22 Parametric Tests

Parametric tests are tests which assume that the underlying distribution of the data being examined are known. The assumed distributions are usually, though not always, normal.

In the following sections three different parametric tests will be performed: (i) autocorrelation test, to test the independence of successive moving betas; (ii) student's 't' test for testing the stability of moving betas over time; and (iii) tests to ascertain the influence of the intervention variable (change in disclosure practice), on systematic risk by comparing the pre-intervention betas and the post-intervention betas between the treatment and control groups.

The purpose of the first two tests: the serial correlation test and testing for the stability of beta over time is to justify the use of intervention analysis mentioned in section 7.333. It has earlier been stated in section 7.31 that the cumulative average residual method assumes (a) independence of successive betas, and (ii) stability of betas over time. If our first two tests show that successive betas are not independent, and that such betas are not stable, then it will be appropriate for us not to use cumulative average residual method. The use of interrupted time series, and intervention analysis will be justified.

8.221 Testing for Independence

Intervention analysis of the type described in section 7.333 is justified in preference to the cumulative average residual analysis, if, among others, successive observations in the time series are random; i.e., their serial correlation, or autocorrelation function (ACF) is not significantly different from zero. (Sunder, 1973, p.36).

A stationary stochastic process is fully determined by the mean, the variance, and the autocorrelation function (ACF). If two processes have the same mean, variance and ACF, then they are the same process. The autocorrelation function displays the autocorrelation structure of a series Z up to a specified lag, k. The k th order autocorrelation coefficient measures the extent to which Z_t and Z_{t+k} observations move together.

The k th order autocorrelation coefficient is estimated as:

$$R_k = \sum_{t=1}^{T-k} \frac{(Z_t - \bar{Z})(Z_{t+k} - \bar{Z})}{\sigma_z^2} (1/T)$$

where $\bar{Z}$ is the mean of the stationary series

σ_z^2 is the variance of the stationary series, and

T is the number of observations after allowing for lag, i.e. (n-k)

The range for R_k for k = 1 to T-k is ± 1

In more precise terms, for Z_t time series process, the ACF of k th order (lag) is defined as

$$ACF(k) = \text{Covariance}\left[(Z_t,\ Z_{t+k}) \ /\ \text{Variance } Z_t\right] \left(\frac{1}{n-k}\right)$$

The ACF(k) is thus a measure of correlation between Z_t and Z_{t+k}.

As the value of k increases, the confidence in the estimate of ACF(k) diminishes.

Significance tests are often useful in deciding if the estimated autocorrelations are statistically significant from zero.

The standard error (SE) of each R_k indicates the standard deviation of distribution with $R_k=0$ for the sample size (T) used to estimate R_k

$SE(R_k) = (1/T)^{\frac{1}{2}}$ at 95% confidence level (Foster, 1978, p.85)

To test the independence of successive moving betas in the treatment group and in the control group, autocorrelation tests were performed for fifteen observations on either side of the intervention point, t_{40}. Results of the autocorrelation tests are shown in table 8.4, and the detailed computations are shown in appendix VIII(A) and VIII(B).

Results show highly significant autocorrelation for lags 1, 2, and 3 for treatment group, and for lags 1, and 2 for the control group. While it is not surprising that there will be significant autocorrelation in the time series of betas since (i) betas in successive months are influenced by similar causal variables (section 5.521), and (ii) there is a built in autocorrelation in the moving betas since moving betas are in effect a moving average process, what is revealing that the autocorrelation coefficients were much higher for the treatment groups than for control groups. It is possible that because of intervention, i.e. change in disclosure practice, betas of the treatment group companies were significantly influenced by the common factor of intervention.

Table 8.4

Autocorrelation Tests: Summary

	Treatment Group Moving Betas	Control Group Moving Betas	Maximum value at 95% confidence level
$\bar{z}$	.926	.826	
σ_z^2	.00443	.00083	
$Cov_{0,1}$	.1165	.0144	
$Cov_{0,2}$	.1102	.0084	
$Cov_{0,3}$	.0981	- .0014	
$ACF_{(1)}$, T = 29	$\left(\frac{1}{29}\right)\left(\frac{.1165}{.00443}\right)$ = .907	$\left(\frac{1}{29}\right)\left(\frac{.0144}{.00083}\right)$ = .599	.1856
$ACF_{(2)}$, T = 28	$\left(\frac{1}{28}\right)\left(\frac{.1102}{.00443}\right)$ = .888	$\left(\frac{1}{28}\right)\left(\frac{.0084}{.00083}\right)$ = .361	.1890
$ACF_{(3)}$, T = 27	$\left(\frac{1}{27}\right)\left(\frac{.0981}{.00443}\right)$ = .819	$\left(\frac{1}{27}\right)\left(\frac{-.0014}{.00083}\right)$ = -.062	.1925

Autocorrelations are significant at 95% confidence level for treatment group betas for lags 1, 2, and 3; and for control group betas for lag 1, and lag 2.

8.222 Testing for Stability

To test the stability of moving betas for individual companies in the treatment group and in the control group, over the nine year period, as listed in tables 8.1 and 8.2, a slope or beta of moving regression betas was computed for each company, the hypothesis being that if the slope remains constant over time, then the beta of betas will be zero. Any significant deviation from zero will be a sign of instability of betas at the company level.

Appendix VIII(C) shows the beta of betas, their standards errors, and 't' values for regression for each company. Applying a 95% confidence level test, with degrees of freedom, (n-2) = 77, column (D) in appendix VIII(C) shows the accept-reject results of the analyses. These accept-reject results are further analysed in table 8.5 in summary form.

From table 8.5 it can be seen that betas at company level were highly unstable, supporting Meyers (1973a), and Sharpe and Cooper (1972) assertions that betas at company level are likely to be unstable. Of the thirty-six companies tested only eleven (i.e. 31%) showed, at the 95% confidence level, that betas were stable, while twenty-five companies (i.e. 69%) showed that betas were unstable at the 95% confidence level.

A further characteristic of these moving betas which can be observed from table 8.5 is that treatment group betas were relatively more unstable than control group betas at the company level. Control group companies are those which have not changed their disclosure practice, while treatment group companies are those which have changed their segmental disclosure practice during the period of investigation. It is possible to surmise therefore that there might be associations between disclosure practice and systematic risk profiles of companies, betas being measures of systematic risk.

Table 8.5

Stability of Betas at Company Level: Summary

H_o : $B = 0$

D.F. : 79-2 = 77; 't' test at 95% confidence level.

	Reject H_o		Accept H_o		Total	
	No. of Companies	%	No. of Companies	%	No. of Companies	%
Treatment Group	16	76	5	24	21	100
Control Group	9	60	6	40	15	100
Total	25	69	11	31	36	100

Of the total sample of 36 companies, only in the case of 11 companies, beta was seen to be stable at 95% confidence level. However, the proportion companies with stable betas were larger in control group companies than in the treatment group companies. Detailed analysis of company level betas and 't' values for regression appears in appendix VIII(C).

8.223 Testing for Impact of Intervention

Parametric tests in sections 8.221 and 8.222 have shown that moving betas in section 8.1 are serially correlated and are unstable. Since cumulative average residual method assumes that observations in the series are independent and stable, it will be inappropriate to use cumulative average residual method to test the impact of change in disclosure practice on systematic risk. Intervention analysis of the type described in section 7.333 is a possible alternative.

Intervention analysis will be used to test the two hypotheses of this thesis mentioned earlier (section 7.1).

The first hypothesis is that "segmental geographical disclosure affects systematic risk". If this hypothesis is true, then the following will also be true:

(i) For the treatment group companies, at the aggregate level, pre-intervention period average betas will be significantly different from post-intervention period average betas.

(ii) For the control group companies, at the aggregate level, pre-intervention period average betas will not be significantly different from post-intervention period average betas.

The second hypothesis of this thesis is that "segmental geographical disclosure is associated with a lower systematic risk". If this second hypothesis is true then the following will also be true:

(iii) For the pre-intervention period, (when disclosure practices for the treatment group are different from the control group), at the aggregate level, average betas for the treatment group will be significantly larger than the average betas for the control group.

(iv) For the post-intervention period, (when disclosure practices for the treatment group are not different from the control group), at the aggregate level, average betas for the treatment group will not be significantly different from the average betas for the control group.

8.2231 <u>Redefining the Timeseries</u>

To be able to test the impact of intervention (change in disclosure practice) on systematic risk, the time series of betas listed in tables 8.1 and 8.2 were sub-divided into five different groups on eitherside of the intervention point, t_{40}, (December 1977), for both treatment and control groups as follows:

A. $t_1 - t_{39}$, pre-intervention matched by $t_{41}-t_{79}$, post-intervention, with 39 moving average betas to encompass the whole series.

B. Allowing for the possibility that the impact of intervention may be diluted over time, to test the more immediate impact on systematic risk, pre-intervention period was defined as $t_{21}-t_{40}$, and post-intervention period as $t_{41}-t_{60}$, resulting in 20 observations on either side of the intervention point.

C. Further, assuming that there might be over-reaction by the market participants in the immediate neighbourhood of the intervention point, the series (B) above was modified. Five months on either side of the intervention point were omitted to take into account possible contamination, and the pre-intervention period was defined as $t_{21}-t_{35}$, whilst post-intervention period was defined as $t_{46}-t_{60}$. This resulted in 15 observations on either side of the intervention point.

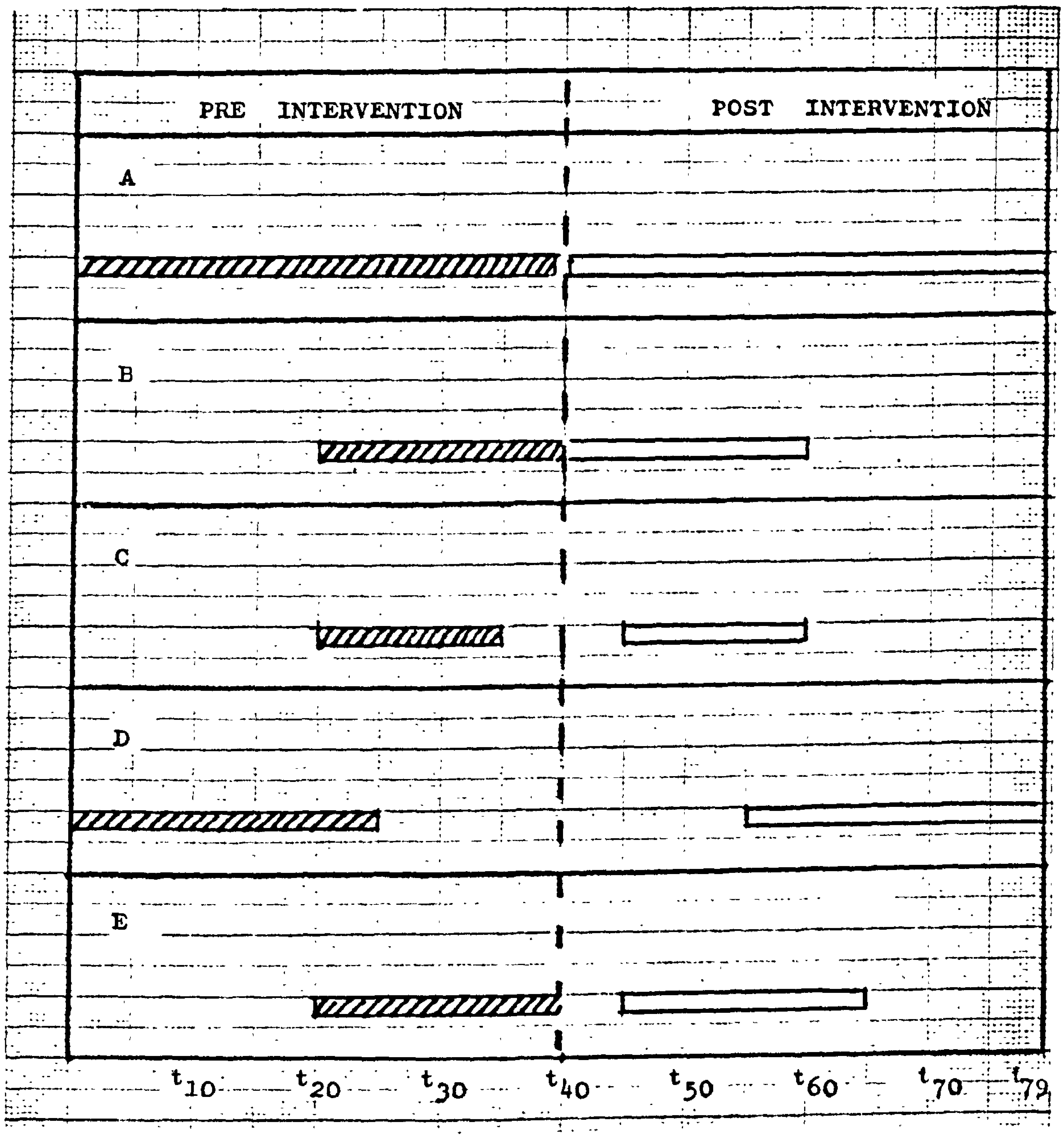
D. To examine the longer term impact of intervention, 15 observations immediately before the intervention, and 14 observations immediately after the intervention were omitted, and the series was redefined. This resulted in t_1-t_{25} as the pre-intervention period and $t_{55}-t_{79}$ as the post-intervention period with 20 observations in each.

E. Finally, assuming no prior knowledge of imminent change in disclosure practice was available to market participants, and allowing for the almost certain possibility that annual results are likely to be made public a few months after the end of the financial year, a five months' lag was assumed after the intervention point. Pre-intervention period was defined as $t_{21}-t_{40}$, the same as series (B) above, but post-intervention period was defined as $t_{46}-t_{65}$, allowing for the lag, resulting in 20 observations in both the pre and the post-intervention periods.

Figure 8.2 is a schematic presentation of the various pre and post-intervention series mentioned above.

Figure 8.2

Redefining the Pre and Post-intervention Series



(A) The whole series: t_1-t_{39}; t_{41}-t_{79}

(B) Immediate impact: t_{21}-t_{40}; t_{41}-t_{60}

(C) Immediate impact and no contamination: t_{21}-t_{35}; t_{46}-t_{60}

(D) Longer term impact: t_1-t_{25}; t_{55}-t_{79}

(E) Lag in publication of results: t_{21}-t_{40}; t_{46}-t_{65}

Having defined the pre and post-intervention series for testing purposes, means and standard deviations of each of these five series were calculated for the treatment group and control group observations. Table 8.6 shows these means and standard deviations which will be used for hypotheses testing purposes.

Table 8.6

Treatment and Control Group Betas: Pre and Post-Intervention

		Treatment		Control		
		Mean	S.D.	Mean	S.D.	N
A.	t_{1-39}	.9421	.0465	.8938	.0377	39
	t_{41-79}	.9470	.1370	.9030	.0720	
B.	t_{21-40}	.9740	.0317	.8770	.0334	20
	t_{41-60}	.8645	.0347	.8585	.0359	
C.	t_{21-35}	.9746	.0366	.8600	.0173	15
	t_{46-60}	.8507	.0212	.8560	.0292	
D.	t_{1-25}	.9176	.0402	.9120	.0352	25
	t_{55-79}	.9932	.1515	.9244	.0783	
E.	t_{21-40}	.9740	.0317	.8770	.0334	20
	t_{46-65}	.8490	.0192	.8566	.0280	

8.2232 Hypotheses Tested

The two hypotheses of this thesis were tested using the means and standard deviations listed in table 8.6 for each of the five series shown in figure 8.2 for both control group betas and for treatment group betas. Results for testing the first hypothesis that "segmental geographical disclosure affects systematic risk" are shown in table 8.7. An examination of table 8.7, "Differences Between Average Betas, Pre-Post" reveals that:

(i) For the treatment group companies, at the aggregate level, average betas were significantly different, at 95% confidence level, in the pre-intervention period when compared with post-intervention period, in series B, C, D and E, but not in series A.

(ii) For the control group companies, at the aggregate level, average betas were not significantly different, at 95% confidence level, in the pre-intervention period when compared with post-intervention period for series A, B, C, and D, and at 98% confidence level for series E.

It is possible to conclude that in the study conducted here, changes in geographical segmental disclosure practices were associated with changes in betas. The lack of significance found in series A in treatment group betas could be explained by the possibility that distant beta values are not as affected by disclosure practice changes as more immediate beta values.

Our first hypothesis appears to be true in all cases except in series A for the treatment group; i.e., in 9 out of 10 possible situations. Results for testing the second hypothesis that "segmental geographical disclosure results in lower systematic risk" are shown in table 8.8: "Differences Between Average Betas, Treatment-Control."

An examination of table 8.8 reveals that:

(i) For the pre-intervention period, at the aggregate level, average betas for the treatment group were significantly larger than control group average betas at 95% confidence level in series A, B, C, and E, but not in series D.

(ii) For the post-intervention period, at the aggregate level, average betas for the treatment group were not significantly different from the average betas for the control group, at 95% confidence level, in series A, B, C, D, and E.

It appears therefore that in 9 out of 10 possible cases, our second hypothesis is true in the investigation carried out here. Possible explanation for series D being out of line lies in the fact that series D includes only distant betas; and as is the case with the first hypothesis, distant betas are likely to be less affected by changes in disclosure practice than more immediate betas.

Table 8.7

Differences Between Average Betas, Pre-Post

Series	Calculated*'t' Values		Degrees of Freedom	't' Values from table	
	Treatment Group	Control Group	(n_1+n_2-2)	5%	2%
A	.2115	.7072	76	1.99	2.36
B	7.8646	1.6849	38	2.02	2.42
C	11.3462	.4566	28	2.04	2.46
D	2.4115	.7281	48	2.01	2.40
E	8.1539	2.0400	38	2.02	2.42

* Detailed calculations for 't' values, 'pre-post' appear in Appendix VIII(D)

(i) For the treatment group, calculated 't' values are significant at 5% level for series B, C, D, and E, but not for series A.

(ii) For the control group, calculated 't' values are not significant at 5% level for series A, B, C, and D. Calculated 't' values for series E is not significant at 2% level.

Table 8.8

Differences Between Average Betas, Treatment-Control

Series	Calculated*'t' Values		Degrees of Freedom	't' values from table	
	Pre-intervention	Post-intervention	(n_1+n_2-2)	5%	2%
A	5.0418	1.7756	76	1.99	2.36
B	9.4175	.5376	38	2.02	2.42
C	10.9560	-.5693	28	2.04	2.46
D	.5234	2.0170	48	2.01	2.40
E	9.4175	-1.0026	38	2.02	2.42

* Detailed calculations for 't' values, 'treatment-control' appears in Appendix VIII(E).

(i) For the pre-intervention period, calculated 't' values are significant at 5% level for series A, B, C, and E, but not for series D.

(ii) For the post-intervention period, calculated 't' values are not significant at 5% level for series A, B, C, D, and E.

8.3 Duration-Onset Analysis

In section 8.21, Kolmogorov-Smirnov test has shown that there are likely to be real differences between treatment and control group betas.

Non parametric test (section 8.21) has shown that differences in betas between the treatment and control group are unlikely to be due to chance. Parametric tests have been used to test the two hypotheses of the thesis: (i) that segmental geographical disclosure affects systematic risk; and (ii) that segmental geographical disclosure results in lower systematic risk.

Analysis of results from 't' tests (section 8.223) show that our two hypotheses are supported. Having concluded that it is likely that segmental geographical disclosure affects systematic risk, and that such systematic risk is likely to be lower as a consequence of improved segmental geographical disclosure, our next step is to establish (i) whether this apparent systematic risk reduction benefit from segmental geographical disclosure is of a temporary or of a permanent nature; and (ii) whether the onset of this apparent systematic risk reduction benefit is an abrupt or a gradual one.

A framework for this duration-onset analysis has been mapped earlier in chapter VII (figure 7.3). To be able to test the duration and onset of changes in systematic risk profiles of treatment group companies as compared with the control group companies, beta differences between the treatment and control group averages were computed (Appendix VIII(F)), and examined (figure 8.3).

An examination of figure 8.3 in the light of figure 7.3 shows (i) that the onset of the change in beta is somewhat abrupt rather than gradual; that market participants are likely to have been taken by surprise, or that there is new information content in segmental geographical data, as shown in change in beta differences at around t_{45} in figure 8.3;

(ii) further that this information is not anticipated, and that there is a lag of around 5 months after the end of the financial year, resulting in a shift of the intervention point from t_{40} to t_{45}.;

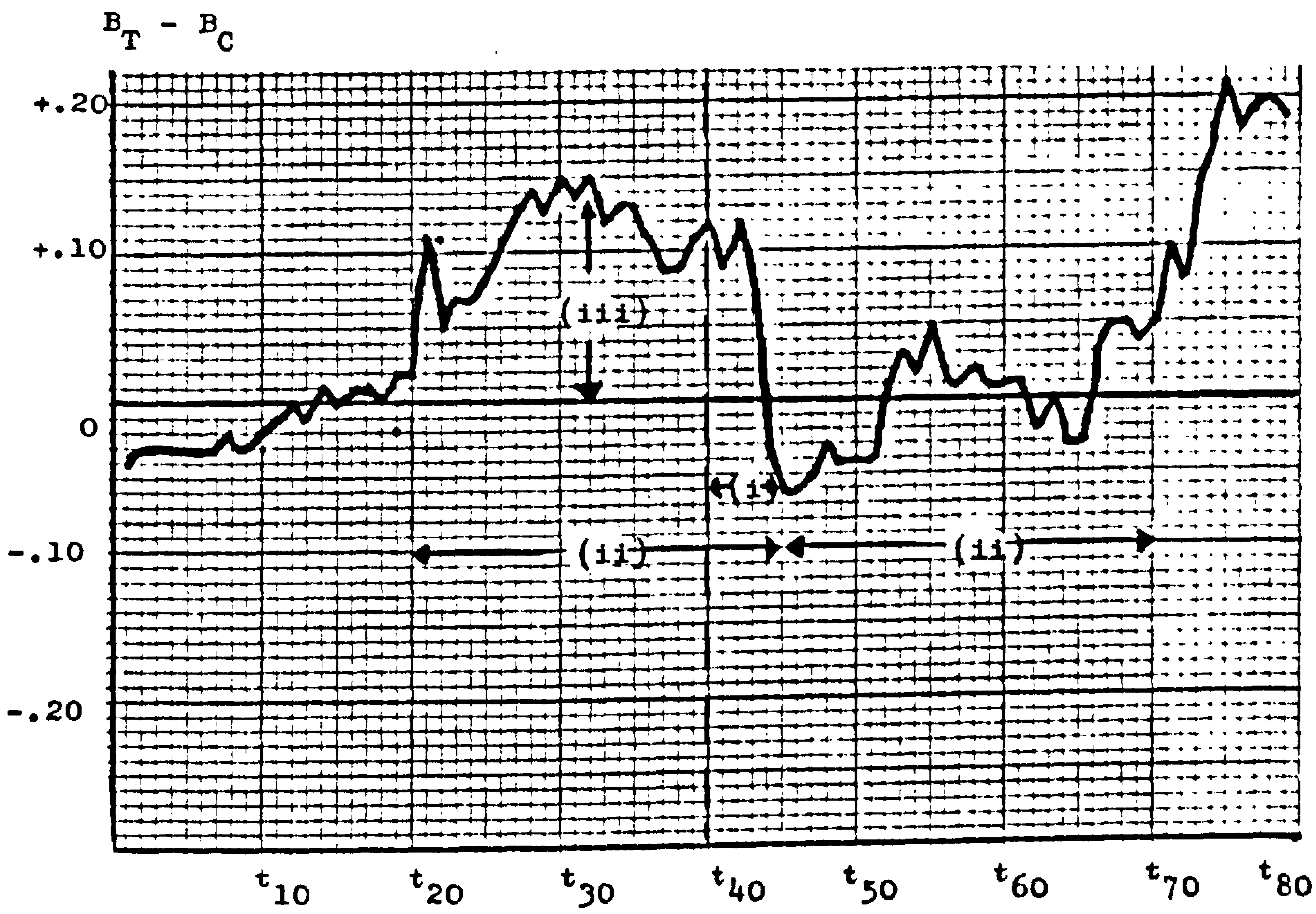
(iii) that the duration of this apparent benefit in the form of reduction in systematic risk is of a semi-permanent nature, lasting for about 25 months after the intervention. After about t_{70} betas seem to drift away. Earlier results from 't' test (section 8.223) have also confirmed this trend in series A and in series D (figure 8.2). A possible explanation of this behaviour of betas in response to intervention could be that once the continuity of finer information disclosure has been established, there is no more new information content in such disclosure. As time passes, other factors tend to dominate. Further research is, however, necessary to explain fully the subsequent drift in betas observed.

Figure 8.3

Differences Between Treatment and Control Group Betas Over Time

B_T: Treatment Group Average Betas

B_C: Control Group Average Betas



(i) The impact of intervention appears to have a lag of approximately five months;

(ii) The impact of intervention appears to last about 25 months;

(iii) The treatment group average betas are noticeably greater than control group betas in the pre-intervention period, but not in the post-intervention period.

8.4 Testing for Confounding Variables

Analyses in earlier sections in this chapter have shown that beta changes and geographical segmental disclosure practices are associated. To minimize the possibility that such associations are influenced by extraneous factors, further tests were carried out to examine associations between systematic risk and possible confounding variables.

Although it is never possible to test for all possible confounding variables, an attempt has been made to test the association between beta and some commonly cited instrumental variables in our samples. If it can be shown that such instrumental variables were not associated with beta changes for the sample companies during the period of current investigation, the reliability of a claim that beta changes are associated with changes in segmental geographical disclosure practices is likely to be improved.

Evidence exists in the literature that some accounting variables are good proxies for instrumental variables influencing beta changes (Beaver, Kettler and Scholes, 1970; Hamada, 1972; Foster, 1975; and others). A summary of some of the major investigations testing the association between systematic risk and various accounting variables cited in the literature appears in Appendix VIII(G). A closer examination of these variables show that there are two important groups of accounting variables which are seen to be associated with systematic risk. These are (i) rates of return on equity and (ii) financial leverage.

Accordingly, associations between these two accounting variables and systematic risk were tested for each of the companies in the treatment group and in the control group for pre-intervention and post-intervention periods.

Following steps were taken to perform this analysis of association between systematic risk and the two accounting variables:

(a) For each company in the control group and in treatment group, financial leverage and rates of return on equity were computed from the annual accounts and EXTEL cards (section 7.2).

(b) Equity was defined as share capital plus reserves plus deferred tax liability.

(c) Return to equity holders was defined as pretax profits available to ordinary shareholders.

(d) Rates of return on equity was defined as the ratio of (c)/(b).

(e) Debt was defined as long term loans plus bank borrowing.

(f) Financial leverage was defined as the ratio of (e)/(b+e).

(g) To allow for two equal segments in the pre and post-intervention regime, to minimize the impact of possible contamination, and to give recognition to the possibility that annual accounts are not likely to be published immediately after the financial year end, data for the year end 1977 (the intervention point) were left out. Pre-intervention period was defined as 1973-1976 inclusive, and post-intervention period was defined as 1978-1981 inclusive, giving us four years in each segment.

Table 8.9 shows the financial leverage, beta, and return on equity for each of the companies in the treatment group and in the control group for pre-intervention period average and post-intervention period average. Linear regression analysis was then performed between:

(i) average beta and average financial leverage for pre-post values;

(ii) average beta and average rates of return on equity for pre-post values.

Table 8.10 shows the regression results, 't' values and tests of significance. It can be seen from table 8.10 that associations between beta and rates of return on equity were not significant at 95% confidence level either for the treatment group or for the control group; associations between beta and financial leverage for the control group was not significant at 95% confidence level, but was significant at 95% for the treatment group. At 99% confidence level association between financial leverage and beta for the treatment group was not significant.

For the control group, the 't' values from statistical tables, for degrees of freedom, n-2=13, at 95% confidence level is 2.17. Our calculated 't' values are .70 for financial leverage and 1.36 for rates of return on equity, both of which are smaller than the value indicated by the statistical table value. Hence it is concluded that there is no evidence that beta changes at the company level were influenced significantly by changes in the financial leverage or by changes in the rates of return on equity during the period of investigation.

For the treatment group, the 't' values from statistical tables, for degrees of freedom, n-2=19, at 95% confidence level is 2.10; and at 99% confidence level is 2.87. Calculated 't' values are 2.79 for financial leverage, and .58 for rates of return on equity. Hence for financial leverage, the calculated 't' value is significant at 95% confidence level, but not at 99% confidence level. For rates of return on equity, the calculated 't' value is not significant at 95% confidence level. Hence it is concluded that for the treatment group beta changes and changes in rates of return are unlikely to be associated; but there is a small chance that there may be some association between beta changes and changes in financial leverage, but this possible association is not strong.

It is concluded, therefore, that at the company level, the confounding variables which we have identified were unlikely to have been responsible for changes in betas. Hence, our earlier findings (section 8.223) relating changes in segmental disclosure practice with changes in systematic risk stands. We can reasonably conclude that changes in geographical segmental disclosure practice were associated with changes in systematic risk of companies in the treatment group. Changes in geographical segmental disclosure are likely to have been associated with changes in the systematic risk perceived by investors in the disclosing companies.

Table 8.9

Financial Leverage, Beta, and % Return on Equity

Companies		Financial Leverage (x)			Beta (y)			% Return on Equity (z)		
		Pre	Post	Pre-Post	Pre	Post	Pre-Post	Pre	Post	Pre-Post
	T 1	.40	.24	.16	.93	.12	.81	38	23	15
	T 2	.40	.66	-.26	.19	.63	-.44	22	17	5
	T 3	.27	.25	.02	1.15	.93	.22	19	10	9
	T 4	.51	.39	.12	1.37	1.27	.10	27	18	9
	T 5	.41	.32	.09	.97	1.21	-.24	32	14	18
	T 6	.23	.38	-.15	.66	1.08	-.42	68	78	-10
	T 7	.34	.16	.18	.72	.61	.11	35	17	18
	T 8	.27	.18	.09	.92	.56	.36	26	13	13
	T 9	.45	.35	.10	1.00	1.08	-.08	15	8	7
Treatment Group	T10	.42	.26	.16	1.01	.91	.10	44	14	30
	T11	.42	.44	-.02	.78	.91	-.13	16	4	12
	T12	.44	.39	.05	.74	.73	.01	24	10	14
	T13	.29	.20	.09	1.21	1.37	-.16	24	22	12
	T14	.37	.33	.04	.94	.94	.00	30	17	13
	T15	.43	.24	.19	1.21	1.14	.07	35	26	9
	T16	.39	.24	.15	.94	.91	.03	22	17	5
	T17	.35	.36	-.01	1.19	1.08	.11	21	25	-4
	T18	.38	.23	.15	.90	1.23	-.33	23	12	11
	T19	.59	.45	.14	1.16	.98	.18	15	42	-27
	T20	.35	.27	.08	.81	.74	.07	33	23	10
	T21	.29	.33	-.04	.98	1.33	-.35	22	10	12
	C 1	.51	.24	.27	.81	.89	-.08	32	30	2
	C 2	.35	.22	.1	.89	1.05	-.16	21	28	-7
	C 3	.26	.18	.08	1.36	1.53	-.17	16	18	-2
	C 4	.44	.29	.15	.92	.76	.16	36	9	27
	C 5	.37	.43	-.06	.78	.79	-.01	27	17	10
Control Group	C 6	.13	.12	.01	.79	.78	.01	32	20	12
	C 7	.32	.28	.04	.89	.64	.25	29	21	8
	C 8	.42	.36	.06	.44	.42	.02	37	17	20
	C 9	.41	.28	.13	.67	.30	.37	18	12	6
	C10	.29	.19	.10	1.00	1.42	-.42	29	24	5
	C11	.39	.38	.01	.98	1.40	-.42	39	33	6
	C12	.46	.30	.16	1.10	.88	.22	32	22	10
	C13	.44	.28	.16	1.01	.79	.22	28	22	6
	C14	.26	.22	.04	.68	.81	-.13	27	28	-1
	C15	.32	.30	.02	1.09	1.12	-.03	33	30	3

Table 8.10

Regression Analysis and Tests of Significance for Confounding Variables

(Financial Leverage, Beta, and % Return on Equity at the Company Level)

		Treatment Group (Pre-Post)	Control Group (Pre-Post)
Degrees of Freedom: n-2		19	13
Financial Leverage (x):	$\bar{x}$	.0633	.0870
	σx	.1122	.0828
Beta (y):	$\bar{y}$	.0000	-.0110
	σy	.2850	.2318
% Return on Equity (z):	$\bar{z}$	.0850	.0700
	σz	.1130	.0846
Cov_{xy}		.0172	.0036
Cov_{yz}		.0035	.0069
$r_1 = r_{xy} = Cov_{xy} / \sigma x . \sigma y$		.5392	.1899
$r_2 = r_{yz} = Cov_{yz} / \sigma y . \sigma z$		.1087	.3534
$t_1 = r_1 (n-2)^{\frac{1}{2}} / (1-r_1^2)^{\frac{1}{2}}$		2.79**	.70*
$t_2 = r_2 (n-2)^{\frac{1}{2}} / (1-r_2^2)^{\frac{1}{2}}$		.58*	1.36*
't' Values from table: at	5%	2.10	2.17
	2%	2.54	2.66
	1%	2.87	3.03

* Not significant at 5% level

** Not significant at 1% level

8.5 Summary

Chapter VIII has been concerned with the analysis of data using the database and research design explained, and hypotheses stated in chapter VII. The objective of this chapter has been to test the two hypotheses in the context of intervention. These two hypotheses are (i) segmental geographical disclosure affects systematic risk; and (ii) segmental geographical disclosure is associated with a lower systematic risk on average.

To test these two hypotheses, two series of moving betas have been generated using moving regression method explained in chapter VII. Nonparametric Kolmogorov-Smirnov two sample test has first been applied which has shown that there are real differences between the average means of the control and the treatment groups. Parametric tests have been applied: first tests of independence of successive betas, then stability tests. Results showed significant autocorrelation up to three lags, and that betas at the company level were highly unstable. Since cumulative average residual method assumes independence and stability of individual betas, cumulative average residual method was not pursued, intervention analysis was used instead, to test the hypotheses. Applying intervention analysis it was shown that both the hypotheses of our thesis are likely to be true at 95% significance level.

Duration-onset analysis was then applied to the beta changes to examine if the duration of the supposed benefit of segmental geographical disclosure was permanent or temporary, and whether the onset was abrupt or gradual. It was concluded that the duration was semi-permanent, and the onset was abrupt.

Finally, influences of possible confounding factors were tested. Financial leverage and rates of return on equity were identified as the two likely confounding factors, and their influences on beta changes were tested using correlation tests. Results showed no significant correlation between beta changes and changes in the values of these two possible confounding variables.

It is concluded therefore that segmental geographical disclosure and beta are significantly associated. Internal validity of our tests have been maintained by using both non-parametric and parametric tests. Possible confounding variables have been tested to improve external validity. In chapter 1X implications of our results will be explored.

Appendix VIII(A)

Autocorrelation Test : Treatment Group Moving Betas

(1)	(2)	(3)	(4)	(5)	(6)	cov 01 (3 x 4)	cov 02 (3 x 5)	cov 03 (3 x 6)
t	t_z	$t_z-\bar{z}$	$t_{z+1}-\bar{z}$	$t_{z+2}-\bar{z}$	$t_{z+3}-\bar{z}$	lag 1	lag 2	lag 3
		$\times10^{-2}$	$\times10^{-2}$	$\times10^{-2}$	$\times10^{-2}$	$\times10^{-4}$	$\times10^{-4}$	$\times10^{-4}$
26	.99	6.4						
7	.98	5.4	6.4			34.56		
8	1.00	7.4	5.4	6.4		39.96	47.36	
9	.99	6.4	7.4	5.4	6.4	47.36	34.56	40.96
30	1.00	7.4	6.4	7.4	5.4	47.36	54.76	39.96
1	.99	6.4	7.4	6.4	7.4	47.36	40.96	47.36
2	1.00	7.4	6.4	7.4	6.4	47.36	54.76	47.36
3	.98	5.4	7.4	6.4	7.4	39.96	34.56	39.96
4	.99	6.4	5.4	7.4	6.4	34.56	47.36	40.96
5	.99	6.4	6.4	5.4	7.4	40.96	34.56	47.36
6	.98	5.4	6.4	6.4	5.4	34.56	34.56	29.16
7	.96	3.4	5.4	6.4	6.4	18.36	21.76	21.76
8	.97	4.4	3.4	5.4	6.6	14.96	23.76	28.16
9	.98	5.4	4.4	3.4	5.4	23.76	18.36	29.16
40	.97	4.4	5.4	4.4	3.4	23.76	19.36	14.96
1	.90	- 2.6	4.4	5.4	4.4	- 11.44	- 14.04	- 11.44
2	.96	3.4	- 2.6	4.4	5.4	- 8.84	14.96	18.36
3	.91	- 1.6	3.4	- 2.6	4.4	- 5.44	4.16	- 7.04
4	.90	- 2.6	- 1.6	3.4	- 2.6	4.16	- 8.84	6.76
5	.86	- 6.6	- 2.6	- 1.6	3.4	17.16	10.56	- 22.44
6	.86	- 6.6	- 6.6	- 2.6	- 1.6	43.56	17.16	10.56
7	.86	- 6.6	- 6.6	- 6.6	- 2.6	43.56	43.56	17.16
8	.86	- 6.6	- 6.6	- 6.6	- 6.6	43.56	43.56	43.56
9	.82	- 10.6	- 6.6	- 6.6	- 6.6	69.96	69.96	69.96
50	.81	- 11.6	- 10.6	- 6.6	- 6.6	122.96	76.56	76.56
1	.82	- 10.6	- 11.6	- 10.6	- 6.6	122.96	112.36	69.96
2	.83	- 9.6	- 10.6	- 11.6	- 10.6	101.76	111.36	101.76
3	.86	- 6.6	- 9.6	- 10.6	- 11.6	63.36	69.96	76.56
4	.87	- 5.6	- 6.6	- 9.6	- 10.6	36.96	53.76	59.36
5	.88	- 4.6	- 5.6	- 6.6	- 9.6	25.76	30.36	44.16
$\bar{z}$ = .926 σ^2_z = .00443						.1165	.1102	.0981

Appendix VIII(B)

Autocorrelation Test : Control Group Moving Betas

(1)	(2)	(3)	(4)	(5)	(6)	cov 01 (3 x 4)	cov 02 (3 x 5)	cov 03 (3 x 6)
t	t_z	$t_z-\bar{z}$	$t_{z+1}\bar{z}$	$t_{z+2}\bar{z}$	$t_{z+3}-\bar{z}$	lag 1	lag 2	lag 3
		$\times10^{-2}$	$\times10^{-2}$	$\times10^{-2}$	$\times10^{-2}$	$\times10^{-4}$	$\times10^{-4}$	$\times10^{-4}$
26	.87	0.8						
7	.85	- 1.2	0.8			- .96		
8	.86	- 0.2	- 1.2	0.8		.24	- .16	
9	.86	- 0.2	- 0.2	- 1.2	0.8	.04	.24	- .16
30	.85	- 1.2	- 0.2	- 0.2	- 1.2	.24	.24	1.44
1	.85	- 1.2	- 1.2	- 0.2	- 0.2	1.44	.24	.24
2	.85	- 1.2	- 1.2	- 1.2	- 0.2	1.44	1.44	.24
3	.86	- 0.2	- 1.2	- 1.2	- 1.2	.24	.24	.24
4	.86	- 0.2	- 0.2	- 1.2	- 1.2	.04	.24	.24
5	.86	- 0.2	- 0.2	- 0.2	- 1.2	.04	.04	.24
6	.87	0.8	- 0.2	- 0.2	- 0.2	- .16	- .16	- .16
7	.87	0.8	0.8	- 0.2	- 0.2	.64	- .16	- .16
8	.88	1.8	0.8	0.8	- 0.2	1.44	1.44	- .36
9	.87	0.8	1.8	0.8	0.8	1.44	.64	.64
40	.85	- 1.2	0.8	1.8	0.8	- .96	- 2.16	- .96
1	.81	- 5.2	- 1.2	0.8	1.8	6.24	- 4.16	- 9.36
2	.84	- 2.2	- 5.2	- 1.2	0.8	11.44	2.64	- 1.76
3	.83	- 3.2	- 2.2	- 5.2	- 1.2	7.04	16.64	3.84
4	.93	6.8	- 3.2	- 2.2	- 5.2	- 21.76	- 14.96	- 35.36
5	.92	5.8	6.8	- 3.2	- 2.2	39.44	- 18.56	- 12.76
6	.92	5.8	5.8	6.8	- 3.2	33.64	39.44	- 18.56
7	.91	4.8	5.8	5.8	6.8	27.84	27.84	32.64
8	.89	2.8	4.8	5.8	5.8	13.44	16.24	16.24
9	.86	- 0.2	2.8	4.8	5.8	- .56	- .96	- 2.90
50	.85	- 1.2	- 0.2	2.8	4.8	.24	- 3.36	- 5.76
1	.86	- 0.2	- 1.2	- 0.2	2.8	.24	.04	- .56
2	.82	- 4.2	- 0.2	- 1.2	- 0.2	.84	5.04	.84
3	.83	- 3.2	- 4.2	- 0.2	- 1.2	13.44	.64	3.84
4	.85	- 1.2	- 3.2	- 4.2	- 0.2	3.84	5.04	.24
5	.83	- 3.2	- 1.2	- 3.2	- 4.2	3.84	10.24	13.44
$\bar{z}$ = .862 σ_z^2 = .0083						.0144	.0084	- .0014

APPENDIX VIII(C)

Company Analyses of Stability of Betas (H_o: B = 0)

Company	Beta of 30 item moving regression; t_1-t_{79}	Standard error of (A)	't' values for regression (A) / (B)	Accept/Reject H_o at 95% confidence level; D.F : 77
	(A)	(B)	(C)	(D)
Treatment Group				
T 1	- .01597	.00118	13.538	reject
T 2	- .01271	.00101	12.533	reject
T 3	- .00107	.00151	0.707	accept
T 4	.00133	.00131	1.013	accept
T 5	.00636	.00087	7.282	reject
T 6	.00575	.00122	4.702	reject
T 7	- .00003	.00095	0.035	accept
T 8	- .00776	.00063	12.311	reject
T 9	.00392	.00064	6.138	reject
T 10	.00140	.00094	1.487	accept
T 11	.00354	.00059	5.999	reject
T 12	.00365	.00125	2.928	reject
T 13	.00358	.00118	3.031	reject
T 14	.00122	.00046	2.662	reject
T 15	.00026	.00100	0.265	accept
T 16	.00201	.00097	2.063	reject
T 17	- .00534	.00092	5.820	reject
T 18	.00912	.00075	12.162	reject
T 19	.00394	.00098	4.003	reject
T 20	- .00124	.00055	2.248	reject
T 21	.01425	.00151	9.454	reject
Control Group				
C 1	.00043	.00072	.594	accept
C 2	.00454	.00085	5.345	reject
C 3	.00447	.00070	6.365	reject
C 4	- .00191	.00113	1.693	accept
C 5	.00008	.00070	0.121	accept
C 6	- .00091	.00144	.634	accept
C 7	- .00446	.00058	7.664	reject
C 8	- .00053	.00067	.804	accept
C 9	- .00918	.00084	10.890	reject
C 10	.00858	.00078	11.035	reject
C 11	.01014	.00062	16.320	reject
C 12	- .00381	.00081	4.686	reject
C 13	- .00399	.00095	4.186	reject
C 14	.00322	.00036	9.028	reject
C 15	.00053	.00035	1.519	accept

* '-' signs are ignored in 't' values for regression since we are only interested in the absolute values here.

* * 't' values from statistical tables at 95% confidence level for 77 degrees of freedom is 2.00.

Appendix VIII(D)

Differences Between Average Betas: 'Pre-Post'

Series		A	B	C	D	E
$N = n_1 = n_2$		39	20	15	25	20
Treatment Group	x_1	.9421	.9470	.9746	.9176	.9740
	x_2	.9470	.8645	.8507	.9932	.8490
	s_1	.0465	.0317	.0366	.0402	.0317
	s_2	.1370	.0347	.0212	.1515	.0192
	$x_1 - x_2$	-.0049	.0825	.1239	- .0756	.1250
	s_1^2	.00216	.00100	.00134	.00162	.00100
	s_2^2	.01877	.00120	.00045	.02295	.00037
	$(s_1^2 + s_2^2)/N$	.0054	.00011	.00012	.00098	.00024
	$[(s_1^2 + s_2^2)/N]^{\frac{1}{2}}$	.02317	.01049	.01092	.03135	.01533
	$t^* = (x_1+x_2)/[s_1^2+s_2^2)/N]^{\frac{1}{2}}$	.2115	7.8646	11.3462	2.4115	8.1539
Control Group	x_1	.8938	.8770	.8600	.9120	.8770
	x_2	.9030	.8585	.8560	.9244	.8566
	s_1	.0377	.0344	.0173	.0352	.0334
	s_2	.0720	.0359	.0292	.0783	.0280
	$x_1 - x_2$	-.0092	.0185	.0040	- .0124	.0204
	s_1^2	.00142	.00112	.00030	.00124	.00112
	s_2^2	.00518	.00129	.00085	.00613	.00078
	$s_1^2 + s_2^2 /N$	.00017	.00012	.00008	.00029	.00010
	$[(s_1^2 + s_2^2)/N]^{\frac{1}{2}}$	.01301	.01098	.00876	.01703	.01000
	$t^* = (x_1+x_2)/[(s_1^2+s_2^2)/N]^{\frac{1}{2}}$	.7072	1.6849	.4566	.7281	2.0400

x_1 = Preintervention average betas
x_2 = Postintervention average betas
s_1 = Standard deviation of x_1
s_2 = Standard deviation of x_2

as in table 8.6

* these 't' values have been used in table 8.7 for significance tests.

Appendix VIII(E)

Differences Between Average Betas: 'Treatment - Control'

Series		A	B	C	D	E
$N = n_1 = n_2$		39	20	15	25	20
Pre-Intervention	x_1	.9421	.9470	.9476	.9176	.9740
	x_2	.8938	.8770	.8600	.9120	.8770
	s_1	.0465	.0317	.0366	.0402	.0317
	s_2	.0377	.0344	.0173	.0352	.0344
	$x_1 - x_2$	.0483	.0970	.1146	.0056	.0970
	s_1^2	.00216	.00100	.00134	.00162	.00100
	s_2^2	.00142	.00112	.00030	.00124	.00112
	$(s_1^2 + s_2^2)/N$	.000092	.000106	.000109	.000114	.000106
	$[(s_1^2 + s_2^2)/N]^{\frac{1}{2}}$	.00958	.01030	.01046	.01070	.01030
	$t^* = (x_1+x_2)/[(s_1^2+s_2^2)/N]^{\frac{1}{2}}$	5.0418	9.4175	10.9560	.5234	9.4175
Post-Intervention	x_1	.9470	.8645	.8507	.9932	.8490
	x_2	.9030	.8585	.8560	.9244	.8566
	s_1	.1370	.0347	.0212	.1515	.0192
	s_2	.0720	.0359	.0292	.0783	.0280
	$x_1 - x_2$	.0440	.0060	- .0053	.0688	- .0076
	s_1^2	.01876	.00120	.00045	.02295	.00037
	s_2^2	.00518	.00129	.00085	.00613	.00078
	$(s_1^2 + s_2^2)/N$	.00614	.000125	.000087	.001163	.000058
	$[(s_1^2 + s_2^2)/N]^{\frac{1}{2}}$	.02478	.01116	.00931	.03411	.00758
	$t^* = (x_1+x_2)/[s_1^2+s_2^2)/N]^{\frac{1}{2}}$	1.7756	.5376	- .5693	2.0170	-1.0026

x_1 = Treatment group average betas
x_2 = Control group average betas
s_1 = Standard deviation of x_1
s_2 = Standard deviation of x_2

As in table 8.6

* these 't' values have been used in table 8.8 for significance tests.

APPENDIX VIII(F)

Differences Between Crosssectional Average Betas

(B_T: Treatment Group Average; B_C : Control Group Average)

t	B_T	B_C	B_T-B_C	t	B_T	B_C	B_T-B_C
1	.85	.89	-.04	41	.90	.81	.09
2	.86	.89	-.03	42	.96	.84	.12
3	.86	.89	-.03	43	.91	.83	.08
4	.86	.89	-.03	44	.90	.93	-.03
5	.86	.89	-.03	45	.86	.92	-.06
6	.86	.89	-.03	46	.86	.92	-.06
7	.94	.97	-.03	47	.86	.91	-.05
8	.93	.95	-.02	48	.86	.89	-.03
9	.92	.95	-.03	49	.82	.86	-.04
10	.93	.95	-.02	50	.81	.85	-.04
11	.94	.95	-.01	51	.82	.86	-.04
12	.93	.93	.00	52	.83	.82	.01
13	.94	.95	-.01	53	.86	.83	.03
14	.94	.93	.01	54	.87	.85	.02
15	.94	.94	.00	55	.88	.83	.05
16	.93	.92	.01	56	.86	.84	.02
17	.94	.93	.01	57	.86	.85	.01
18	.93	.93	.00	58	.87	.85	.02
19	.94	.92	.02	59	.86	.85	.01
20	.93	.91	.02	60	.84	.83	.01
21	1.02	.91	.11	61	.84	.83	.01
22	.89	.84	.05	62	.85	.87	-.02
23	.91	.84	.07	63	.83	.83	.00
24	.93	.86	.07	64	.84	.87	-.03
25	.96	.88	.08	65	.86	.89	-.03
26	.99	.87	.11	66	.94	.91	.03
27	.98	.85	.13	67	.97	.92	.05
28	1.00	.86	.14	68	.97	.92	.05
29	.99	.86	.13	69	.97	.93	.04
30	1.00	.85	.15	70	.98	.93	.05
31	.99	.85	.14	71	1.12	1.02	.10
32	1.00	.85	.15	72	1.09	1.02	.07
33	.98	.86	.12	73	1.16	1.02	.14
34	.99	.86	.13	74	1.17	1.00	.17
35	.99	.86	.13	75	1.21	1.00	.21
36	.98	.87	.11	76	1.19	1.01	.18
37	.96	.87	.09	77	1.20	1.01	.19
38	.97	.88	.09	78	1.23	1.03	.20
39	.98	.87	.11	79	1.24	1.05	.21
40	.97	.85	.12				

APPENDIX VIII(G)

Some Possible Instrumental Variables of Beta

	Income						Div.	Lever -age		Cash		Asset	
	Net Income	Net Income/Total Assets	Net Income/Book Value of Equity	Net Income/Market Value of Equity	Changes in Net Income	Operating Income	Dividend Payout	Leverage (Operating)	Leverage (Financial)	Liquidity	Cashflow	Assets - Size	Assets - Growth
Ball and Brown (1967)	x				x								
Beaver, Kettler and Scholes (1970)				x	x		x		x	x		x	x
Petit and Westerfield (1972)				x			x				x		
Hamada (1972)									x				
Beaver and Dukes (1972)									x				
Rosenberg and McKibbin (1973)									x				
Breen and Lerner (1973)					x								
Gonedes (1973a)		x			x								
Lev (1974b)								x					
Lev and Kunitzky (1974)					x								
Bildersee (1975)			x						x	x			
Foster (1975)	x												
Beaver and Manegold (1975)						x							
Gonedes (1975)	x	x											
Myers (1976)					x				x				
Griffin (1976)	x						x						
Thompson (1976)	x			x			x		x				x
Dotan (1977)									x				
Rugman (1978)	x												
Bowman (1979, 1980)	x								x				

8.6 References

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CHAPTER IX

IMPLICATIONS

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IMPLICATIONS

Sections

9.0 Introduction

In Chapter VIII the hypotheses of this thesis related to information content and risk assessment aspects of geographical segment disclosure have been tested and results obtained. These results have been further analysed to test the duration-onset aspects. In this chapter the results will be restated and implications for financial reporting will be explored.

Implications of the results will be analysed as follows: First the direct implications will be analysed. Direct implications of the results are related to (i) information content of segmental geographical data and its implications for market efficiency; and (ii) implications for risk assessment in geographically diversified multinational companies.

Implications of an indirect nature will be explored next. Indirect implications of this research are in the area of policy formulation in financial reporting. Under the heading of implications for disclosure policy voluntary and mandatory disclosures will be discussed. Voluntary disclosure will be analysed in the context of agency theory, agency costs, incentive signalling and moral hazard problems.

Mandatory disclosure will be discussed next. In this context arguments for and against regulation will be explored in the light of market failure theory and capture theory. The nature of nonmarket failure will be analysed, the problems in setting adequate disclosure standards in the area of geographical segment disclosure will be analysed, and the possible contribution of this research to the issue of geographical segment disclosure will be stated.

First the implications for market efficiency.

9.1 Implications for Market Efficiency

It has been shown earlier (section 8.2232) that for the treatment group of companies, companies which changed their disclosure practice from nondisclosure to disclosure of geographical segment information, at the aggregate level, average pre-intervention betas were significantly different from post-intervention betas; no such differences were found for the control group of companies which have disclosed geographical segment information before and after the intervention point. It has also been shown that such differences in betas were not significantly influenced by confounding factors such as changes in rates of return on equity or changes in financial leverage (section 8.4). The implication of this association between geographical segment data and changes in systematic risk is that geographical segment data are likely to have been reflected in the stock prices resulting in beta changes for the treatment group of companies.

Earlier in this research, information has been distinguished from data and knowledge (section 2.2). Data are simply facts, which are obtained through empirical observations. Knowledge is a group of law-like generalizations which relate data to their environment; information is the resultant co-ordination of data with knowledge when data are screened, edited and evaluated for use by a specific user in a given situation (Caspari, 1968).

The possible existence of information content in geographical segment data, as has been found in the results in chapter VIII implies that geographical segment data, (transmitted by companies), which are simply facts, are likely to have been related to the geographically diverse environments of the conglomerate multinationals by the users (investors) for use in a given situation (buy, sell or hold decisions), resulting in the transformation of geographical segment data into geographical segment information.

Having established that geographical segment data are likely to have information content, to establish its implications for market efficiency it is necessary to examine the speed with which such information may have been impounded in the stock prices.

"In order to demonstrate that it serves shareholders' interest better that companies publish all information which contributes to the efficiency of the market rather than to withhold data which might be beyond the understanding even of the reasonably informed investor, it is necessary to take account of the evidence in support of what has come to be known as the efficient market hypothesis" (Keane, 1975, pp.231-232).

Market efficiency is about information processing efficiency. In a world of perfect information, market efficiency is a tautology, and disclosure is redundant. In a world of imperfect information where insiders can use private information for private gain at the expense of others, disclosure can be beneficial to the society if the costs of producing and disseminating additional information do not exceed the gross gain to the society.

In the classical economic world disclosure is irrelevant. In the neoclassical world it is assumed that there are advantages of possessing information. Disclosure consequences in the classical economic world of perfect information, assuming managers as insiders, and all other interested parties as outsiders can be mapped in the following manner:

Environment:	Classical economic world of perfect information	
Participants:	(i) insiders:	managers;
	(ii) outsiders:	all other interest groups

Scenarios	Disclosure Consequences
S_1: No valuable information	Nothing to disclose
S_2: All information is known to everyone	Disclosure is redundant
S_3: Market is efficient in the strong form; (it can predict as well as it could if it possessed inside information)	Disclosure has no impact

In general such arguments are false. "At its heart is a misunderstanding of the efficient markets arguments. Past observations on prices and dividends, as well as the general financial and technical information available on a firm, do provide information about the future; they do not provide all the available information but only a portion of it. There is nothing at all "inefficient" about a market where more information is more informative about future possibilities" (Ross, 1979, p.179).

The duration-onset analysis (section 8.3) has shown that the onset of the beta changes in the treatment group as compared with the control group was more likely to have been abrupt than gradual. Information disclosure studies in the context of capital markets (chapter IV) have shown that the notion of market efficiency is about information processing efficiency. In an efficient market the market should reflect all new information 'without undue delay'. Our results show that this notion of market efficiency is likely to have been true for multinational companies in the London Stock Exchange in the semi-strong sense. The abruptness of the onset of beta changes show that there was a quick response in stock prices. Public information regarding segmental geographical prospects were likely to have been taken into account in the stock price changes. This result is somewhat in contrast to earlier study conducted by Collins (1975) who investigated market efficiency with regard to product line reporting in the USA. Using cumulative average residual method to formulate trading strategy, Collins reported that "the market was not efficient with respect to the non-public segment revenue and profit data of nondisclosure firms for 1968-1969."

The contribution to knowledge which can be derived from this current study is that (i) intervention analysis has been used instead of cumulative average residual method for reasons stated earlier (section 7.31); (ii) unlike previous studies which have tested the information content of line of business activity, this study has investigated the information content of segmental geographical data; and (iii) the database is exclusively of UK origin while most of the earlier studies have examined US database.

9.2 Implications for Risk Assessment

Relevance of current research in the area of risk assessment fall under two headings:
(i) at the general level; and (ii) at the technical level.
At the general level, it has been seen in chapter VIII that when comparing control and treatment group betas, segmental geographical disclosure is likely to result in lower systematic risk for disclosing companies (table 8.8). More specifically, it was shown that in

the pre-intervention period,nondisclosing treatment group average betas were significantly larger than the disclosing control group average betas; in the post-intervention period, when the disclosure practices of the treatment group and the control group were similar, there were no significant differences in the average betas of the two groups.

It has been stated earlier in this research (chapter V, appendix V(A)), that for a well diversified investor, unsystematic risk does not matter, all that matters is systematic risk, B. If beta is the relevant factor in measuring risk, and consequently in establishing risk premium for equity cost of capital, then geographical segment disclosure practice, which has been shown to be associated with beta changes, could also be a relevant factor in the assessment of risk as perceived by investors in geographically diversified multinational companies.

Comparing our findings with earlier studies cited in this research (section 6.5), the following observations seem pertinent:

Mautz (1968), and Backer and McFarland (1968) have stated that there are likely to be benefits from segmental disclosure. Our findings support their views. Choi (1973b) investigated the relationship between financial information disclosure in an international setting and the firm's cost of equity capital, and found that improved disclosure is likely to result in lower equity cost of capital. Our research findings showing that systematic risk for disclosing companies overall are likely to be lower than non-disclosing companies supports Choi's findings.

Similarly, Dhaliwal (1978), and Dhaliwal, Spicer and Vickrey (1979) have empirically tested, and have found evidence in support of, the hypothesis that segmental disclosure had a favourable effect on the cost of equity capital. The contribution to knowledge of this present research is that it extends this reduction in cost of equity capital notion to (i) segmental geographical disclosure, and (ii) to the UK database.

Kochanek (1974) tested the association between stock price volatility and reporting practice and found that weekly stock price volatility ratio was smaller for good reporters than for poor reporters. If control group companies in our research are seen as good reporters in preintervention period, and treatment group companies in the preintervention period are categorized as poor reporters, then our finding that preintervention period betas for control group companies were lower than treatment group companies, supports Kochanek's findings that good reporters are likely to have lower risk.

Our findings are, however, in sharp contrast to Kinney's (1972). Kinney investigated the voluntary disclosure of geographical segmental data for 25 multinationals for the period 1964-69 and found that only in 3 cases out of 25 were there any benefit from geographical diversification. The important point of difference between Kinney's study and current research is that Kinney investigated the total variance of earnings, including unsystematic risk, while in our present study, the area of investigation is systematic risk only.

In the international capital markets context, Grubel (1968) has demonstrated the benefits of international portfolio diversification supporting a segmented international capital market hypothesis, meaning that there exist imperfections in international capital markets. Levy and Sarnat (1970) have conducted a study similiar to that of Grubel, but included less developed countries in their sample, and concluded in similiar fashion to that of Grubel, thus arguing for lifting of restrictions on international capital movements. Agmon (1972) has argued against the Grubel-Sarnat-Levy hypothesis of segmented international capital markets. According to Agmon, the international capital market is unlikely to be segmented. His conclusion was based on a limited sample of four industrially advanced countries while Grubel, and Levy and Sarnat had a much larger number of countries in their samples.

While our observations about segmented international capital markets can only be of an indirect nature, it is possible to make direct observations about another aspect of international capital market studies: country influence. Following King (1966) who demonstrated industry influence in the determination of systematic risk, Lessard (1974) demonstrated the relevance of decomposing the betas of internationally diversified companies into world, country, and industry factors. If segmental geographical disclosure affects systematic risk, as has been found in current research, and geographical disclosure implies that information about country factors are inherent in geographical information,then it is possible to conclude that our research result supports Lessard's conclusion that the country factor is an important influence in the determination of beta.

If country influence is an important influence in the determination of beta, then the implication of this research can be seen to lie also in the theory of Arbitrage Pricing (section 5.523) and multifactor models of capital asset pricing (section 5.522) in general.

The arbitrage pricing theory states that rates of return on any security is a linear function of 'k' factors, but it does not tell us what these factors are. If segmental geographical disclosure practice is a relevant factor in beta determination, and beta is a relevant factor in establishing required rates of return, then it is possible to conclude that geographical segment disclosure practice is one of these 'k' factors.

Apart from its relevance in beta determinants as mentioned above, there are technical implications of this research in risk assessment. One of the major issues in the measurement of systematic risk is the horizon problem (section 5.512). The horizon problem in the contoxt of segmental geographical disclosure is the problem of deciding how long the period of observations should be over which the prices information should be collected and analysed to be able to establish a realistic risk profile for multinational companies.

The duration-onset analysis (section 8.3) has shown that the duration of changed beta for treatment group companies in response to changes in segmental geographical disclosure practice was semipermanent; i.e., the duration of the impact of intervention lasted for about 25 months, after which the impact seemed to be diluted by more immediate factors (figure 8.3). Our findings seem to support the stance taken by Brenner and Smidt (1978) who have stated that betas would not be stationary over indefinite length of time.

9.3 Implications for Disclosure Policy

It has been shown that geographical segment disclosure is associated with a reduction of systematic risk for disclosing companies when compared with similar non-disclosing companies. If geographical segment disclosure is associated with benefits to user groups such as investors, and if an important attribute of an adequate financial reporting system is the satisfaction of user needs (section 2.11), then should such disclosure of segmental geographical data be left to voluntary efforts of information producers, or should such disclosure of geographical segment data be mandatory? This is one of the general questions in disclosure policy. The answer to such a question lies in an understanding of the arguments for and against voluntary and mandatory disclosure systems.

9.31 Voluntary Disclosure

In chapter VIII it has been shown that for the treatment group, average betas in the post-intervention period were significantly different from average betas in the pre-intervention period, pointing to the possibility of information content of segmental geographical data in response to the intervention variable, segmental geographical disclosure practice. It has also been shown that results of duration-onset analysis point to the abruptness of the beta change after the intervention point when treatment group average betas are compared with the control group average betas. This has been construed to mean that the stock market reacted in an efficient manner to impound the new information about segmental geographical prospects in the stock prices of the disclosing companies.

Further, it has been shown that in the pre-intervention period treatment group average betas were significantly larger than control group average betas, but in the post-intervention period there were no significant differences between the treatment and control group average betas, pointing to the possibility that intervention (segmental geographical disclosure practice) is associated with a reduction of systematic risk for disclosing companies.

It can be argued therefore that all is well; in an efficient market the information content of geographical segment data which might result in a reduction of systematic risk for disclosing companies overall will automatically be taken care of by the market mechanism, and there is no need for any regulation of disclosure practices of companies in the economy. Bird and Locke (1981) support this view of efficiency of the market mechanism. Additional support for the efficiency of the market mechanism, suggesting that voluntary disclosure is a desirable mode of operation is posited in Agency Theory.

9.311 Agency Theory

Agency Theory posits that there are incentives to voluntary disclosure. In modern corporations, such as geographically diversified multinationals which have been investigated in this research, ownership is separated from control. While shareholders may not be tied to the fortunes of the firm because they can diversify their portfolio of investments, the management of a firm has a long horizon tied to the firm. The economic fortunes of the management depend on those of the corporation. In a competitive market with no mandated disclosure, the managers of firms will find their compensation linked directly to the fortunes of the firm on an ongoing basis and will be precluded from profiting directly from inside information. In such a situation, they will have a strong self interest in disclosing relevant information to the outside market (Ross, 1979; Fama, 1980), as long as it is necessary to disclose such information to compete for capital and credit in the market place (Mautz and May, 1978). Segmental geographical disclosure may necessitate some costs in information production and competitive disadvantage but so long as the advantages in the form of obtaining credit and capital outweigh the costs, managers will be in favour of disclosure (section 3.32).

Managers of treatment group companies may have decided to disclose segmental geographical data because the advantages of disclosure might have been perceived to be greater than costs of such disclosure. This is in support of agency cost theory (Jensen and Meckling, 1976), which states that if investors find it worthwhile to obtain detailed information about the firm then the price they are willing to pay for the firm's stocks will be inversely related to the cost of obtaining that information. In other words, the cost of obtaining financial information will be borne by the firm directly, or it will be imposed upon the firm via the stock price setting mechanism. Recent investigation by Chow (1983) into the impact of the SEC 1933 Act also supports this view.

9.312 Agency Costs

Agency costs arise because the manager's (the agent's) interests do not necessarily coincide with the interests of shareholders or the bondholders (the principals). For example, the manager, if he owns shares, has incentives to convert the assets of the corporation into dividends. Similarly the manager has incentives to transfer wealth to himself in the form of perquisites at the expense of the principal. (Watts and Zimmerman, 1979).

Bondholders and shareholders anticipate the manager's behaviour and appropriately discount the price of shares or bonds at the time of the issue. Hence the promoter (or manager) of a new corporation receives less for the new issue. This difference in the market value of the securities is part of the cost of an agency relationship and is called the residual loss being borne by the manager. (Jensen and Meckling, 1976).

Because of the residual loss which the manager has to bear, he has incentives to make expenditures to guarantee that he will not take certain actions which harm the principal's interest or that he will compensate the principal if he does. These are "bonding" and monitoring expenditures and are additional elements of agency costs. Contracting to restrict dividend payments and expenditures to monitor such dividend covenants are examples of monitoring costs.

The third element of agency costs results in a reduction of the total agency cost. This is related to the marginal utility of the perquisites and wealth transfers that the managers can make for themselves. While the providers of monetary capital have no direct interest in the survival of any particular firm, the managers of the firm, however, have a much more permanent interest in the survival of the firm as they rent a substantial lump of their wealth - their human capital - to the firm, and the rental rates for their human capital as conveyed to the managerial labour market are likely to be dependent on the degree of success of the particular firm. (Fama, 1980).

An equilibrium occurs when the net cost of an agency relationship, the agency costs are minimised by trading off the decrease in the manager's utility due to the residual loss, the monitoring and bonding expenditures, and the increased utility due to increased perquisites.

Accounting procedures such as segmental geographical disclosure are devices used to reduce the agency costs of contracts. Since these costs vary across firms, accounting procedures and reporting practices will also vary giving rise to variety of techniques and formats. (Watts and Zimmerman, 1979, p.278).

9.313 Moral Hazard

One of the consequences of information on aggregate production and resource allocation is its effect on the relationship between management and investors. In earlier accounting literature this relationship has been described in terms of stewardship theory. In the economics literature, particularly in insurance (Arrow, 1971, p.142) this is treated as a problem of moral hazard and is of prime concern to agency theory (Beaver, 1981). Although the agency cost reduction role of accounting is merely the modern counterpart of what is traditionally known as the stewardship function, unlike the stewardship function, the agency cost approach is more concerned with economic incentives than with such concepts such as 'fairness' or right to know. (Ronen, 1979, p.431).

In an agency setting a moral hazard problem arises because of an information asymmetry. There is general concern that the agent will use his superior information to maximize the agent's self interest at the expense of the principal. This is the moral hazard problem. Moral hazard not only includes such acts as fraud and shirking, but it also includes other actions that are not in the best interests of the principal such as risk-reward trade offs made in project selection.

There is a moral hazard problem associated with markets in information. How is the buyer, the investor, who by assumption is ignorant, to verify the validity of the information (geographical segment data), he is buying?

Disclosure regulation can induce individuals to be truthful by exacting penalties for transmission of false information, but it would be simplistic to think it is a cure for all moral hazard problems. Several responses to the moral hazard problems are possible.

One response is to "provide for public disclosure of firm's information so as to remove the superior information position of management. Hence, the information asymmetry that leads to the concern over moral hazard is removed" (Beaver, 1981, p.49). Another option is to provide an incentive contract for management so as to provide goal congruence between the manager and the owner.

9.314 Incentive Signalling

Determining the costs and benefits of any particular disclosure regulation hinges on whether one supports the classical view or the incentive signalling view. "Aside from stewardship function, whether it is in the old vintage form or under the modern label of agency costs, ... accounting clearly plays an additional role: providing information for resources allocation - internally within the firm and externally for consumption - investment decisions. From this perspective of the role of accounting, the issue is: do companies have incentives within the free market mechanism to provide correct signals for decision-making? Should signalling be regulated because the market does not offer sufficient incentives for correct signalling?" (Ronen, 1979, p.415).

The traditional view that insiders will never reveal their information, preferring to exploit them directly is too simplistic.

The neoclassical view that management, as agents of stockholders, will release all information up to the point where the marginal benefit to stockholders just equals the marginal cost is also inadequate.

A more complete explanation of the forces in the free market that lead to disclosure is provided by incentive-signalling analysis, which elucidates the competitive incentives for the revelation of inside information.

The marginal analysis, in effect, defines the information that will be disclosed, while the incentive signalling analysis explains the mechanism of disclosure (Ross, 1979).

The incentive signalling theory is really an extension of the traditional theory, but it arrives at different implications for policy because it makes some assumptions that are different from those implicit in the traditional theory. The traditional view argues that there are no constraints that prevent the manager from suppressing and exploiting inside information. The incentive signalling approach argues that the absence of such constraints is incompatible with competitive financial markets in managerial services (Fama, 1980).

Historical analysis of voluntary disclosures have been made by Edey (1968, p.137) for UK companies for the period 1862-1900, and by Benston (1969) for US companies for the pre 1933 SEC Act. Edey reported that in the period 1862-1900 many UK companies voluntarily adopted the optional articles included in Table A of 1862 UK Companies Act. Benston reported that as of 1926, of the firms listed on the New York Stock Exchange, 100% published balance sheets, and disclosed net income; 71% disclosed depreciation and 45% disclosed cost of sales.

More recently, in a survey of UK published accounts, the ICAEW (1982) reported that of 300 large companies selected from the Times Top 1000 companies, for the year ending 30th June 1982, 225 companies (i.e., 75%) disclosed some form of segmental geographical information. Such findings confirm the view that there are incentives to voluntary disclosure in an unregulated market.

That management will have an incentive to disclose good information (unless doing so will jeopardize its value to the firm) is not difficult to conceive (section 3.33). Such disclosure will raise the value of the firm, and therefore the managers' compensation. But with bad news, the analysis is not symmetric. Those with no news will suffer by being lumped in with those suppressing bad news.

"In a voluntary system of financial reporting, it is to be expected that some companies will not disclose. However, if market participants deem segment reporting important for a particular firm, they will interpret the lack of disclosure by that firm as bad news and will reduce their willingness to buy that company's shares; therefore lack of disclosure will lead to a higher cost of equity capital for the nondisclosing firm than for a similar disclosing firm" (Horowitz and Kolodny, 1980, p.23).

This incentive signalling analysis in a free market can be criticised on the following grounds:

a. Even if it were true that over the long run the market would penalize companies which withheld segmental geographical information, in the interim inefficiencies may persist.

b. Moreover, confidence in the securities market rests upon the public's notion of fairness, and fairness is related to the equal access doctrine. Under this doctrine, the public may deem it unfair when only some firms voluntarily disclose segmental data, and for those firms not disclosing, only insiders, large investors and institutions with sizeable resources have access to such information.

c. "At best, nondisclosure would be a noisy signal which cannot be unambiguously interpreted. It would be consistent with both the following possibilities: (1) effect of segment information on the stock price would have been negative, and (2) effect of segment information on the stock price would have been positive but the cost of disclosure (including adverse effects on competitive advantage) outweighs the benefit (increase in stockholders' wealth); that is, the net positive value is negative" (Ronen and Livnat, 1981, p.475).

If the market mechanism cannot be relied on to guarantee either comprehensive disclosure of segmental geographical information, or a setting in which nondisclosure can be interpreted unambiguously, then one needs to consider the circumstances under which regulation of segmental reporting can be justified.

9.32 Mandatory Disclosure

It has been stated in the previous section that the argument in favour of voluntary disclosure rests on the assumption of market efficiency and incentives to voluntary disclosure. But market efficiency does not necessarily imply economic efficiency (section 4.23), nor does the existence of incentives to voluntary disclosure exclude the possibility of information asymmetry and moral hazard (section 9.314). If voluntary disclosure is inadequate to satisfy user needs, mandatory disclosure could be a possibility. Yet, economic efficiencies in allocation and distribution are not necessarily best served by mandatory disclosure unless it can be shown that costs of nonmarket failure are necessarily smaller than costs of market failure. The public goods characteristics of accounting information, and multiperson nature of social choice implies that accounting policy choice such as segmental geographical disclosure is a political choice in an institutional setting.

9.321 Market Failure

It has been shown that the treatment group betas were affected abruptly as a consequence of intervention (section 8.3), pointing to the possibility that the London stock market was likely to have been efficient in response to segmental geographical information for multinationals. However, the efficient markets hypothesis says that all information is impounded in the stock prices, it does not necessarily say that such impounding is done correctly. If the information set is incomplete, immaterial, or meaningless, then efficient markets notion can do very little to ensure a socially desirable allocation of resources.

It has earlier been shown that the usefulness of segmental geographical information is circumscribed by the problems of segment identification, materiality and meaningfulness (section 3.3). Information asymmetry is likely to exist between managers (who are insiders) and users (who are outsiders.) Therefore managers have incentives to suppress bad news and disclose good news. Ball and Brown (1967), and Niederhoffer (1971) have shown that stock prices tend to rise with good news and fall with bad news. Patell and Wolfson (1982) have shown that good news is more likely to be released when the security markets are open while bad news appears more frequently after the close of trading.

The efficient security market hypothesis relates to individual values, not to the relationship between individual value and the social value, while accounting information disclosing segmental geographical information may have public value apart from private value. (Beaver and Demski, 1974; Demski, 1974).

Since accounting information may have public value, it is possible to envisage that

"... management has a responsibility to disclose any information (other than commercial secrets) which is material and relevant to shareholders' portfolio needs, that is provide the market with all data, however technical or incomprehensible to the 'ordinary investor', which affect the market value of the shares and the allocation of capital to the company, and to provide the individual investor or his advisor with ... information which will enable the investor to place the shares in a 'covariance' category. This might include a breakdown of sales into product lines, analysis of the firm's activities into geographic or economic regions, and possibly a probabilistic analysis of future returns ..." (Keane, 1975, p.239).

Public disclosure of segmental geographical information would therefore seem to be in the societal interest. In the absence of such public disclosure of segmental geographical information:
"there are clear incentives to information search ... for those with unusual detective abilities, large resources and influences. The resulting private search for information not only has redistributive effects but may also lead to economic inefficiencies in the form of reduced aggregate output" (Hakansson, 1977, p.413).

The impact of accounting information such as segmental geographical data on aggregate output can be seen through its influence on cost of capital. It has been shown (section 8.3) that segmental geographical information and beta changes were associated. If beta changes and equity cost of capital are associated then the distribution of cost of capital among firms is likely to be influenced, and consequently the allocation of capital to various users in the economy. Choi (1973b), and Makin (1978) also supports this view.

One view of accounting information is that no one should be excluded from information published by enterprises.

But the problem is that without the exclusion of those who do not pay for the information, no rational person will be prepared to pay for any of it. This is the 'free rider' problem (Bromwich, 1981). The existence of free riders constitutes the evidence that accounting can sometimes be called a public good since its supply is not reduced by the consumption of any individual (Samuelson, 1954). The existence of public good characteristics makes the operation of market mechanism difficult. Gonedes and Dopuch (1974) have argued that the prohibition of insider trading gives accounting information some public good characteristics. Such public good characteristics requires an analysis of externalities.

9.3211 Externality

Though there is far from unanimity about the meaning of the term externality in the economics literature, the interdependence notion is one of the more accepted versions of the definition of the term 'externality' (Foster, 1980, a). Yet, the existence of interdependencies is only a necessary, but not sufficient condition for the existence of externalities. An interdependence between two firms exists when action taken by one firm affects the other. Indeed in some sense the action of any firm affects all other firms in the economy indirectly. An externality arises when the interdependence gives rise to a misallocation of resources - in particular the interdependence between the two firms is such that the results of decentralised decision-making by each firm is pareto inferior to a centralised solution.

Externalities in financial reporting can arise from either:
(i) timing of information releases or
(ii) the content of these releases.

If two firms have the same reporting period, and are in the same risk class but release their earnings and investment plans at different times, there is 'timing' externality. Content externality can arise when information disclosed by one firm can affect the production or investment decisions by other firms.

The possibility of externalities in information generation (financial reporting) imply that regulation of accounting information production may lead to an allocation of resources that is pareto superior to that achieved by a free market equilibrium allocation. Moreover, changes in information production induced by regulation may alter the values of securities portfolios and through those values, the distribution of wealth among individuals. Either one or both of these potential influences adds a social value dimension to the regulation of financial accounting information. (May and Sundem, 1976).

It has been shown that accounting has public goods characteristics. Such public goods characteristics result in the possibilities of the existence of externalities. Although there are incentives to voluntary disclosure under incentive signalling theory, corporate management also has incentives not to disclose unfavourable information. Therefore, left to market forces, there would result an asymmetrical or uneven possession of information among market participants. This is the market failure argument.

The most celebrated attempt to allow for non-unanimity while retaining the concept of pareto optimality was the 'compensation principle' formulated by Kaldor and Hicks (Prest and Turvey, 1965). Under this compensation principle, when externalities exist, the gainers would compensate the losers such that in the end everyone is better off.

While in principle it is possible to devise such an elaborate compensation system through the price mechanism, such a system may be too costly, or simply infeasible because of the burden of bureaucracy. Yet, without some form of collective action, the parties benefiting in the presence of externalities have no incentive to internalise the effect on third parties.

"A necessary (but not sufficient) condition for regulation to create a socially better allocation of resources and/or distribution of wealth is that it at least be capable of producing a different allocation and/or distribution than would be attained in a free market. There are several reasons that this condition may be met.

First, regulation can impose production of information on entities with comparative advantages in producing the information. However, these entities do not necessarily have a private incentive to do so. In this way, it may be possible to alter the information set employed privately by investors in forming their preferences for various securities by altering the distribution of costs of information. Such alteration may affect resources allocation and wealth distribution directly by changing production opportunities of other (external) information suppliers .....

Second, since optimal investment strategies imply inter-firm comparisons, some external economies in information processing may be achievable through imposition of certain uniformities in financial accounting information produced. This may mean lower costs of acquiring information for investors and other decision makers.

Third, to the extent that a policy apparatus lessens the probability of major scandals, it may contribute to the general perception of risk over a vast number of risky investments and, therefore, the level of savings and investment in the economy as a whole". (May and Sundem, 1976, p.749-750).

However, the sufficient condition for mandatory disclosure policy formulation "requires that the realized inadequacies of market outcomes be compared with the potential inadequacies of non market efforts to ameliorate them", (Wolf, 1979, p.107), and market outcomes be found inferior to the alternative solution.

"Existing institutional arrangements, such as markets, should not be condemned until it can be shown that there is an alternative regime which can produce socially superior output", (Leftwich, 1980, p.193).

9.322 Nonmarket Failure

Although it has been shown that segmental geographical disclosure is likely to enhance market efficiency (section 9.1), and benefit shareholders (section 9.2), the idea that the association between segmental geographical data and efficiently determined market prices can be used as a basis for information production has been disputed by Gonedes and Dopuch (1974), May and Sundem (1976) and Demski (1974), when costs and benefits of disclosure in a societal context are taken into account.

Since information production has a cost, "there is clearly a limit to which the principles of full disclosure can be implemented" (Keane, 1983, p.149).

Further, the magnitude of benefits, net of costs is also of an uncertain nature due to information overload phenomenon (section 2.221), and the reasons underlying the self interest theory of regulation (Posner, 1974). On the issue of information overload, it is possible that as more and more detailed segmental geographical information becomes available, investors may find that in most cases their information processing ability is able to extract increasingly less meaningful information to aid the decisionmaking process. Thus, "as financial statements come to include more and more information, they become meaningful to an increasingly small number of sophisticated users" (Anderson and Myers, 1975, p.30). The possibility of being increasingly useful to a minority of sophisticated users gives rise to the arguments supporting the "capture theory" or "self interest theory" of regulation. Capture theory states that regulation is likely to be supplied in response to the demands of interest groups struggling among themselves to maximize the incomes of their members (Posner,1974, pp.335-336).

Apart from costs of information production, there are costs of monitoring and enforcement as well as the hidden costs of implementation of the legislation itself.

Disclosure regulation may also result in production of too much information - information that would not be produced by companies operating on their own account. Further, due to problems of meaningfulness, segment identification and segment materiality (section 3.3), they may not lead to production by the most efficient producer.

Externalities and public goods characteristics in accounting information give rise to the suspicion of market failures, and creates demand for regulation. Sufficient condition for regulatory policy is to show that the impact of non-market failures on society is less harmful than any possible market failure. This is almost impossible to prove either way.

Disclosure regulation may be able to induce individuals to be more truthful by exacting penalties for transmission of false information, but it would be simplistic to think it is a cure for all moral hazard problems. The real effect of disclosure regulation may be "simply to shift the burden of monitoring and verifying from the private sector to the public sector, with no evident gain in economic efficiency." (Ross, 1979, p.183).

9.33 <u>Social Choice</u>

Competition in the product market and/or competition in the capital market are the usual bases upon which a priori standing for the profit maximization hypothesis is established. Incentive signalling and voluntary disclosure discussed earlier in this chapter are based on this profit maximization notion.

Among the administrative or regulatory alternatives to product and capital market competition that have been considered from time to time as a means of controlling the exercise of managerial discretion are more extensive accounting disclosure and vigorous anti-trust enforcement.

Enforcement agencies are complex systems. Complex systems are constrained because of 'bounded rationality.' By 'bounded rationality' is meant bounds on the rate at which information can be absorbed per unit of time, limits to information storage capacity (in an effective retrieval sense), and bounds on the information processing ability of the decision maker. Given bounded rationality, only finite spans of control are feasible. One way of alleviating the constraint of limited span is to engage in a capacity augmenting strategy via delegation, and redesign of the organisation. This is called the process of "decoupling".(Williamson, 1970).

Such decoupling in financial reporting systems in a societal context can be achieved by a system of semi-official regulatory authorities, such as the Stock Exchange, or Accounting Standards Committees.

Given the existence of possible market failures, heterogeneous interest groups and user preferences, non-market failures, and bounded rationality, theories of disclosure regulation can be categorised into three types:

1. "Market Failure" or "Public Interest" theory, firmly rooted in welfare economics, provides an economic rationale for what regulation ought to do - improve economic efficiency by correcting market failure. Though rich in analysis, this theory fails to capture adequately the way in which regulation actually works in the real world. (Phillips and Zecher, 1981).

2, "Public Choice" or "Capture" theory, rooted in history, political science and law, in addition to economics, provides a rationale for understanding why regulatory agencies and programmes often do not deal effectively with the economic problem of inefficient allocation of resources. According to capture theory, the prime beneficiaries of regulation are not the public, but those being regulated (Posner, 1974).

3. Yet another theory of regulation is that regulators themselves receive net benefits at the expense of both consumers and regulated firms (Eckert, 1974; Schwert, 1981). Once a regulatory body is set up, it tends to justify its existence long after the original reason for the setting up of the agency has disappeared. Information becomes a symbol of power and authority (section 2.24). In an ongoing regulatory environment, the predominant function of providing segmental geographical data can embrace the danger of supplying excuses which satisfy the demand created by the political process in an institutional setting (Watts and Zimmerman, 1979). Support for such hypothesis of institutional behaviour can be found in Weber (1947).

Which theory is correct? No theory is ever perfect, and theories are never right or wrong. Theories can only be evaluated in given institutional settings and user objectives. (Demsetz, 1969; Beaver and Demski, 1974; Cushing, 1977). Further, social choice being a political process (Watts and Zimmerman, 1979), all three theories have partial truths.

In a multiperson setting decisions concerning the use of accounting systems require some value judgments as to which user groups' preferences are paramount. In the absence of such value judgments, given that a multiperson user setting implies heterogeneous requirements and expectations, one has to cope with the Arrow (1951) impossibility theorem, and the problem of nontransitivity in social choice. Cushing (1977) has argued that social choice based on pareto optimality is impractical.

Arrow's choice theory transplanted into accounting and public policy economics implicitly presents the relevant choice as between an ideal norm and an existing "imperfect" institutional arrangement. This 'ideal norm' or "nirvana approach differs considerably from a comparative institution approach in which the relevant choice is between alternative real institutional arrangements." (Demsetz, 1969, p.1).

9.331 Economic Consequences

No matter which disclosure policy is adopted, there are economic consequences. By economic consequences of financial reporting is meant "the impact of accounting reports on the decision-making behaviour of business, government, unions, investors and creditors." (Zeff, 1978, p.56). In a setting of multiperson user groups and heterogeneous expectations one could conceivably include many more decision-makers. But, in general, how financial reporting alternatives affect the economic fortunes of various user groups is the domain of economic consequences.

Economic consequences of segmental geographical disclosure embrace costs and benefits of disclosure. If there are benefits from segmental geographical disclosure in the form of more accurate risk assessments by the market makers, then ignoring cost considerations it can be stated that shareholders' wealth maximization criterion is satisfied. When cost considerations (section 3.32) are included, disclosure benefits, net of costs become uncertain. This is not to say that market efficiency is not a desirable objective, but that market efficiency is not, by itself, a sound criterion for making policy decisions. "Market efficiency is a desirable attribute of a market, as long as other criteria for evaluating a market are not ignored" (Anderson and Myers, 1975, pp.31-32). Such other criteria include societal effects.

Economic consequences of segmental geographical disclosure have been discussed in detail elsewhere in this research (chapter III). Summarizing earlier discussions, possible economic consequences of segmental geographical disclosure can be stated as follows:

A. At the individual level:

- (i) Distribution of wealth among individuals
- (ii) Allocation of risk among individuals
- (iii) Use of resources in the private search for information.

B. At the firm level:

- (iv) Allocation of resources among firms

C. At the aggregate level (economy as a whole):

- (v) Use of resources devoted to the production, certification, dissemination, processing, analysis, and interpretation of financial information
- (vi) Use of resources in the development, compliance, and enforcement and litigation of regulations
- (vii) The aggregate consumption and production (e.g. the effects on the rate of capital formation).

Because these consequences may affect various constituencies differently, the selection of an appropriate reporting system for segmental geographical disclosure is a social choice. As in any social choice situation, there is considerable controversy over which economic consequences and constituencies should be considered in a policy setting (Beaver, 1981; Zeff, 1978). The resolution of such issues requires a framework that recognizes the role of information in a multiperson setting, and the rationale for regulation as an institutional solution.

There is no general agreement among researchers as to which institutional setting is most appropriate.

Benston (1976) made comparisons between the mandatory US system and the UK system of private regulation, and on balance concluded in favour of the UK system. The Wilson Committee Report (1980) discussing the balance between statutory and voluntary regulation commented:

> "There is, in effect, something of a continuum ... the issue therefore is not whether statutory or non-statutory methods ... are preferable in some absolute sense, but whether the existing balance is appropriate ... " (para.1099)

Ronen (1979) argued in favour of mandatory disclosure because of the possible existence of moral hazards. Empirical research can only provide evidence. Policy makers in the light of the evidence have to find the right balance in the context of institutional arrangements.

9.332 Disclosure Policy

"In a 'general' theory the specification of users should be able to cope with a variety of users and multiperson configurations" (AAA, 1977, p.3). Such multiperson configurations could include companies large and small, uninational and multinational, and operating in different cultural environments.

Jaggi (1975) has explored the impact of the cultural environment on financial disclosure. Choi (1980) has explored the cross cultural aspect of financial reporting. McComb (1979), Nair and Frank (1980), Gray (1980), and Nobes (1983) have analysed the cultural aspects of international reporting and classification. All these studies provide additional dimensions to the multiperson configuration, and choice of objectives. A positive theory of accounting is a prerequisite to understanding how firms react to changes in disclosure requirements. In a multiperson setting, where choices are not transitive, Arrow (1951), has shown the impossibility of a consistent social choice based on pareto optimality criterion. Cushing (1977) has shown the absurdity of a pareto optimality criterion in a policy context. Bator (1958, p.378) stated: "Pareto optimality as such may not be necessary for bliss."

"Agency theory asserts that in the absence of compulsory disclosure regulations, company managers would still have an incentive to supply ... financial statements to shareholders and creditors and would enter into bonding arrangements for this purpose. The voluntary acts may be undertaken to reduce agency costs, that is costs arising from the separation of ownership from control and the conflict between ownership and management interests" (Ma, 1982, p.129). Based on agency theory Watts and Zimmerman (1979) suggest that accounting theories are supplied in response to demand for theories.

Theory construction is a continuing process. A dynamic theory must evolve in the light of changing circumstances, and is a cumulative activity in the manner suggested by Kuhn (1970). In this accumulation of knowledge, through which theory is likely to evolve, empirical analysis has an important role to play through the process of theory verification.

"It is probably correct that if a theory becomes too precise too early it can have tendencies to become too sterile. It is also probably correct that if a theory stays too vague and ambitious too long it can be harmful in that nothing can be done to disprove it or change it. This probably means that theories, when vague, should at least be stated in a form which makes the adding of precision possible as knowledge increases. It also probably means that theory should run ahead, but not too far ahead, of the data so that the trap of premature precision can be avoided. It certainly means that theories, whether vague or precise, must be in such a form that empirical data can influence them". (Festinger, 1950, p.271).

This research has thrown some light in this process of theory construction, giving empirical evidence on the influence of segmental geographical disclosure practices on risk profiles of UK based multinationals.

But, a theory is a prescriptive or descriptive model whose validity is independent of any goal structure, while a policy requires a commitment to goals, and therefore, requires a policy maker to make value judgments. Policy decisions presumably are based on both an understanding of theories and acceptance of a set of goals.

"Since the selection of a set of goals is inherently a value judgment, most debate about sets of goals is a debate about whose value judgments are best. The resolution of the problem of goals must be resolved by general agreement, not by proof of correctness." (May and Sundem, 1976, p.748).

So it is with disclosure policy.

9.4 Summary

Chapter IX has been concerned with the implications of the results of the tests of hypotheses in this research. First implications for market efficiency have been explored. It has been shown that since treatment group average betas in the postintervention period were significantly different from preintervention period, there was likely to have been association between segmental geographical disclosure practice and systematic risk, suggesting that segmental geographical data had information content. It has been further shown that the impact of this change in systematic risk profile has been abrupt in response to the intervention variable, suggesting that the London stock market was likely to have been efficient in a semi-strong sense in response to segmental geographical information about multinationals.

Implications for risk assessment have been discussed next. It has been shown that geographical segment disclosure is associated with risk assessment benefits for the disclosing companies since post-intervention period betas for treatment group were lower in response to intervention. Geographical segment disclosure can result in lower equity cost of capital. The contribution to knowledge of this research lies in the following: First, market efficiency and risk assessment have been explored in the context of geographical segment disclosure, while earlier research in this area have been almost exclusively in the the context of line of business disclosure. Second, the methodology applied in this research is intervention analysis while cumulative average residual methodology has been the vogue in earlier research. Third, while most of the earlier research have been conducted on US data, this research has used a UK database.

Having explored the implications for market efficiency and risk assessment, the implications for disclosure policy have been discussed next. The advantages and disadvantages of mandatory and voluntary disclosures have been examined in the context of agency theory, incentive signalling, market failure and nonmarket failure theories. It was concluded that due to the multiperson nature of accounting information, and its public goods characteristics, any recommendation on disclosure policy will have to be settled as a political choice in an institutional setting.

Chapter X following will summarize the main strands of this research, and point to areas of possible further research.

9.5 References

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10.0 Introduction

In earlier chapters of this thesis the research problem has been introduced and its theoretical background has been explored. Prior research has been cited and discussed, the database and research design have been explained, results obtained and implications analysed.

In this chapter the following is envisaged:
First, the major threads of this research will be brought together in summary form by restating the research problem, the research approach used, and results obtained from this research. Implications of this research and its contribution to knowledge will be discussed next. Following this the limitations of this research will be stated and areas for future research will be discussed.

10.1 Summary

In chapter I, the problem of geographical segment disclosure has been introduced. First, the historical development of financial reporting has been traced, and the importance of geographical segment disclosure in the context of conglomerate mergers has been shown. The objective of this research has then been explained, and the limited nature of the objective has been pointed out. Following this the possible contribution to knowledge from this research has been discussed.

In chapter II, the relevance of user needs and user environments in a disclosure framework has been explained, following which the concepts of information in a quantitative as well as a qualitative sense has been explored. Since financial information can affect various user groups, information problems in a multi-person setting have also been discussed.

Having explained the information concepts in chapter II, the issues of segmental information disclosure have been analysed in chapter III. Disclosure criteria - predictive ability, decision usefulness, and social welfare maximization have been explained and their interdependence have been emphasised. Geographical segment disclosure being the special area of investigation in this research, the need for geographical disclosure, and special problems related to geographical segment disclosure have been analysed separately.

Capital markets' reaction to segmental geographical disclosure has been the concern of the next two chapters. Chapter IV has explored the problems of information disclosure in the capital market emphasising market efficiency concepts and tests, and shown the relationship between the efficient markets concept and the concept of economic efficiency. Chapter V has been concerned with risk assessment in capital markets. The concept of risk has been explained, developments in portfolio theory, market model, and capital asset pricing have been explained, and the special problems of risk measurement in a geographical segment disclosure context in a capital asset pricing framework have been dealt with. The relationships between geographical segment disclosure and international capital markets have also been explored.

Prior research in geographical segment disclosure have been discussed in chapter VI in a background of disclosure problem in general, and segmental disclosure in particular. It has been shown that prior research in the area of geographical segment disclosure have been extremely scarce, and support for the benefits of geographical segment disclosure has been found in the international capital markets literature.

The empirical element of this research has been introduced in chapter VII where hypotheses, database, and experimental design have been explained. It has been stated that the two hypotheses of this research are related to (i) market efficiency and (ii) improved risk assessment benefits stemming from geographical segment information. Reasons for the choice of the database have then been discussed and the rationale for choosing intervention analysis in preference to cumulative residuals analysis have been explained.

Chapter VIII has been concerned with analyses of the data to test the hypotheses using the experimental design argued for and explained in chapter VII. Results obtained have substantiated both the hypotheses of this research; support has been found for market efficiency in a semistrong sense, as well as for risk assessment benefits stemming from geographical segment disclosure.

In chapter IX the implications of the findings in chapter VIII have been analysed. Implications of the findings from this research have been categorized under three headings: implications for market efficiency; implications for risk assessment in general and in the context of international capital markets in particular; and the implications for disclosure policy formulation.

This then is an outline of what has been done in this research. The contribution to knowledge stemming from this research will be explained in the next section.

10.2 Contribution to Knowledge

In chapter I, (section 1.6), expectations about contribution to knowledge stemming from this research were stated. In this section the realization will be matched with earlier expectations to establish what has been achieved.

(i) It was stated that segmental disclosure studies in general have been scarce in the UK context. Almost all prior studies of an analytical nature in this area have used US databases. One of the objectives of this research was to extend disclosure studies of an analytical nature to a UK database. This has been accomplished.

(ii) There has been only one earlier study of an analytical nature using a UK database, i.e., Emmanuel and Pick (1980), which was concerned with examining the forecasting ability of segmental data. There has been no study in the UK context exploring the risk assessment aspects of geographical segment information. Even in the USA, where most of the disclosure related studies in the capital markets context have been carried out, apart from Kinney (1972), there has been no published research in the area of geographical segment disclosure. Even Kinney was not exclusively concerned with geographical segment disclosure; his main concern was disclosure of a line of business variety.

By concentrating on segmental geographical disclosure, this research has filled a gap in the spectrum of knowledge.

(iii) Similarly, market efficiency studies on segmental information in the UK has not been undertaken in the past. Earlier studies on stock market efficiency in the UK context have examined weak form efficiency (Dryden, 1970a), and semistrong form efficiency in response to rights issue announcement (Marsh, 1979), but none of the earlier studies have tested the efficiency of the London stock market in response to segmental information. By examining the London stock market's reaction to geographical segment information this research has contributed to market efficiency tests in the UK context.

(iv) This research has contributed to the fund of knowledge by substantiating the claim that the country factor is an important influence in international capital asset pricing (Lessard, 1974).

(v) The establishment of the country influence as an important variable in the international capital market setting provides evidence in support of multifactor capital asset pricing models, such as Arbitrage Pricing Theory (Ross, 1976). The country factor could be identified as one of the 'k' factors in the linear regression in arbitrage pricing (section 5.523).

(vi) On methodology, this research has used intervention analysis rather than cumulative average residuals. The contribution to knowledge from this lies in providing support for intervention analysis as a plausible method of research in testing market efficiency, alongside, if not supplanting, the popular cumulative average residuals.

Similarly, it has used moving betas to generate a time series of betas, and beta of betas to test the stability of the beta series. Intervention analysis, though rare, is not entirely new in security markets research. Deakin (1976) for instance, has used intervention analysis in studying the behaviour of security returns. Similarly, moving regression analysis, though rare, is not entirely new. Following Brown, Durbin and Evans (1975), Collins and Simonds (1979) have used the moving regression method. What is entirely new, however, is a simple technique: beta of betas (section 8.222) in testing the stability of beta over time. Since this is novel, and has not been used previously in security markets research, the use of beta of betas can be construed as a contribution to knowledge.

(vii) Finally, on policy issues, this research will have contributed to the fund of knowledge having re-examined the arguments for and against regulation, the weaknesses of incentive signalling, and the costs of market and non-market failures. This will add substance to the issue of segmental disclosure in the United Kingdom.

10.3 Limitations

Limitations of this research are of two types:

A. Limitations stemming from the limited nature of the research objective outlined in chapter I (section 1.4); and

B. Limitations inherent in the methodology used in this research.

A. Limitations stemming from the objectives are:

(i) Restriction in the scope of this investigation due to being solely concerned with geographical segment disclosure, to the exclusion of line of business or other forms of disclosure. While this is a strength of this research in that it has explored a comparatively new territory, it is also a weakness in that it has searched only a small part of the problem.

(ii) Similarly, this research has been concerned with only a UK database, which means that it has external validity of a limited nature, especially when the inferences are extended to other countries.

(iii) The user group investigated are investors only, to the exclusion of many other user groups, such as employees, trade unions, consumers, regulatory authorities and many others.

(iv) It has excluded the direct consideration of the costs of segmental disclosure from its scope, concentrating almost exclusively on disclosure benefits. A complete policy analysis demands that costs as well as benefits should be included in the scope of the investigation.

(v) Even while investigating disclosure benefits, this research has been concerned with risk assessment aspects only, to the exclusion of other possible benefits, such as the improved forecasting ability of segmental data.

(vi) Even within the realm of risk measurement aspects, this research has only used the two parameter mean-variance model on which the capital asset pricing model is based, thus excluding the higher moments such as skewness or kurtosis from the scope of the investigation.

(vii) Finally, to avoid 'estimation risk' (section 5.511) which demands that the number of companies investigated should be smaller than the number of data points in the time series, this research has investigated only thirty-six companies, twentyone in the treatment group, and fifteen in the control group. A larger number of companies could make the investigation more complete.

All these limitations have been necessary to keep this research within a manageable size and in recognition of constraints as to the availability of data.

B. Limitations stemming from the research methodology are:

(i) Firstly, market related risk, beta has been analysed to derive the results of intervention effect. Limitations related to the use of beta in intervention analysis remain the limitations of this research. Breen and Lerner (1972) have investigated the use of beta in regulatory proceedings and found it lacking because empirical measures of beta are known to depend upon
(a) the estimation equation that is used;
(b) the choice of market index, and (c) the specific period that is selected for beta measurement. There are other problems related to the use of beta in capital markets research such as the stability of betas, the intervalling effect, the effect of nontrading, and others. These inherent limitations have been mentioned earlier in this research in chapter V (section 5.5).

(ii) Risk assessment of multinationals in this research have been accomplished in the context of capital markets theory. It is possible that the Capital Asset Pricing Model may not be whole story about risk and return on either a theoretical or an empirical basis. It may be possible to evaluate disclosure effort outside the capital market framework. A wider social or organizational viewpoint may be desirable (Fieldman and March, 1981).

(iii) Companies chosen in the sample have been made mainly on the grounds of practicality. Since geographical disclosure was being investigated, the companies had to have substantial overseas business. Companies had to be listed continuously on the stock market during the nine year period of investigation to be able to measure the disclosure impact on their stock prices. It is possible, therefore, that there are biases inherent in the sample. Such biases could include survival bias and large company bias. To the extent that such biases do exist, they constitute further limitations of this research.

(iv) Finally, there is a limitation due to the choice between a type I and a type II error. "In performing statistical tests, there exist chances of making mistakes due to the fact that purely by chance a sample may not be representative of its population or that the underlying distributions of the dependent variable measure do not confirm to those assumed in the statistical tests employed" (Collins and Dent, 1979, p.17). The possibility of making errors due to inappropriability of the method used in this research has been reduced by applying stability tests and tests of autocorrelation to the beta series (section 8.22). But the possibility that the sample of thirty-six companies chosen may not be representative of the population remains.

Errors resulting from statistical testing in this research can be of type I or type II variety. Type I error would occur when it is decided that geographical segment disclosure affects risk profile, when it really does not. Type II error would occur in failing to find an effect when one exists. If there are errors in this research, it would be of type I variety.

To the extent that type I error might remain, this is a limitation of this research. However, it is not possible by applying statistical tests to eliminate both type I and type II errors at the same time. "In any statistical inference a danger exists of committing one of two alternative types of errors" (Siegel, 1956, p.9). Control should be applied to that error which would have the greatest cost were the error realized.

If it is determined incorrectly that there is a market effect, when in fact there is none, then financial statement users will have to bear the costs of additional information production, and diseconomies will result from type I error. On the other hand, if type II error is committed i.e., one fails to find significant change in risk profiles as a consequence of geographical segment disclosure, when there existed such a change, then the potential consequences are likely to be more costly than would be the case with a type I error. Thus type II error is likely to be more costly from societal viewpoint than type I error. This is so in the case of geographical segment disclosure issue because in most instances the information is likely to be available in companies, and the additional cost of disclosing existing information may not be all that great in spite of potential competitive disadvantages. This, however, is subjective, and not necessarily conclusive.

Control of type II error is difficult, but not impossible. One of the ways the control of type II error can be achieved is by exercising due care in selecting appropriate 'treatment' and 'control' group firms. This, hopefully, has been achieved by distinguishing companies as to their geographical segment disclosure practices (section 7.2). A second way of minimizing a type II error is to use test procedures which are appropriate. Moving regression analysis, stability tests, and tests for serial correlation (section 8.22) have been performed to achieve this.

The influence of extraneous variables have also been tested by examining the influences of changes of rates of return on equity, and changes in financial leverage on moving betas (section 8.4).

The possibility of type II error remaining has been minimized. The possibility of type I error remains. But the limitations of this research due to the existence of type I error remaining has been considered to be less costly than the possibility of type II error remaining. Support for this view of costs of type I and type II errors can be found in Collins and Dent (1979).

10.4 Areas for Future Research

Areas for future research as a sequel to this research study can be grouped into four categories:

A. Within the framework of financial reporting.

B. Extensions in the context of international capital markets.

C. Within the capital markets framework, but outside the framework of the Capital Asset Pricing Model.

D. Beyond the framework of capital markets research.

A. Within the framework of financial reporting extensions to current research can be as follows:

(i) By eliminating some of the restrictive assumptions of this research such as increasing the number of companies in the sample, by including companies from many different countries in the sample, by selecting a different intervention point, by examining line of business disclosure in a framework of intervention analysis, and by investigating a further control group, additional evidences could be obtained which would extend the external validity of this research.

(ii) By investigating disclosure costs, such as costs of competitive disadvantages, costs of information production and dissemination, possible agency costs, and costs of non disclosure by comparing costs of equity capital and costs of obtaining credit between disclosing and nondisclosing companies over time, this research could be extended and be helpful in policy formulation in the area of financial reporting.

(iii) In the context of disclosure in general, Cerf (1961), used a consensus study (6.12) which has been used by Singhvi and Desai (1971) and others to establish a disclosure index. In the context of segmental disclosure it would be possible to establish a similar disclosure index. This would help in reducing many of the problems of segment identification, segment materiality, and meaningfulness; it would also help in deciding which items are worth disclosing and which are not. A questionnaire could be designed listing a large number of possible items that could be disclosed in the context of segmental disclosure. A voting mechanism could be used to identify which items are important. Perhaps some kind of factor analysis or similar multivariate analysis could be used to establish discriminating power of each of these possible disclosable items.

B. Extensions to this research in the context of international capital markets are envisaged as follows:

(i) A comparative analysis could be conducted by comparing line of business disclosure with geographical disclosure. Information about geographical segments can, in many cases, include line of business information when a particular subsidiary is engaged in a single product activity; similarly line of business disclosure can in some cases include geographical information. In the international capital markets literature the Grubel (1968) and Agmon (1973), debate has been about whether there exists benefits from geographical diversification. It has earlier been stated in this research (section 9.2) that to be able to demonstrate conclusively that international capital markets are segmented, it is necessary to show that the benefit from international diversification is greater than uninational line of business diversification for matched pairs.

This could be achieved as follows: First companies of similar size and similar product groups (according to standard industrial classification) could be selected, but there would be one characteristic which would be different between the control group and the treatment group. One group would be entirely uninational, while the other group would have to be transnational. If it could be shown that the risk characteristics of the uninational companies are significantly different from that of transnational companies, then some conclusive evidence regarding segmentation of international capital markets would emerge.

(ii) A further extension in the area of international capital markets would be investigating industry and country influences on UK based multinational's systematic risk profiles.

C. Within capital markets research, but outside the framework of the Capital Asset Pricing Model this research could be extended by examining the higher moments such as skewness or kurtosis differences between disclosing and nondisclosing companies over time. Similarly it would be possible to investigate the total variance and not just systematic risk differences between disclosing and non-disclosing companies, in the same manner as Kinney (1972).

D. Beyond the framework of capital markets but within the framework of financial reporting, this research could be extended by investigating actual or potential costs and benefits to user groups other than investors.

Such extension could be in the area of employee reporting for instance, and could be conducted in an organization theory context.

10.5 Concluding Remarks

This research has examined geographical segment disclosure in the United Kingdom in the context of diversification and mergers. Theoretical analyses of this research have explored information theory and the theory of capital markets. Additional support in terms of theoretical development has been found in the international capital markets literature. The limited objective of this research has been to investigate risk assessment aspects of UK based multinationals disclosing geographical segment information. Empirical investigation in this research has shown that geographical segment data are likely to have information content; that the London stock market is likely to have been efficient in a semi-strong sense in response to geographical segment information; and that geographical segmental information disclosure is likely to be associated with overall risk reduction for disclosing companies.

The contribution to knowledge stemming from this research lies in its conduct of market efficiency tests in the UK context of which there have been so few; in being the first ever study to test the disclosure benefits hypothesis for geographical information in the context of the United Kingdom; in the use of relatively novel methodology in the form of intervention analysis and beta of betas;

and in providing evidence bearing on the segmentation of international capital markets using UK based multinationals.

Areas of future research can be seen to exist in the field of financial reporting, in the field of international capital markets and beyond. The policy implications of this research can be seen to lie in the potential contribution to the debate on segmental disclosure in the United Kingdom.

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CHAPTER XI

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