A STUDY INTO THE RELATIONSHIP BETWEEN ACCOUNTING INFORMATION AND SHARE PRICES

by

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ABSTRACT

This research reports on an investigation into the utility of published accounting information to the most sophisticated user the investor. The approach adopted is to paramorphically represent the investor's decision making process by seeking to establish a set of causal relationships between accounting number based inputs to this process, and the outputs, viz relative share prices. Unlike previous studies in this area, this research explicitly recognises the configural nature of human information processing activity. Application of an appropriate methodology to uncover and explore these configural realtionships, Automatic Interaction Detector (AID), offers original insights into the share price fixing mechanism. More specifically the results obtained provide evidence on:
1) the degree of association between published accounting data and share prices and thus a measure of the value of accounting information to investors,
2) the compexity of the investor's decision making process and
3) the validity of certain established theories in finance.

Whilst analysis highlights the strong relationship between historic accounting information and relative share values the evidence presented is consistent with the thesis that only a limited set of measureable accounts-based variables may be used in the assessment process, viz earnings, dividends, short-term liquidity and marketability. Moreover, the complex set of interactions identified between these variables confirms a priori expectations on the configural nature of the investor's decion making process. A close examination of these interactions reveals that although earnings and dividends may dominate relative share values, the extent of their influence varies with the underlying quality of earnings. These findings have implications for the theory of share valuation, the dividends versus earnings controversy and the role of investment risk in the U.K. stock market. Empirical evidence relating to to the capital structure debate is also provided.

Other areas of investigation encompass an examination of the most appropriate measures of relative share valuation for this type of research, a comparison of the merits of linear additive and configural analytical techniques, and the dimensionality and normality of financial ratios.

The operational utility of the 'decision-usefulness' criterion in the evaluation of accounting numbers and the use of pragmatic empiricism in the application of this criterion are also critically appraised.

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

LIST OF TABLES

LIST OF TABLES (concluded)

LIST OF FIGURES

LIST OF FIGURES (concluded)

LIST OF APPENDICES

CHAPTER I

THE SCOPE AND NATURE OF THE RESEARCH

1. Introduction

In recent years there has been a significant change in emphasis within the accounting profession away from the traditional stewardship function and more towards a decision-usefulness paradigm. Official recognition of this change can be found in both the U.K. (The Accounting Standards Steering Committee, 1975) and in the U.S. (American Accounting Association, 1977). The objective is to enhance the underlying utility of accounting information to the user, which implies the need for changes in the format and content of financial statements to make them more relevant to his particular decision making process. However, despite the benefits that would accrue to financial statment users from some changes little progress has been made in overcoming the conceptual, theoretical and empirical contraints which prevent significant progress being made in actually meeting the user's informational needs. The crux of the problem stems from, on the one hand, the constraints imposed by traditional accounting methods (eg. S.S.A.P.2) on the accountant and, on the other, the inability of users to specify the information that they require from financial statements. Furthermore, even if it were possible for all user groups to detail all their informational needs, it is unlikely that the accountant could produce a single report to cover all of these, nor could he reasonably argue that his function is to provide non financial information readily available from more immediate sources. However, although the objective of being able to satisfy all user needs may be unobtainable, there is a definite need to clarify the issue of the current utility of accounting information to the sophisticated user and thus provide a foundation upon which improvements can be made.

In this thesis we advocate the use of empirical research to aid this development and believe that emphasis should be placed on understanding informational needs of the most sophisticated user group, namely the investment community. We have chosen to focus upon this group, who are generally considered the most skilled and dynamic of all users, as this subsumes most other user groups (althought we recognise not all). Investment analysts are reported in many articles and finance texts as using accounting information in their decision making process, although, it is noted that of course this source of information represents only a part of the total amount of information available to the analyst. Thus as there is evidence to indicate that published accounting information is used by the external analyst in company appraisal, it is reasonable to expect a relationship to exist between the valuation of a company by an investor and the data produced in the annual accounts. This hypothesis has been examined empirically by a number of researchers (see chapter IV for a review) to date and the general conclusion reached is that although certain accounting numbers seem to be related to share values, there still exists a very large gap in our understanding of characteristics of the equity decision process. Benston (1981) in a recent review of this area concludes:

> "While these findings are not trivial, they provide but limited conclusions about which specific data are used by investors."

The aim of this thesis is to investigate the utility of accounting information to investors by examining the relationship between accounting numbers and relative share prices. Whilst this type of study is not designed to lead to recommendations for changes to the structure and content of accounting reports, such exercises should contribute towards, providing relationships can be found to exist, towards clarification of the role accounting information plays in the share price fixing mechanism. Furthermore, the establishment of a set of relationships of this nature can provide a basis for the examination of current theories on share valuation and market behaviour. Consequently the scope of this thesis covers important issues in both accounting and finance. On the one hand there is an attempt to gain insight into investors' informational needs and on the other, an examination into how various factors, discussed at length in the finance literature, such as dividend policy, gearing, risk etc. actually appear to affect the investors share valuation process.

2. The Dynamic Nature of Accounting

Tricker(1979) in his article on research in accounting describes accounting as "an adaptive subject responding to changing situations in the world it serves" and further indicates that accounting must continue to adjust to the environment in which it is employed or it will become redundant and worthless. This point of view is reinforced by Abdel-Khalik(1975) who sees the users of accounting information as having complex and dynamic needs which the accountant must respond to and try to satisfy. However, both these views on the function of accounting have a strong proviso, which is that when accounting does change to meet environmental needs, the changes should be based upon systematic theory and a better understanding of the purpose for which accounting statements are employed. Without a sound conceptual framework and a thorough understanding of user informational needs, any changes introduced by the accounting professional suffer from the possibility of being unjustified, and at worst misleading, and may serve merely to undermine the purpose of accounting statements in general.

One of the key problems in the development of accounting practice is that it appears to be following a "flavour of the month" approach (taken from Tricker) in that proposed changes in accounting measurement have become so profuse that the potential user of accounts becomes bemused or sceptical about "all" accounting information. This weakening in the perceived utility of accounting statements is attributed to societal pressure to find quicker and better solutions to current perceived problems. One possible cause of this situation is the absence of empirical evidence to substantiate any proposed changes in accounting principles. Without empiricism there will always be the missing link between environmental needs and the accountants' response to satisfy those needs.

Beaver(1979) in his paper on current trends in accounting research argues that if information is to have a value to the user, then it must be capable of altering beliefs such that actions are altered. Furthermore the author believes there is a need to emphasise a "positive rather than normative" approach to the problem and to be "empirical rather than analytical". As a result Beaver suggests that security price research is the most positive route forward to solve many of the important issues that remain unanswered.

In this thesis some of the empirical evidence presented may help contribute towards providing a basis for understanding some of the financial informational needs of investors. If it is possible to uncover an association between accounting information and the end result of an important decision making process that uses that information, then it is reasonable to make inferences as to the nature of the decision making process, the informational requirements of the user and possibly the format and presentation of financial statements. Because of the dynamic nature of accounting any set of relationships may vary over time and require continual reassessment, but without any formal structure it is not possible to readily determine the changes to the structure necessary to meet enviromental needs. For example, if in this study a strong association were found between certain accounting variables and relative share prices, the consequences of redefining or excluding any of these variables from an annual report would be to modify the utility of the accounts to the investor and result in him (unwillingly) having to change his decision making processes. Thus one of the benefits that could result from this type of study which attempts to clarify the role of accounting information in the investors decision making process is that it could aid in the improvement of the content of accounting statements.

3. <u>The Research Design</u>

One of the principal criticisms in accounting and finance research made in the literature is that many studies which could prove valuable to advancing the body of knowledge employ a research design inappropriate to the topic under consideration. Abdel-Khalik(1975) suggests two main reasons for this behaviour by researchers. The first is that they approach the problem with a purely scientific structure which often leads to "weak research design". The second reason stems from the dynamic nature of accounting and the constantly changing environment which means that even "well planned research may not lead to a known predictable outcome and the inferences applicable in any given setting are not necessarily applicable to others". Consequently the results of such research become contingent on the situation and most become situation specific.

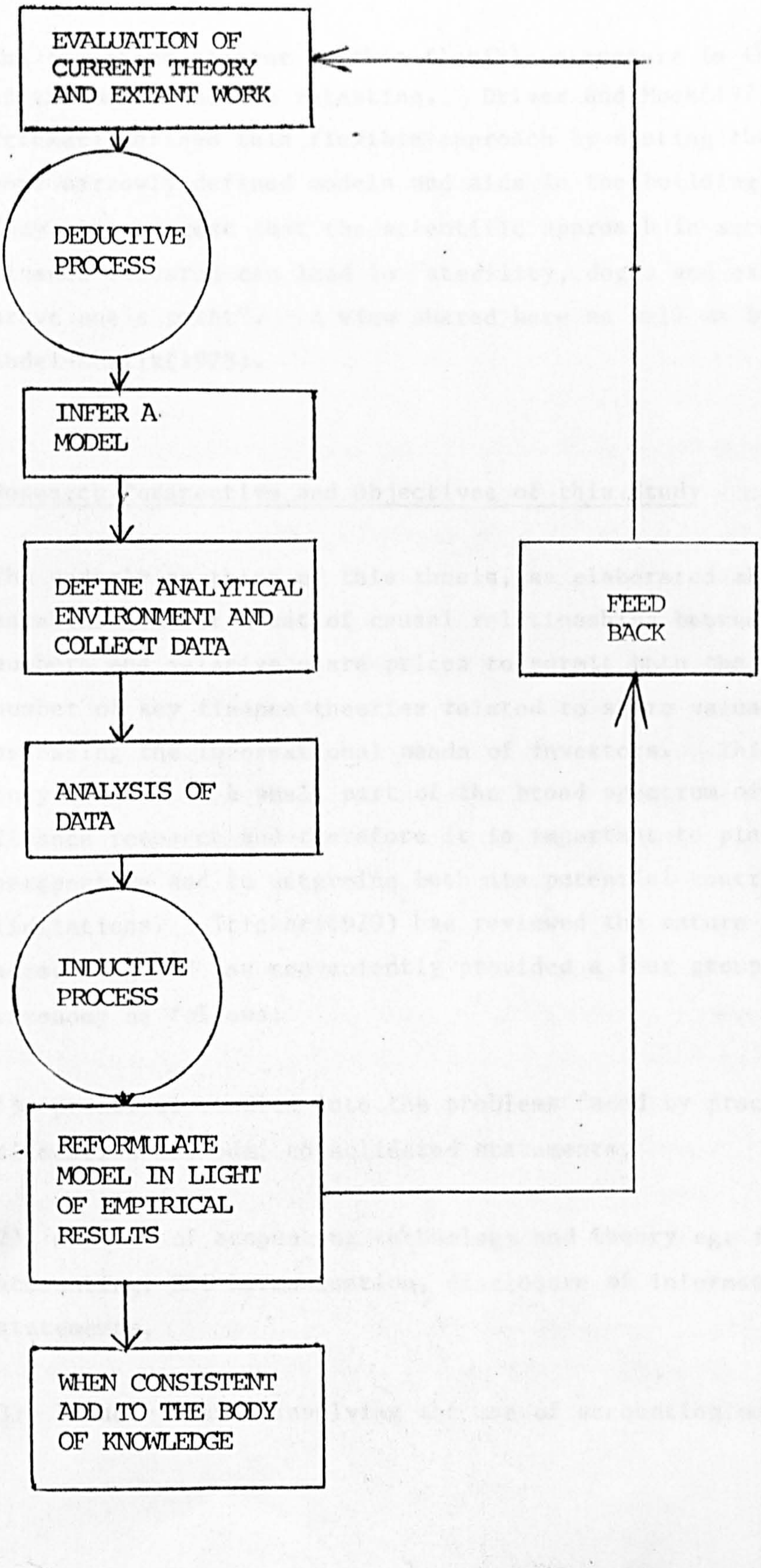
Tricker(1979) examines two approaches to this problem of research design. The first is the classical deductive approach where the flow of research commences with a body of knowledge, followed by the formulation of hypotheses and finally ends with the testing of those hypotheses. If the hypotheses prove to be supported the body of knowledge is added to, if not, then nothing is achieved. This type of research structure is usually confined to the pure sciences such as physics and chemistry, where the failure to obtain positive results can be considered as unimportant in the advancing of the frontiers of knowledge. If this attitude is adopted in accounting research it will often lead to a frustrated researcher!

The second approach is called the "feed-back" method (Tricker, 1979) or the naturalistic approach (Abdel-Khalik and Ajinkya, 1979) and is more appropriate for accounting and finance research as it takes into consideration the less exact nature of the social sciences, of which accounting and finance are members. Figure 1 shows how this approach has been adopted in this research.

The figure shows that the first step in the process is to evaluate the current theories and relevant empirical studies. In this thesis this aspect is covered by a detailed review of three areas namely, the utility of accounting information to investors, the ability of humans to process such information and the conceptual framework covering the many finance issues on share valuation theory. In this way we are able to formulate a model that we would expect to find in the real world. Once the data has been collected and the environment for the analyses has been established then the model is tested for its appropriateness. The process does not stop here, however, as it would in strictly scientific research, for the results of the analyses are then used to reformulate the original model, which is then retested for robustness under different conditions.

Figure 1.1

RESEARCH DESIGN: THE NATURALISTIC APPROACH



In other words the research design allows for feedback and continual reformulation of the basic model. Finally, when the model is found to be consistent with the empirical results, that is a causal relationship has been established, then it may be accepted as part of the body of knowledge.

The important element of this flexible structure is the reformulation of the model and the retesting. Driver and Mock(1975) (quoted by Tricker) defined this flexible approach by stating that it leads to more narrowly defined models and aids in the building of theory. They also suggest that the scientific approach in accounting and finance research can lead to "sterility, dogma and excessive need to prove one's point". A view shared here as well as by Abdel-Khalik(1975).

4. Research Perspective and Objectives of this Study

The underlying theme of this thesis, as elaborated above, is the establishment of a set of causal relationships between accounting numbers and relative share prices to permit both the testing of a number of key finance theories related to share valuation and for assessing the informational needs of investors. This study, however, only relates to a small part of the broad spectrum of accounting and finance research and therefore it is important to place it in perspective and to determine both its potential contributions and limitations. Tricker(1979) has reviewed the nature of research in accounting and has conveniently provided a four group project taxonomy as follows:

1) practical studies into the problems faced by practioners eg. cost allocation methods, consolidated statements,

2) matters of accounting technology and theory eg. inflation accounting, EEC harmonisation, disclosure of information, value added statements,

3) broader issues involving the use of accounting numbers eg.

decision making and the information needs of user groups, human asset accounting, and

4) long term concept issues eg. human information processing, human value systems and the effects of information.

We can see that our research can mainly be grouped into the third type of project, that is the area of broader issues involving the use of accounting numbers, although our results could have implications for accounting theory (type 2) and also for long term concept issues (type 4). Despite this break down into the different types of research, each definition still covers a vast spectrum of research topics and in order to appreciate the scope of this thesis it is necessary to be more specific.

The starting point of our empirical work is the examination of the degree of association between published accounting information and relative share prices. Whereas this is of interest in its own right, both with regard to accounting and human information processing issues, we will be using the models developed to explore, in a novel way, a number of fundamental issues relating to company valuation and financing decisions. Although a number of other studies have also attempted to unravel the complexities of the share price fixing mechanism and to establish the link between accounting information and share prices the results of these studies have not been very enlightening and have "added only rudimentary insights into the decision making processes of users" (Abdel-Khalik, 1975). The reasons for this general lack of advancement have been attributed to many factors ranging from conceptual problems, communication deficiencies and inappropriate methodology (Benston, 1981).

Whilst we hope we have benefited in our endeavours from the experiences of these earlier researchers we recognise that there are many key issues in the theory of finance that remain uncertain and vague in practice (as opposed to theory), for example, do dividends actually influence share prices, is the market indifferent to capital structure how is risk evaluated in the U.K. stockmarket and what are the key factors that determine the rate at which the market discounts earnings? This study is designed to attempt to shed some light on some of these grey areas.

Apart from employing a theoretically defensible and more robust framework, we believe that we have also adopted a new and more appropriate methodological approach. All the extant studies in this area have employed linear additive statistical tools. This means that any association uncovered is explained by a string of weighted variables and implies that each variable has a specified contribution to the model regardless of the values of other variables.

Research into the way humans process information has revealed that this linear additive approach is not a true representation of how input variables are combined within a decision making process (eg. Libby and Lewis, 1977, Baker, 1977), and that the investment decision process does incorporate certain configural relationships (Slovic, 1972). In other words an analyst's interpretation of an item of information is likely to vary depending upon the nature of other information in his possession. For example, Slovic(1969) found that a high dividend yield was a more favourable indicator than low yield when the profit margin trend was down, while the reverse is true when the trend is up. This interaction between variables can be explained quite rationally and therefore can be considered to be a fundamental part of the share price fixing mechanism. The major drawback of the Slovic approach to understanding the investment process is that it requires the close monitoring of how the analyst processes information and is limited to the number of analysts that can feasibly be studied. Although this approach reveals interesting results it is fraught with potential methodological bias and misinterpretation of the analytical process and consequently is severely limited from an inductive point of view.

To overcome the deficiences of both approaches we have used a novel methodology known as AID (Automatic Interaction Detector). In the first place AID permits large data bases to be analysed in a global manner, and secondly searches and allows for interaction between variables. Thus by applying this technique in the appropriate manner it is possible to explain relationships between accounting information and share prices in a way that would appear to be consistent with the cognitive processes of the stock market.

This broad outline of the issues examined in this thesis can be summarised in the form of a set of specific objectives:

a) to test the hypothesis that there is a relationship between accounting numbers and relative share prices.

b) to test the hypothesis that the cognitive processes of the market as a whole are interactive by nature.

c) to study the applicability of the various theories on share valuation, dividend policy, capital structure, fundamental risk and systematic risk in the U.K. stockmarket.

Nevertheless, this thesis is not without its limitations. Firstly, it is important to recognise that accounting information represents only a subset of the total information available to the investment community. The effect of this is that any conclusions we draw are limited to the quantitative variables as opposed to qualitative variables which are very difficult to measure and consequently not amenable to the type of analysis reported in this thesis. Secondly, the results of this study are confined to one time period and therefore any conclusions drawn must be qualified in this respect. Lastly, whilst we recognise that share prices are considered to be reflections of future expectations rather than historic performance, we have employed a methodology that tries to explain relative share values in terms of historic accounting information. However, we would argue that by relating accounting information to relative share values on the day after the publication of that information, that we have reduced this potential problem to a minimum. Furthermore, in chapter IV some empirical evidence is reported that suggests that the use of forecast data in this type of analysis is unlikely to significantly improve the models derived.

5. Outline of the Thesis

In order to achieve our objectives defined above this thesis is arranged as follows. The next three chapters develop the conceptual and theoretical issues underlying the research further with the aim of clearly identifying the research task. In chapter II the purpose and utility of published accounting information is highlighted with particular emphasis on the "hidden strengths" of accounting numbers. The next chapter, chapter III, addresses the implications of human information processing in accounting. This includes an examination of the nature of the decision making process and formulates a basis for the use of models to paramorphically represent the investor's decision making process. In chapter IV we examine the extant literature and current theories on the link between accounting information and share prices. The objective of this chapter is to establish a conceptual framework as an aid to the subsequent model building. In other words we attempt to formulate our models on the back of a thorough grounding both in theory and from a detailed analysis of related empirical work and thus provide a sound basis for the interpretation of our results. In this chapter several hypotheses related to the theory of finance are developed.

The next part of this thesis presents the data analysed, the empirical models formulated and their relationship with the conceptual framework. Chapter V presents the data analysed and includes the criteria for selecting companies and variables included in the analyses, the various tests performed on the data to assess its amenability to statistical analysis and an examination of the dimensionality of the variables. In chapters VI and VII the models developed are evaluated in terms of both their statistical rigour and the inferences they permit about the issues in accounting and finance investigated and more specifically on the acceptability of our hypotheses. As an extension of these analyses chapter VIII discusses in detail the utility of risk to the investor. Finally the thesis is completed with a summary of the conclusions, benefits, limitations and constraints of the study and points to areas where it would seem further research could be conducted.

CHAPTER II

THE PURPOSE AND UTILITY OF ACCOUNTING INFORMATION

1. Introduction

The origin of company annual accounts as we know them today dates back to the Companies Act of 1844 when legislation was introduced compelling the management of limited companies to provide shareholders with a report on how they had employed the funds under their control. The purpose of the Act was to provide support to management claims that they had acted honestly and in the shareholders' best interest, and thus try to prevent the fraudulent behaviour found in several joint stock companies around that time. The function of the annual accounts was simply to provide shareholders with a means for assessing the stewardship role of management. This idea of stewardship was not new, in fact it dates back to the Middle Ages (Guter & Guter, 1978), the 1844 Act merely formalised the type of report.

Over the last ten years the accounting profession has begun to examine the structure of financial reporting and accounting as a whole, the aim being to produce information that is more meaningful to the user. The purpose of accounting information has therefore received a great amount of attention and many theories have been proposed, almost invariably argued on a normative basis, on how to change the content of accounts to meet these new goals. Unfortunately many of these theories have been divorced from an understanding of how accounting information is used in practice and therefore have little value.

The purpose of this thesis is to provide some empirical evidence on how accounting information appears to be used by a particular user group, namely the investor, by the use of model building. From the evidence revealed by this study it is hoped that we may be able to (1) shed some light on the informational needs of the investor and thus aid the construction of a framework upon which changes to the format and content of financial statements can be based, and (2) gain a valuable insight into the nature of the investor's decision making process which in turn should provide a basis for evaluating such pertinent issues in finance as the impact of gearing on share values, the role of dividends in the market and the valuation of shares in general. In this chapter we therefore review the theory underlying the decision usefulness approach to accounting with a view to establishing the purpose of accounting information as perceived by the accounting profession. In addition we examine what we like to call the "hidden strengths" of accounting numbers, and demonstrate how valuable such information is as an input to the financial decision process.

2. Objectives and Function of Financial Statements

The Institute of Chartered Accountants' conventional view of the aim of financial reports, as expressed in Recommendation N15 in 1952, was that "The primary purpose of the annual accounts of a business is to present information to the proprietors, showing how their funds have been utilised and profits derived from such use". This view was withdrawn in 1974 because it was felt that it was incomplete and unsympathetic to modern needs. In 1975 the Corporate Report(A.S.S.C., 1975) replaced this conventional view with the following:

> "The fundamental objective of corporate reports is to communicate economic measurements of and information about the sources and performance of the reporting entity useful to those having reasonable rights to such information."

This view has been reciprocated in the USA where in 1977 the Committee on Concepts and Standards for External Financial Reports produced a Statement on Accounting Theory and Theory Acceptance(A.A.A., 1977) in which they classified the conventional view of financial reporting as "Normative or Classical", and this revised view as the "Decision-Usefulness" approach. This report, however, suffers from the same major drawback of the Corporate Report in that although it is possible to obtain a concensus on what the objectives of a financial report should be in an ideal world, there would appear to be no concensus on how to achieve these objectives and still maintain a comprehensive method of reporting (Peasnell, 1978).

The Corporate Report is to be commended for specifying a more dynamic objective for accounting information, instead of the traditional stewardship/rearview mirror approach it has argued for the need to understand user needs and then to make the necessary changes to financial reports so that these needs can be satisfied. Nonetheless, whilst it is admirable to suggest new objectives, if these are so abstract that it is not possible to determine how they can be achieved, the net effect is to undermine current accepted values and thus leave the accounting function in mid-air. Before it is possible to meet the objectives of the Corporate Report it it necessary to understand how the various user groups use accounting information. If the objective is to produce accounts that provide any user, be he a shareholder, employee or creditor, with information that can be readily input into their particular decision making models, then it is essential to understand exactly the parameters of each particular model. Furthermore, if it were possible to define all "user models" then, and only then, could a revolutionary set of accounts be produced that satisfy all user needs (Revsine, 1972; Miller, 1972). Obviously this is unrealistic and therefore accountants must be content to produce accounts that go part of the way towards meeting this goal.

In a report issued by the Institute of Chartered Accountants(1976) presenting the views of thirteen academics on the Corporate Report, the wide spectrum of opinion and theory presented indicates that it is unlikely that any consensus on how to improve financial statements will be obtained in the near future. This would appear to stem from the myriad of different definitions of the economic value of an entity prevailing among economists, and the inability of traditional accounting procedures to meet the requirements of each theory.

3. Measuring Economic Value

Implied in the Corporate Report view of the purpose of accounting information is the need to communicate economic measurement of an entity which implies that economic values are required and can be readily obtained. Brealey(1976), who is not an accountant, in his paper "Recommendations Regarding the Content of Financial Reports" puts forward the opinion that financial accounts should be orientated towards providing the investor with the necessary data to produce an assessment of the value of an investment in terms of the discounted value of all future cash flows. He draws an analogy with capital budgeting using the premise that investing in a security is the same as investing in any other asset. Brealey's recommendations include replacing the current profit and loss account with a cash flow account and suggesting that the balance sheet should be divorced from any subjective evaluation by the accountant with all assets and liabilities valued at their market value, or, where no secondary market exists, at their present value to the firm. Further recommendations are that more emphasis should be placed on including in the annual report a wide range of forecast and historical data.

These radical changes would meet resistance from most accountants for they would require a radical change in accounting concepts and accepted principles. Brealey recognises this, but defends his position by arguing that if the accountant does not meet user needs (ie. his perception of these) and continues to impose arcane rules which have no economic logic then the standing of the profession is in danger.

The basis of Brealey's proposal is that some attempt should be made to aid the investor in assessing his investment using economic concepts. This implies that accounting statements should be based upon present value principles. If the accounting profession were to implement this type of proposal it could be construed as directing users on how accounting information should be interpreted rather than simply changing presentation and contents in response to user needs. Besides the fundamental problem of whether or not this new approach to reporting would actually be more useful to the user, there still remains the unanswered question of whether accountants could maintain their objectivity and neutral presentation with no bias towards or against any particular user group(Sprouse and Moonitz, 1962).

It is one thing to change the valuation methods and accounting conventions to report historic events in a more suitable manner to meet user needs, but when the accountant is faced with forecasting future cash flows, or rather verifying managements' forecasts, then he is then taking on the rather more complicated and uneviable role of interpreter and corporate planner. Surely if management wish investors to have this type of information they should provide it independently of the auditor. Moreover, if he were involved and the forecasts prove to be wrong then it is plausible that it could be the accountant who would become the scapegoat of both management and shareholder.

Tricker(1976) approaches this problem from a different point of view. He stresses that financial statements have a heavy stewardship function that should not be forgotten although he does recognise the need to meet changing enviromental needs. Moreover, he suggests that the wrong question is being posed, in that financial reports do not contain information, merely data describing financial health, "Information results from the use of those data by a decision maker ..... Data has a cost, information has a value". Thus information is a function of the user and is dependent upon his personal decision making process. Tricker further states "To understand information is to understand the user and his needs; often these cannot be predetermined. The job of the accountant should be to increase the information potential for the user". The conclusion from this point of view is that no matter how much data is produced and regardless of the quality of that data, it is an impossible task to meet the decision takers flexible and ad hoc perceived needs for relevant information.

This different view on the use of accounting data would at first seem to be regressive in that it appears to be saying that accountants should avoid the problems of user needs and concentrate on the stewardship function. This line of thought is not however regressive but progressive, in that it provides a structure upon which improvements can be made. If accounting is described as an exercise in producing data based on conservatism, consistency and convention then any changes to that system must be based upon actual utility and not simply "perceived" utility to the user.

This problem of meeting user needs is seen by Perrin(1976) as asking the accountant to produce more information on the future of the business rather than the past, but even then this is unlikely to satisfy the critics of accounting reports. Perrin believes that at this stage in accounting knowledge, where relatively little research has been conducted, it is difficult to reconcile the objectives of accounting and the accounting report. In concluding his paper he suggests that accounting research be "stepped up" and that in the meanwhile no attempt is made to "pronounce on the scope and aims of published financial reports as though the current and hurried study (that is the Corporate Report) were or could be exhaustive, definitive or conclusive".

The above discussion reveals a wide discrepancy between the views of academics on how to meet the objective of communicating economic measurement to the user. On the one hand there is the idealistic and revolutionary views of Brealey, and on the other the perhaps more traditional or evolutionary views of Tricker. It would appear that perhaps the only way to produce some sort of concensus on how to improve accounting would be to understand user needs more fully, that is to try to provide the accountant with an empirical framework upon which changes to meet user needs can be based. In the final assessment the accountant is only a provider of neutral data which the user turns into decision useful information. If the accountant goes beyond this basic role then he could have a conflict of interest as different user groups will require different interpretations of the same set of figures eg. management and employees. Therefore if changes are to be made it is essential that a

> "set of criteria for accounting measurement and disclosure which ideally, could yield a universal form of financial report equally useful and neutral or non-discriminatory, as amongst the interests of several groups of users"

(quoted from Perrin) is established.

Perhaps one clear example of how the accounting profession is introducing changes to meet enviromental demands is in the measures taken to reflect the impact of inflation on corporate health. Such has been the pressure to make changes, many years of debate including an enquiry by a Government Committee (Sandilands, 1975) have eventually produced an accounting standard on inflation accounting (SSAP 16). The theme of the catalogue of events leading to this latest standard has been the questioning of the usefulness of traditional historic accounts during periods of high inflation.

Nevertheless, the theoretical underpinnings of the new standard as promulgated does seem to be a little weak. There is some survey evidence from the United States by Chandra(1974), Estes(1968) and Brenner(1970) that suggests that financial analysts, who are the most sophisticated interpreters of financial reports, are in general satisfied with historic accounts. In fact Brenner concludes his study; "On the basis of these results . . . current values are only desirable if they are presented as supplementary information to historic cost figures".

Other studies, also in the United States, by Ro(1980), Beaver et al(1980) and Gheyara and Boatsman(1980) have produced empirical evidence which suggests that there exists no evidence that replacement cost disclosures, as defined by ASR 190, provide any new information that affects security price returns. In a review paper on the use of replacement cost disclosures in the U.S.A., Watts and Zimmerman(1980) conclude that

> "We think that because of the diversity of the procedures used and the virtual unaminity of the results, these papers represent a compelling case for the conclusion that there is no evidence that the S.E.C. ASR 190 disclosures produce any benefit for investors."

It should be noted, however, that the studies cited above are U.S. based and therefore caution must be exercised in generalising to current cost accounting in the U.K.

These studies may appear to suggest that current cost figures may add little to the overall utility of conventional historic cost accounts for decision making. However, accountants would argue that analysts are not really aware of how misleading historic cost accounts are and that there is an education problem. Furthermore, at the time of some of the earlier studies inflation was relatively low and therefore the peceived benefits were not fully appreciated by analysts. The conflict that this circular argument indicates is that either the accountant does not really understand the analysts' needs or that the analyst does not fully appreciate the value of the figures presented to him. Chandra's study lends support to the theory that the preparers of accounting information do not value information for equity investment decisions the same way as security analysts do. Beaver(1979) suggests that this is not strictly true in that analysts analyse accounting data based on the assumption that it is correct, ie. neutral and objective, and therefore because the investor will perceive inflation adjusted accounts to be more useful (because the accounting profession say so) then inflation adjusted figures will become the acceptable means of assessment. What is worrying about this whole debate is the lack of empirical research supporting the proposed changes as being the best solution to a perceived problem.

A study by Lee and Tweedie(1977) into the extent to which ordinary shareholders understand the information contained in an annual report suggested that most shareholders had problems in interpreting the information contained in the report, although it must be stressed that shareholders, as opposed to investment analysts, may not necessarily be the most sophisticated users of accounting information. Lee and Tweedie state that:

> "Clearly, the needs of the private shareholder, as recognised by the Corporate Report, are not being met if he is in the position of being unable to understand the information presented to him."

They conclude that this communication gap can be overcome by either educating the shareholder or changing the entire basis of presentation of financial information. Furthermore they suggest that the problem of inflation accounting is not major for the shareholder who cannot even understand traditional accounting data. It is feasible that there is scope to simplify accounting statements to suit this large body of shareholders. Nevertheless, if they are expected to make financial decisions for themselves, then there is a limit as to how far simplification will help them in this task, especially if they have no financial training. Therefore, although Lee and Tweedie suggest methods to close the communication gap between the peparer and user of accounts, the answer would seem to lie in ensuring that shareholders have access to sound financial advice, after all with a legal problem a lawyer is consulted.

We have so far indicated that accounting information in its current form is frequently perceived by many academics and practioners as being unable to meet user needs. To those outside the profession this continued dissatisfaction could easily be interpreted as meaning that financial statements are somewhat redundant. The answer to this problem lies largely in discovering how the expert user (whose needs subsume those of the less skilled user) uses financial statments and what additional information, if any, is really required for decision making. In this study we attempt to provide some empirical evidence on the underlying relationship between accounting information and relative share values and thus provide some insight into the actual needs of the investment analyst. However, before this can be achieved it is essential to recognise the potential utility of accounting information in its current form for decision making. In the following section we therefore concentrate on the inherent usefulness of financial statements.

4. The Hidden Strength of Accounting Numbers

The empirical evidence in this second area is continually growing and, in general, the results indicate that modified historic accounts, despite all their inherent faults, do contain a great amount of useful information providing they are interpreted in the correct manner.

The most usual purpose for examining accounting information is to evaluate the financial health and performance of an entity. However, accounting numbers by themselves are difficult to assimilate and awkward to compare. It is a fruitless exercise simply to compare the value of outstanding debt for two companies without taking into account some consideration of the relative size of these companies. Obviously a large company is likely to have more debt than a small company, purely because it is larger, but this does not indicate that it is financially in a worse position. Thus the usual approach used to evaluate relative performance is to adjust the absolute numbers into financial ratios. Once the ratios are computed it is possible to compare 1) company trends and projections of future performance (intra-company analysis) and 2) performance between firms on an industry relative basis (inter-company analysis).

Weirich(1976) reports that this approach to analysing historic accounts has been used since the 1800's and has the benefit of being objective and quantifiable. One problem in making inter-company comparisons based on ratios is the need to have a yardstick against which it is possible to compare and evaluate performance. With the aim of providing analysts and management with the ability of make useful and meaningful comparisons several commercial organisations produce industry average ratios, (Dun and Bradstreet and Inter-Company Comparisons are examples). As a concept for analysing company reports, ratio analysis is well established but the properties of financial ratios and their informational content are still in the process of being developed (see Lev and Sunder, 1977; Johnson, 1979; Whittington, 1980a and Sudarsanam, 1981a for examples of the current research in this area). In recent years more attention has been given to this area with much emphasis placed on the predictive quality of financial ratios when used in the appropriate framework. By reviewing some of these empirical studies it is possible to form an opinion on the overall utility of accounting information.

5. Financial Ratios and their Descriptive Ability

Many empirical studies have investigated the association between accounting numbers and the occurence of several different events and have led to the conclusion that financial ratios have certain predictive ability. In so far as these events are often determined by the financial health of the entity under examination, and that the financial health of that entity is reflected in its financial ratios, these results are not really surprising. However, the benefit of this type of approach is that it provides a systematic understanding of how financial ratios interact with external events and thus gives the analyst an objective assessment of the state of an entity under examination. Unfortunately, it has been proved too often that when the analyst is left to his own intuition he tends to make judgement errors (Slovic, 1969; Goldberg, 1968). In the following discussion we examine the relationship between accounting information and corporate bankruptcy, bond ratings, systematic risk and a number of other related areas.

5.1 Corporate Bankruptcy

Corporate bankruptcy has been a focal point in this area of the utility of accounting information since the early 1930's. Studies by Romser and Foster(1931), Fitzpatrick(1932), Winakor and Smith(1935) and Merwin(1942) have all used a univariate ratio approach and all have substantiated the theory that failing companies have poorer ratios than successful companies and that the warning signs are there several years prior to actual failure. Unfortunately none of these studies tested their results on subsequent data and therefore it is not possible to assess the predictive ability of their models. One interesting point worth noting from these studies is that each study produced different ratios for discriminating between the failed and non-failed companies, thus implying that the warning signs are present in different facets of the company profile.

The first main study to test the predictive ability of ratios was by

Beaver(1966) who computed thirty conventional ratios for 79 failed and 79 non-failed companies for a five year period. For each ratio Beaver compared the means of each group for each of the five years and tested for significant differences. He found that there was a continued decline in the failed set over the five year period and that the differences between the means on many ratios of the two groups were statistically significant. On subsequent application of his model to a larger data base of equal numbers of failed and non-failed companies he found that he was 90% accurate in classifying companies correctly into their respective groups, although it is stressed that ex-post discrimination is not the same as prediction. However, because of the lack of consideration given to prior probabilities and the fitting of a cut-off to minimise his errors, as his discussant Neter(1966) points out, his claims of predictive ability are not supported for each ratio distribution. In addition the study possesses various other methodological flaws (Taffler, 1976 for a full discussion). Consequently although Beaver made an important contribution to the literature in revealing the potential benefits from this type of research, his results cannot be accepted at their face value.

The next major study in this area was by Altman(1968) who used a multivariate approach to analyse the differences between companies classified as either bankrupt or non-bankrupt. The obvious value of a multivariate approach is that it is able to analyse the full financial profile of a company contemporaneously and thus improve the accuracy of a derived model. Altman applied a two group linear discriminant analysis (LDA) approach to discriminate between two identifiable groups, failed and non-failed companies. His final model comprised five ratios which when tested was found to be able to classify correctly 96% of companies into their respective groups. Despite the accuracy of Altman's model, the component ratios are not altogether intuitively acceptable and there are several methodological flaws (Taffler, 1977; Joy and Tollefson, 1975; Johnson, 1970). Nevertheless, this multivariate study was recognised as an important step forward in assessing the use of multivariate ratio analysis.

The above studies were all conducted in the U.S.A. and therefore are not strictly appropriate for advocating the use of ratio analysis in the U.K. for such a purpose although it is reasonable to believe that the principle should still apply. In the U.K., Taffler(1976) produced a bankruptcy model using similar methodology to Altman's, although Taffler's M.D.A. model differs in nature from Altman's in that no stock market measures were included in the analysis. Since the development of his original model Taffler has developed a second model (see Taffler, 1981a) which is reported to have undergone a considerable amount of testing and general assessment in several practical applications. At present these results show that the model is 98% accurate in categorising all quoted industrial firms that have failed since 1976 as failures at least one year prior to failure. Taffler's holistic approach to analysing accounting information has revealed that not only is it possible to determine if a company is at risk of failure or not, but it also provides a means of measuring the company's level of general economic performance over long time periods.

Taffler's model is not the only M.D.A. model to be developed in the U.K. Spellman(1978), Fadel(1977) and Mason and Harris(1979) have developed models for analysing construction companies but subsequent performance of their models is not known. Marais(1979) also developed a general model which, although currently in use by DataStream International Ltd., suffers from severe methodological weaknesses (Taffler, 1981b).

The above studies are relevant to this thesis as they provide empirical evidence on the utility of financial ratios for measuring corporate health and demonstrate that accounts in their present form do possess meaningful information provided the numbers contained therein are analysed in the appropriate manner. In addition these studies demonstrate that multivariate models are likely to be an effective way of analysing a set of annual accounts, which after all are multivariate documents. (Studies by Pinches et al, 1975 and Taffler and Sudarsanum, 1980 using Principal Component Analysis have empirically demonstrated this characteristic; see Chen and

Shimerda(1981) for a summary of this area of research.) The multivariate approach has shown that the whole is worth more than the sum of the parts. However, data for the prediction of bankruptcy is only a subset of the information needs of the investor and therefore it is necessary to briefly review other studies that show further evidence on the utility of accounting data in more general decision areas.

5.2 Understanding Bond Ratings

A good example of the utility of accounting information in another area which is not too far removed from the equity investors purview is the evaluation of risk premiums on fixed interest loan stock (often referred to as bonds). In the U.S.A. Fisher(1959) related the risk premiums on such bonds to several accounting-based and market-based ratios, and found that his model could explain 75% of the variation in the premium. Despite the apparent high explanatory power of his model no indication is given on its success in predicting future premiums. However his results clearly suggests that accounting ratios do have an association with market orientated factors and that risk premiums are related to fundamental risk.

Other research in this area has concentrated on the understanding and prediction of bond ratings which are used extensively by the U.S. investment community as a surrogate measure for the riskiness of bonds. These bond ratings are arrived at by the judgement of informed and sophisticated financial analysts. Researchers such as Horrigan(1966), Pinches et al(1973), Peavy(1980), West(1970,1973) and Kaplan and Urwitz(1979) have tried to model the bond rating process by relating the rating to the fundamental characteristics of the corporation. Horrigan(1966) for example developed a model based on about 200 bonds with unchanged ratings between 1959 and 1964, and attempted to predict the bond rating of newly issued bonds and changes in bond ratings for 1961 to 1964. His explanatory data consisted mainly of accounting ratios. The results of this study revealed that the model was able to explain 65% of the variation in bond ratings and was able to classify correctly about 55% of the new bond issues and changes in bond ratings. Pinches and Mingo(1973) found similar results using linear discriminant analysis to study bond ratings. They analysed 132 bonds and used a holdout sample of 48 bonds to test their model. It was found that their model was able to correctly classify 65% of their sample with none of the misclassifications in error by more than one category, and on the holdout sample 56% were correctly classified.

Both the above studies and several others into bond ratings are discussed at length in a comprehensive review by Kaplan and Urwitz(1979) who go on to report their own bond rating analyses. They found that a model based upon a subordination variable, total assets, one financial ratio and the common stock beta could correctly classify two thirds of the 67 new issues in their holdout sample. Furthermore by introducing two additional financial ratios they could improve the predictive ability to 69%.

The overall conclusion to be reached from an examination of these bond rating studies is that "it appears that relatively simple functions on historical and publicly available data can be used as an excellent first approximation for the highly complex and subjective bond-rating process" (Kaplan and Urwitz, 1979:233). The overall accuracy of the models developed to-date ranges from 60 to 80% and is probably difficult to improve upon given that certain qualitative factors are omitted from the models and that there is a high probability of judgement error by the bond rating agencies(Goldberg 1968). We conclude from these analyses that if it is assumed that bond ratings are indicators of economic performance, then the inference is that financial ratios are able to measure economic performance providing they are combined in the appropriate manner.

In the U.K. there have been few studies in this bond rating area and therefore it is not possible to be conclusive about the ability to replicate these findings. One reason for the low interest in this area in the U.K. market is due to the high trading costs incurred when buying bonds, about 4%, which makes switching very expensive.

5.3 Accounting Numbers and Share Prices

Further evidence on the hidden strengths of accounting numbers can be found in the literature on systematic risk in the stock market. Systematic risk, or beta, is defined as that part of company risk which cannot be diversified away and measures the response of a company's share price to movements in the stock market as a whole. In recent years much emphasis has been placed on using betas for measuring portfolio risk(for example the collection of papers in Lorie and Brealey, 1978). On the one hand they provide a means for measuring ex-post risk-return performance, and on the other a means for deriving conditional expectations of future risk-return performance. However, one problem with using technical betas, that is betas derived from a simple regression of historic share price data, is that although they are adequate for measuring past performance, they do not necessarily provide good estimates of future betas.

With the aim of trying to predict future betas more acurately research has been conducted into relating beta values to accounting numbers. The first study in this area was by Beaver, Kettler and Scholes(1970) who examined the systematic risk of 307 firms and found that dividend payout, leverage, earnings variability and the covariability of earnings to the aggregate level of corporate earnings, were each separately highly correlated with beta. They also tested to find if the accounting data could be used for prediction purposes and provided evidence that their regression model was more accurate in forecasting future beta values than a naive forecast based on historic beta values alone.

In a study by Gonedes(1973), however, it is reported that no empirical relationship could be found between market-based and accounting-based estimates of systematic risk. Gonedes in comparing his findings with those of Beaver et al argues that Beaver's results could have been caused by spurious correlation and therefore cannot be accepted at their face value. However, Gonedes does qualify his argument by stating that this difference may be explained by the use of different methodolgoies and data.

In a later paper by Beaver and Manegold(1975) which attempts to replicate Gonedes results it is reported that there appears to be "an enormous amount of estimation error in the accounting beta computed by Gonedes, due to a program error." Not only do Beaver and Manegold's results provide some evidence to dispute Gonedes negative results but also they claim to find a relationship between accounting-based and market-based betas. On a more positive note, Gonedes does report that "accounting income numbers, if appropriately transformed, do reflect a statistically significant amount of information impounded in market prices". A further study by Rosenberg and Marathe(1975) found that the variance of cash flow, variance of earnings, growth in earnings, market capitalisation, dividend yield and gearing all contributed to a model for forecasting short term betas. They found that the use of a "fundamental beta", a beta derived from accounting information, was more accurate in forecasting future betas than just using historic or technical betas.

The results of these studies, with the exception of Gonedes(1973), and others by Eskew(1979), Thompson(1976), Rosenberg and McKibben(1973) and Castagna and Matolcsy(1978) clearly show that accounting measures of risk are associated with market risk and suggest that fundamental betas are likely to provide better forecasts of future betas than technical betas. Despite the intuitive appeal of these findings, however, they only refer to the U.S.A. and Australian stock markets and at present there is no evidence of this nature from the U.K., although it would seem reasonable to expect similar results.

The above discussion clearly demonstrates the wide use of accounting information in practically all aspects of finance and stock market performance. In a comprehensive review of the use of "statistical classification models in common stock analysis" Altman(1980) cites several other areas where accounting information has been found to possess strong explanatory power:-

1) Capital Structure Decisions. Studies in this area have investigated the characteristics of debt versus equity issuing firms

(Martin and Scott, 1974; Marsh, 1979), different aspects of the share repurchase decision (Norgaard and Norgaard, 1974) and the prediction of those firms likely to convert convertible debt over a short time horizon (Frank and Weygandt 1971).

2) Common Stock Returns. The information content of accounting numbers has been examined by Gonedes(1974) and Altman and Brenner(1981) who attempted to examine the relationship between accounting data and share price movements.

3) Common Stock Price and Earnings Classification. The studies in this area have looked at the determinants of price-earnings ratios (Walter, 1959; Shick and Verbrugge, 1975), the characteristics of firms with volatile share price movements (Klemkosky and Petty, 1973) and the factors causing firms to have low or high earnings (Haslem and Longbrake 1971).

4) Common Stock Investment Classification. With a similar objective to the bond rating studies discussed above, that is trying to understand the characteristics of a decision making process, studies have been conducted into the characteristics of firms in various investment categories eg. growth, quality, speculative etc. (White, 1975).

Although Altman(1980) does express his concern that most of these studies have statistically based methodological problems and/or mediocre results, he does believe that these efforts are worthwhile in that "the state of the art has been advanced." Our overall conclusion from these studies, despite Altman's criticisms, and those studies discussed earlier is that accounting numbers are on a face value basis useful and that exploitation of this utility depends on interpreting this information set in the appropriate manner.

5.4 The Descriptive Ability of Accounting Ratios

One of the tests used above to measure the utility of accounting information, rather than its descriptive ability, has been the ability to predict certain outcomes. Thus, it is implied that financial ratios possess predictive ability. This implication can be criticised on the same basis that accounting information is criticised for its rear view mirror approach. Greenball(1971) states that;

> "Since an accounting method is expressly designed to measure past and present occurrences, but not the future, it is incorrect to speak of the predictive ability of an accounting method or number."

Taffler(1976:84) also comments on this aspect when reviewing Altman's and Beaver's studies;

> "What he has done(Altman) on an ex-post basis . . .is to show that firms which have gone bankrupt differ from non-failed firms in terms of their financial ratios . . .. In testing his secondary sample he is not predicting bankruptcy but simply saying that certain firms ressemble in terms of their financial characteristics firms which have already failed, more than those which have not and others conversely."

In essence what is being proposed is that accounting numbers can only describe a particular state at one point in time. Prediction by definition requires an assumption to be made about the occurrence of a future event and not simply an evaluation of the past. This should not, however, be interpreted as denying the practical utility of such statistical models as those referred to above for although they merely describe a particular state, they are objective, and as the empirical evidences suggests, apparently able to provide some indication of the probabilities of future events occurring.

This aspect of the descriptive ability of accounting numbers is worthy of further comment as it is one of the main assumptions made in this thesis. Whilst the above studies have demonstrated that financial ratios appear to pocess the ability to reflect the economic attributes of the firm, several writers have pointed out the pitfalls of accepting this premise as being totally free from defects. Gonedes and Dopuch(1979) for example argue that

> "Some changes in the properties of individual firm's accounting

numbers may have been induced by changes in their accounting techniques and not by changes in the relevant attributes of their decisions."

In other words, observed differences in accounting numbers between firms may be due either to the economic attributes of the various management decisions or to different accounting techniques. In the latter event any inference on the economic attributes of the firm concerned could be misleading, and consequently the use of accounting numbers for their descriptive ability is undermined.

The extent of this distortion is not, however, considered to be large. Nair(1979) for example, in a study into the effect of alternative depreciation and inventory techniques in the ranking of firms on their economic attributes, found that different accounting methods did not significantly distort his rankings. Nair concludes that the distortionary impact of accounting methods should not be exaggerated and that the basic economic attributes of the firm are unlikely to be swamped by the distortionary effects of accounting techniques.

Sudarsanam(1981) in a review of the literature in this area, concludes that this issue cannot be "conclusively resolved with the available evidence" and that in research of this nature it is necessary to accept that there is likely to be a significant variation in accounting techniques between companies. The relevance of this conclusion to this thesis is that we must be aware of the potential impact that this lack of uniformity in accounting techniques may have on the models developed. It would, however, seem probable that the effect of different accounting policies on observed accounting numbers will be random in nature, and therefore any inferences drawn from a set of observed relationships would be valid. Consequently, providing these relationships are economically meaningful, the use of accounting numbers in the understanding of complex decision situations remains acceptable.

Besides the issue of the predictive ability of the above studies there are several other minor criticisms of this type of research and the conclusions draw from it. These are as follows:

1) the models are restricted to accounting variables only and it is plausible that other measures, such as the quality of management, could improve their practical utility and accuracy. However, as accounting numbers reflect the net effect of manage ment de cisions the impact of this additional information may be marginal.

2) there is a lack of consensus in the results with different models having different ratios and weights which might imply to the unitiated that the models are sample specific (Chen and Shimerda, 1981). However the underlying characteristics being measured are probably the same (see Pinches et al 1975, and Johnson 1979) despite the apparent differences in the ratio sets.

3) the life span of any such models are possibly limited as company characteristics are liable to change over time under the influence of the economic environment as well as the decisions of their own managements. Further inter-temporal analysis is therefore required to measure the continued accuracy of the models.

The criticisms cited above are not major enough to prevent further research in this area being justified. Providing the researcher is aware of the possible pitfalls then very useful research can be performed. We believe that there are potential benefits from adopting a multivariate (holistic) approach to the analysis of aggregate investor behaviour. Such an exercise we hope will provide some evidence on the utility of financial ratios in fundamental analysis and aid in the task of developing an empirically based framework which may then be useful when changes for improving the data content of accounts are being considered. We believe that the results presented and discussed in the latter half of this thesis demonstrate the practical utility of this approach by providing an insight into a number of fundamental and unresolved issues in the finance area.

6. Summary

The above discussion has concentrated on the purpose of financial statements and the practical utility of accounting information. It was seen that accounting statements in general do not meet the specified objectives of the Corporate Report(1975) and that this can be attributed to the following:

1) in order to satisfy the objective of making accounting reports meet user needs it is essential to understand how users use accounting data. Without this basic understanding of how users process information any proposed changes to meet perceived user needs will only be useful by chance alone. Furthermore, if it can be assumed that different user groups have different needs, then it is necessary to have a basic understanding of how each group, or even each different individual, processes this type of information.

2) there is little, consensus on how financial statements can meet the objective relating to the communication of economic measurement. The reason for this is that there are many definitions of economic worth.

3) it is difficult to see how the accountant can maintain his role as an unbiased and neutral commentator on the stewardship of management, and at the same time adapt his concepts and principles to a more dynamic and forward looking type of reporting. Moreover, the reporting of forecast information could be fraught with problems.

The answer to the problem of how the objectives set in the Corporate Report can be met, lies in the understanding of how users process accounting data. Once a decision making system has been defined it is then possible for the accounting profession to make changes to the data reported so that the decision making process can be enhanced. As the defining of the users' decision making process is fraught with problems when normative reasoning is employed, it would appear that the only real solution to the problem lies in empirical research building a foundation upon which changes can be made.

The second issue examined in this chapter concerned the hidden strengths of accounting information. Despite the numerous criticisms voiced on the inadequacy of accounting data, the empirical studies discussed reveal that financial statments, when analysed in the appropriate manner, possess a great amount of descriptive power. Furthermore, the accuracy of the models created from this type of analysis allows us to consider their assessments as predictive. The general conclusion from the discussion is that there is a large body of useful data contained in annual accounting statements and to exploit this data is largely a matter of analysing it in the appropriate manner.

We conclude that the two distinct issues reviewed above both have similar implications for this study. On the one hand it is suggested that to advance the frontier of accounting and finance knowledge it is necessary to conduct empirical research, and on the other, it seems reasonable to use accounting information to do so.

In the next chapter we continue development of our analytical framework by examining some of the implications that the human information processing literature has for the model building approach in the identification of the underlying relationships within a decision making process.

CHAPTER III

UNDERSTANDING THE INVESTOR'S JUDGEMENTAL PROCESS

1. Introduction

Associated with the general discontent expressed by many academics in the ability of accounting information to meet user needs, there has been a growing interest, although almost exclusively in the U.S. and Australia, in applying the large body of psychological literature on the human information processing system to the accounting and finance area. It is believed that in order to understand the factors at work within any judgemental process it is essential to have some idea of the characteristics and biases which affect man's assessment of those factors.

In the accounting and finance area the theories on what factors (including accounting information) influence investors are well established and can be found in most finance textbooks (Firth, 1975 and Lorie and Brealey, 1978 are examples). However, despite much theory, there does not appear to be a coherent understanding of how the investor actually uses these factors in his decision making process. Slovic(1969) comments on this as follows,

> "All too often expert judgement (in this thesis the investor) is regarded as a mysterious, intuitive phenomenon, incapable of being described precisely".

In this chapter we construct a conceptual framework for our subsequent analyses by discussing the implications of the psychological literature for the development of user models. This discussion will be split into two parts. In the first the problems of data expansion and cognitive complexity and their probable effect on the user will be examined. In the second part we review the literature on "paramorphic representations" of the decision making process. This includes an assessment of both the linear additive and configural approaches to modelling human judgement. The aim of this chapter is to provide an insight into the nature and complexity of a decision making process and the most appropriate way of analysing such a process.

2. The Policy of Data Expansion in Financial Reports

In the previous chapter it was shown that in general accounting statements in their current format are conventionally considered suboptimal in that they do not effectively communicate all information necessary to meet perceived user needs (A.S.S.A. 1975, A.A.A. 1977). It was argued that this perceived deficiency in conventional accounting statements could only be overcome by seeking a better understanding of how users of accounting information process this type of data and that this understanding can only be acheived by empirical research. Whilst this line of reasoning is acceptable to some academics (Tricker, 1976 and Perrin, 1976 are examples), there is a large body of academics and practioners who feel that empirical research will take too long to conduct and that radical changes in accounting are required immediately. Unfortunately, lack of faith in empiricism has only led to a mixed collection of ideas and theories; Revsine(1970) describes the "proponents of change as seemingly united only by their dissatisfaction with the extant reportings".

As a result of this lack of consensus on how to improve financial statments there has been a general policy of data expansion which seems to be acceptable to most practitioners and academics and has even been ratified by the FASB(1976) in the U.S.A. as a means of meeting user needs. Revsine(1970) in his paper on data expansion and acounting information explains this behaviour as follows:

> "Expanding the range of data provided is viewed as a means of overcoming the limitations of contemporary reports without necessitating detailed knowledge of user models."

In other words, because there is a lack of understanding about user needs and as there is no agreement on the appropriate conceptual framework upon which to base any proposed changes, the accounting profession finds that a policy of data expansion, that is reporting all data which is conceivably relevant, is generally acceptable. The premise upon which this policy is based is that as there are "a vast multitude of (decision making) models used in practice" (Greenball, 1971), it is impossible to meet and satisfy all user needs. Futhermore, if a policy of selective item reporting is adopted then it can be argued that this only reduces the utility of accounting information to some user groups who may need the data which is not reported.

One advocate of this policy of unlimited data expansion is Keane(1977) who argues that if an item of data, or a particular framework for reporting, is peceived to be important by any user then it should be reported regardless of the cost. Keane even goes so far as to recommend that if there is more than one method of reporting a particular item, or set of items, then all such methods should be reported, as someone somewhere may believe that one method is more relevant for his particular decision making process than another. He concludes his paper by stating that "it is sufficient that a given item of financial data be useful, without being more useful than other data, to warrant its inclusion in the corporate report". Whilst the Keane approach is not without its problems, the policy of data expansion has also been advocated by expert users who believe that additional data on certain items would help them make better decisions (see Casey(1980) for a review).

2.1 The Costs of a Data Expansion Policy

Data expansion may at first appear to be the best solution to the very difficult problem of satisfying user needs, but it is not without its costs. Firstly, there are the costs associated with data collection and communication, and although the marginal cost per data item may be low, all costs must be seen to be warranted and therefore the additional data must be peceived to be useful. If the Keane approach discussed above were adopted in a blind manner it is feasible that financial statements would become even more voluminous and expensive to produce than at present. Nevertheless, even if the production costs were not prohibitive there is a far more important negative effect which could have a real cost to the user, this is the potential decline in the efficiency of processing information and an associated reduction in ability of make "optimum" decisions. This negative effect described as information overload in the psychological literature (Goldberg, 1968), has been found to be present in other decision making environments (Jacoby, 1974) and therefore it is reasonable to assume that it could apply to the interpretation of accounting information. If the accountant were to succeed in providing data that satisfied all user needs but in so doing reduced the value of that data to the user due to the effect of information overload, then he has merely solved one problem at the expense of creating another.

Moreover, if the accountant accepts the premise that it is not sufficient to supply information but that the information should be useful to the user, then he can no longer ignore the way in which that information is actually processed. In other words it is not enough to theorise what could be useful, emphasis must be placed on what is useful. Obviously, this requires empirical research to find out which items of data are actually used and in which way. Furthermore, such research should not be blind to the way in which humans process information and thus make decisions.

3. <u>Optimum Information Processing</u>

Over the last ten years a number of articles (eg. Revsine, 1970; Miller, 1972) have been written relating the human information processing theories of Schroder, Driver and Streufert(1967) to the use of financial statements by decision makers. Schroder et al describes man as having "the ability to utilize alternative meanings of the same stimuli and to build up and use different patterns of interrelationships within the same set of meanings". They further suggest that man processes the stimuli by firstly ordering them along existing conceptual dimensions and then by combining and integrating these dimensions to make his decision. Obviously the number and complexity of the conceptual dimensions for any individual are dependent upon his experience, education and creative thinking ability.

Based upon this description of how man processes information Schroder et al propose that man's ability to make effective decisions is dependent upon two aspects as follows:-

1) the conceptual ability of the decision maker, that is his ability to organise and combine the stimuli being processed into conceptual dimensions.

2) the environmental complexity, that is the number of stimuli that have to be processed by the decision maker.

This means that the ability of an individual to make the best decision is dependent upon his intelligence and experience and secondly the amount of information at his disposal. Schroder et al further state that for a given level of conceptual ability the decision maker will become more effective as the environmental stimuli increase from zero. In other words if we start with no information, we are able to make better decisions as the amount of information increases. However, there is a limit to the amount of stimuli that can be processed, after which decision quality declines. This theory suggests that there is an optimum level of environmental complexity, above which there is information overload. In other areas such as consumer preferences this theory has been ratified by a number of empirical studies (Schroder et al, 1969 and Jacoby, 1974 are examples). In the accounting area studies by San Miguel(1976), Casey(1980) and Moriarity(1979) have, in general, found similar results to the studies in other areas and as such lend some support to the theory that it is potentially possible to swamp a decision maker by providing too much information.

A further finding from the psychological literature, which has a bearing on the policy of data expansion, concerns man's belief that he makes better decisions with more information. One illustrative study, that of Oskamp(1965), relating to the clinical assessment of a patients personality by 32 judges found that as the amount of information provided about the patients increased, the accuracy of their judgements remained the same, about 30%, but their confidence in their judgements increased dramatically and "their certainty about their decisions became entirely out of proportion to the actual correctness of these decisions." Slovic(1972) in a paper on human judgement and investment decision making, suggests that these findings may partly explain the tendency to provide the investor with as much information as possible. Consequently, although the investor may feel more confident in his decision making, it may be argued that he may well become less effective through the dysfunctional consequences of the information overload phenomenon. Further discussion on this aspect is given in Taffler(1981c), Snowball(1980) and Goldberg(1968).

Revsine(1970) uses the Schoder et al model for discussing the trend of data expansion at the expense of the utility of financial statements to the user. Revsine argues that data expansion without consideration of the way in which humans process information is more regressive than progressive. He concludes by saying:

> "If as accounting theorists we choose to embrace the data expansion approach, then, given the enviromental complexities contraint we must decide what information is to be in the expanded report. Knowledge that a particular kind of data is relevant cannot serve as a sole criterion for admissibility since there are numerous kinds of potentially relevant information."

Miller(1972) develops Revsine approach by stating that as there are many user groups with different levels of cognitive complexity, it is impossible to draw up accounts to meet all their needs in the optimal manner. The best solution argued by Miller to this problem is for the accountant to concentrate on meeting the needs of the most sophisticated user, namely the investment analyst. Although this approach reduces the utility of accounting statements to some users through superoptimality, it is seen to be preferable to reducing the quality of the investment analyst's decisions through lack of information. In a following paper Wilson(1973) comments that Miller's assumption that the utility of accounting information to other user groups will be reduced through superoptimality is not proven and that there is evidence to indicate that regardless of the levels of cognitive complexity of different decision makers their optimal information load may be very similar. As a result Wilson agrees with Miller that the accounting profession will make more progress by concentrating on the investment analyst to determine the needs of all user groups but, he stresses, for different reasons.

Wilson goes onto conclude that while there may be some preliminary evidence which supports the relationships in the accounting area, "this evidence is tenuous at best". Jensen(1970) (quoted by Wilson) warns us against readily accepting

> "empirical evidence obtained by behavioural experiments as a basis for establishing accounting policy. Not only is it difficult to extrapolate from such studies but often the studies themselves have conflicting results."

There is however the recent study by Casey(1980) who argues from his results that potential information overload may well be a problem in accounting and not merely a perceived problem resulting from relating the psychological literature to accounting research. In his study Casey asked 122 bank loan officers to participate in a questionnaire study whereby they were required to predict which of ten real-life firms would declare bankruptcy. He split his sample into three and provided each group with a different quantity of information. The results showed that too little information produced an inferior performance but that the medium and large quantites of information groups where indifferent on predictive ability. However, the large quantity of information group took significantly longer in its their assessment than the medium group and therefore was less efficient in its decision making. Casey attributes this inefficiency to the additional information needed to be processed and concludes that this is clear evidence of information overload.

Whilst Casey's results do provide some evidence to confirm that the Schroder et al(1967) theory on information load may have some relevance in accounting, they also reveal that although the group with the largest quantity of information took longer they were able to consistently classify two companies more accurately than the middle information group. Thus the conclusion reached by Casey on the applicability of information overload theory in accounting must be considered a little tenuous, although his results do indicate that further research in this area is important.

A further study of interest was conducted by Moriarity(1979) who examined the ability of accounting students to classify firms as bankrupt or non-bankrupt based upon four different levels of information load. The results revealed that the level of least information proved to be the optimum both in terms of accuracy and time. Whilst any conclusions from this study must be considered tenuous at best due to the unusual mehodology employed, Moriarity has indicated the potential problem of information overload that may exist in the accounting area.

The conclusion that we arrive at from the above discussion is that when considering the utility of accounting information it is essential to be aware of the way in which information is processed. We have seen that the psychological literature suggests that information overload is potentially a problem when a policy of data expansion is blindly pursued. Currently the accounting profession is in an awkward position in that it does not know whether the current level of information supplied in accounts is suboptimal, optimal or superoptimal in satisfying user needs. Furthermore given the empirical evidence to date it is not possible even to conclude that information overload is a problem in accounting. Thus we are forced to return to the call for more empirical research.

In this thesis we do not directly test the information load phenomenon in the same way as Casey(1980), but look at in from rather a different angle. In the first place by examining the association between accounting information and share prices we hope to gain an insight into which data items appear important to the market as a whole. From this insight and by assuming that the market model is the sum of all individual investor models, it may be possible to make inferences about the conceptual complexity of the investor's decision making process. Furthermore, it is also possible tentatively to suggest that the strength of the association between relative share valuations and different items of accounting information might shed some light on which items are likely to be important to the investor.

A policy of data expansion that does not significantly add to the informational content of these key items may at the very least not be very helpful in improving the utility of accounting information.

A second indirect way in which the above discussion may have a bearing on this thesis concerns our expectations of the complexity of the resultant models in our analyses. It is argued above that there is a limit on the number of input items that can be effectively processed by the decision maker. If we consider the investment analyst's informational needs we find that they are very numerous encompasing both micro- and macro- economic factors which may influence the future performance of the company in question and thus current share prices. It would therefore seem that the analyst's task envirnoment is already complex, even before he starts his detailed assessment of each of these factors. As accounting information is only one of these factors, albeit a priori an important one, it would seem not unreasonable to expect a complex relationship to exist between accounting information and share prices. Whilst at this stage we cannot be very precise as to the form of models developed in this thesis, it is likely that only a small set of measures will be found to be important.

4. The "Paramorphic Representation" of the Investment Analyst.

In our quest to establish a relationship between accounting information and relative share values we concentrate on attempting to understand the factors at work in the market as a whole rather than studying the idiosycratic decision making processes of a few investment analysts. Whilst we believe that analysing the market as a whole is likely to yield more useful results, we recognise that the decision process of the market is the sum of the individual decision processes of many expert analysts. Consequently we believe that it is reasonable to expect the market to possess similar characteristics to that of the individual as a decision maker and that to conduct meaningful research it is essential to adopt a methodology which has the ability to accommodate such characteristics.

The task of the expert judge is to process information and make a decision, and it is in his ability to interpret and integrate that his success resides. However, the way in which the expert uses information in his decision making process is difficult to describe with any degree of precision. Slovic(1969) suggests that if the expert is asked to reason why he made a certain decision he will either describe a long list of factors and rationalise these, or, he will simply reply "because it looks like it!" Both answers indicate that although the expert does process information, he is unable to clearly define how he uses it to make a decision, that is his self insight is poor.

There have been many studies into the way in which humans make decisions and, although these have mainly concentrated on the clinical psychology area (see Goldberg, 1968 for a review), they have implications for other research areas, such as accounting and finance. Libby and Lewis(1977) and Wright(1980) review the existing psychological literature in accounting and try to evaluate the state of the art of the understanding of human information processing research in accounting. This area covers a wide spectrum of topics but we shall only concentrate on one part namely the "paramophic representaton" of the decision making process.

Paramophic representation is a term used by Hoffman(1960) (quoted from Dawes and Corrigan, 1974) which describes the use of a linear model to represent expert judgement. Dawes(1971) explains this term more fully as follows:-

> "The term was chosen because Hoffman did not mean to imply that the actual psychological process involved in the judgement was that of weighting various variables, but rather that this process could be simulated by such a weighting."

In other words the judgement process is regarded as a complicated system with many varying interactions which therefore cannot be replicated in an isomorphic manner by a formal model. Nevertheless, if the output of a simulation model corresponds to that of the judge, it is reasonable to conclude that the model has captured the judgement policy, albeit in a way that weights and combines different key variables. Models of this nature only approximate the behaviour the decision maker, they do not imitate. It should be stressed that it is this concept of analysis which is used in this thesis for understanding the market's decision making processes not any other.

4.1 The Linear Additive Approach

The use of linear models to approximate the expert's decision making process has been examined by several researchers. Goldberg(1970) reports on a comprehensive study whereby the judgements of clinical psychologists were simulated by a linear model. The results revealed that the model was able to outperform even the best psychologist. Dawes(1971) investigated the use of a linear model to vet applications for postgraduate education and found that 55% of the applicants could be rejected without screening out any who would have in fact been admitted by the committee. Dawes concludes by suggesting that this method for screeening helps make decisions which are "less capricious and more valid than those by the decision maker relying on his own intuition". Goldberg(1968) and Dawes and Corrigan(1974) provide further reviews of the modelling of the expert judge and in each case the general conclusion is that the model can outperform man. One further and perhaps worrying result from these studies is the lack of consensus in the decisions made by experts. Libby and Lewis(1977) comment:

> "The results of psychological research using the lens model approach (that is paramorphic representation) have generally indicated that many expert judges such as clinical psychologists, radiologists and stockbrokers make judgements that are consistent over time, but indicate little consensus among judges."

Before considering the studies that are more relevant to the use of this approach in accounting and finance it is important to examine briefly the reasons for these perhaps unexpected results. Why does a model outperform an individual trying to do the same job? Dawes(1971) suggests the following reasons:-

1) a mathematical model is an abstraction of the process it models and hence, if the decision maker follows valid principles, then these

will be abstracted by the model.

2) the model is not affected by fatigue, headaches or boredom which are factors that could and do reduce the quality of an individuals decision making process. In statistical terms individuals suffer from random error and bias.

A paramorphic representation of man is not affected by extraneous variables, and as long as these variables are not related systematically to the decision under examination, then a model will attach the appropriate weights to the key variables.

In the area of accounting and finance, one study which is particularly relevant to this thesis is that of Wright(1977) who tested the linear predictability, consensus and accuracy of student predictions of stock prices. He supplied each student with five items of information for 60 companies and asked them to predict the share price movement. He then developed a linear model relating the information cues to the actual share price movements. The results revealed that the linear model performed better than the students, interjudge disagreement was high although the estimation ability of the students was significantly better than chance, and that there was cognitive bias to overestimate low priced shares.

Wright was demonstrating the use of the Brunswick lens approach (see Libby, 1975) for assessing how man compares with a mathematical model and, although his results indicate that similar results to those found in the psychological literature could be found in accounting and finance, the use of students could potentially have reduced the value of the experiment. Several researchers have, however, investigated the extent of this problem of using students as surrogates and found that the performance of students and the expert judge to be very similar (Abdel-Khalik, 1974; Ashton and Kramer, 1980). Consequently, although the use of students has been a common feature of the studies conducted in this area to test linear models (see Libby and Lewis, 1977 for a full review), the empirical evidence in the accounting and finance area does lend support to the theory that models may be able to outperform the expert's intuition".

4.2 The Configural Approach

Despite the accuracy of linear models to simulate the expert's decision making process it is generally accepted that humans process information in a configural manner.

> "since clinicians generally describe their cognitive processes as complex ones involving the curvilinear, configural and sequential utilisation of cues, one might expect the linear additive model would provide a rather poor representation of their judgement" Goldberg(1968).

Whilst linear models have been able to isolate key decision variables, they have not so far been successful in describing the complex manner of the use of information in practice. This is mainly attributable to two restrictions, firstly the methodology used does not permit interaction between variables to be revealed, and secondly, because experts cannot describe the interaction between variables, it is not possible to formally model such relationships into such a model.

A study which revealed some empirical evidence on the configural nature of the investment manager's information processsing is by Clarkson(1966). Clarkson's study involved the development of a simulation model, as opposed to the statistically derived models discussed above, of one investment trust manager's investment evaluation process. The model developed was formulated by breaking down the decision process into separate analytical processes and then constructing simple decision rules for each of these processes. Clarkson then went on to compare the similarity between the portfolios derived from this model with the actual portfolio of the fund manager and found that there were few differences. Whilst Clarkson's study is of a fund manager and provides no statistical evidence on the strength of the association between accounting information and share prices per se, the success of his model in classifying companies indicates that he was able to capture the main characteristics of the decision making process, and further analysis of the decision rules adopted reveals that this process contains many configural relationships. Consequently one conclusion from this study is that the investor's decision making process may be expected to be configural.

In order to overcome the perceived problems with linear models, several studies have used nonlinear or configural techniques to model man with the hope of producing a more informative and realistic representation of his decision making process. Goldberg(1968) reports on several studies which used ANOVA to search for interaction between variables in a particular complex decision making environment. The results were found to be "disheartening" as configural relationships could only account for 3% of the total variance examined.

The use of ANOVA as an analytical technique in cognitivive research in the area of accounting and finance is not uncommon and in general the results have agreed with those found in the psychological literature. (Libby and Lewis, 1977 provide a good review of this work.) There are, however, two studies that are of particular relevance to this thesis in that they investigate the way in which investment analysts process information.

The first of these studies is by Slovic(1969) who applied the ANOVA technique for describing the way in which stockbrokers employ information for evaluating stocks. Slovic commences his article by addressing the problem of linear additive models and stating that they

> "have not been successful in describing the complex patterned or configural use of information, that is, the process whereby an item of information is interpreted differently from one time to the next, depending on the nature of other available information. Since experts generally claim that they use information configurally, it is important that techniques used to describe judgement be sensitive to such processes."

Slovic's reasons for choosing stockbrokers as subjects were that their task is an important one, the decision is extremely complex with many information sources and there is evidence that financial analysts believe that relevant factors are interpreted in a configural manner (Slovic quoted the Clarkson, 1962 study to substantiate this claim). The study involved selecting two stockbrokers and asking them to examine 11 dichotomous factors for 128 companies in order to arrive at a rating of the likelihood that the market price would rise over the following six to twelve months. The analysis of the results revealed that the correlation between the experts was low and that they had quite distinct decision making models. This was unexpected as the second broker was selected by the first broker based upon his knowledge of the other's similar attitudes and training.

Slovic attempted to measure the amount of interaction between the variables which at first appeared to be low. However, he pointed out that the method employed to measure interaction, which had been used by the other ANOVA studies, did not provide a true measure of interaction, and he therefore recalculated the variance explained and concluded that interaction accounted for 36% of the variance of Broker A and 85% of Broker B. If one accepts Slovic's mathematics then clearly his stockbrokers decision model were interactive.

A further interesting twist to this study was that Slovic asked the brokers to rate each of the 11 factors on how they perceived their relative importance. These weightings were then compared with the model weights and Slovic concluded that the brokers showed only a small insight into their own decision making process, thus suggesting that the perceived needs of users might possibly differ from their actual needs. Slovic ends his article by stating that these results "provide experimental evidence to support the commonly believed notion that judges use information configurally".

The second study of importance is by Slovic, Fleissner and Bauman(1972) who conducted a similar study to the one discussed above. In this study 18 subjects took part, 13 stockbrokers and 5 students, who were asked to rank the expected share price movement of 64 stocks using eight dichotomous variables. The results revealed that a) there were substantial differences between individual uses of variables, b) the most heavily used variable was earnings yearly trend and c) brokers exhibited more disagreement in their use of variables than did the students. As regards interaction they found that although some of the brokers revealed that their processing systems were highly configural, most of the systematic variance of their judgements could be accounted for by means of a linear additive combination of factors. Slovic et al concluded their study by suggesting:

> "that techniques such as ANOVA and multiple regression have considerable promise as devices for describing and furthering our understanding of the use of information in investment decisions."

Before leaving this study completely it is interesting to note that the subjects were also asked to rank information variables on perceived utility. Again a low correlation between actual and perceived utility was obtained, although it was found that the students seemed to have more idea on how they processed information than did the brokers, possibly because they were attempting to apply theory they had been taught.

The two ANOVA studies discussed above, and the Clarkson (1966) study, provide strong evidence that the investment analyst processes information in a configural manner. Moreover, when the analysts were asked to rationalise the interaction found to be present between certain variables they were able to provide intuitively sound and economically reasonable explanations of their actions. Furthermore, despite the clear interactive nature of the way in which investment analysts process information, it was demonstrated that simple linear additive models were capable of performing just as well as the more complicated configural models. Ashton(1979) demonstrates statistically why a linear formulation may provide a good fit to a non-linear configural task environment.

The ANOVA technique has therefore been shown to be useful in revealing the interactive nature of investment analysis, but it is not without its limitations. Firstly, in the studies presented above only dichotomous variables were used, and therefore the experiments cannot be accepted as modelling the true decision making process. Secondly the ability of the technique to create a picture of how the variables interact is severely restricted. The results have very simply shown that variable A interacts with variable B, but because of the nature of the technique and the need for a large number of observations, it is not possible to measure whether variable C interacts with the interaction of A and B. In other words, if it were found that the earnings trend interacts with the support trend (a measure of how low the share price has fallen), as in Slovic(1969), then we would want to know how the earnings yield, for example, related to the original interaction and in what circumstances did the interaction change. Only in this way is it possible to build up a full understanding on how the investment analyst interrelates his conceptual dimensions when processing information. We must therefore conclude that, despite providing some insight into the interactive nature of decision making, the ANOVA type of study is very restricted.

On the other hand linear additive techniques have in several studies proved to be as good as, if not more accurate than, the configural approach for modelling judgements. Furthermore empirical evidence from the psychological literature and from Wright(1977), which was discussed above, suggests that linear additive techniques are more consistent in their evaluations than even the best judge. Nevertheless, the linear additive approach is not without its limitations. Firstly the resultant combination of variables tell us very little about how the expert decision maker uses these variables in his decision making process. Whilst no one would suggest that the model is not useful for bootstrapping, that is helping the decision maker make better decisions, it is questionable whether it is very informative about the way information is actually processed.

Secondly, even if we accept the premise that these techniques highlight key decision variables, it is not possible to make inferences about their relative influence within the decision model. There is some evidence (see Dawes & Corrigan, 1974 and also Ashton, 1976 for a review) that if the regression weights are replaced with unit weights, the models are still able to outperform the expert judge. If we accept that this empirical evidence is correct, then we can only conclude that the regression variables are influential, but we are unable to qualify our statement as to which variables are more important than others.

5. Other Characterists of the Human Information Processing System

In concluding this discussion of the characteristics of the human information processing system, it is instructive to briefly examine some of the heuristic decision rules which we use in complex task situations. The empirical research into these heuristics reveals that they are likely to introduce systematic biases into the evaluation process and thus may cause errors in judgement. Typical heuristics are as follows:

1) The Availability Bias. This heuristic relates to the bias caused by either recent experience or lack of experience. For example Taffler(1981c) suggests that it is feasible that a bank loan officer may be overcautious in his judgements if a customer has recently defaulted on a loan.

2) Conservatism. This describes our difficulty in assimulating new information. Very often we tend to pay insufficient attention to new cues and find difficulty in reassessing our views. The reverse can also be true (ie. "non-conservatism") whereby we pay too much attention to new cues, heavily overemphasizing the importance of the newly received data and forgetting our prior knowledge.

3) Illusory Correlation. Often we tend to interpret evidence in accordance with our previously held beliefs when in fact our beliefs are wrong. In other words we see what we want to see and build an illusion of correlation between the cause and the effect.

4) Hindsight Bias. This heuristic describes our inability to go back in time and recollect our views on the probability of an event occurring. Once we become aware of an event taking place then we tend to believe that it was inevitable and that prior to the event we knew what would happen.

5) Illusion of Validity. Under certain conditions we can become more certain about our judgements even though the accuracy of our prediction remains the same or declines. This usually happens when dealing with large qualities of collinear data.

6) Anchoring and Adjustment. In order to simultaneously make sense of a large number of pieces of information and synthesize these into an overall judgement, we often start with an initial view, that is the anchor, and then adjust in the light of the other data. Typically however we are unable to adequately adjust our judgements to reflect the implications of the other data.

Taffler(1918c) and Wright(1980) provide a more detailed discussion of each of these heuristics and provide many references to empirical tests in both the psychological and accounting area. It is sufficient for our discussion to point out their existence and to be aware that judgement errors caused by these biases are likely to be present in the investment analysts decision process. The impact of these various heuristics on our resultant models depends upon whether the bias is systematic or random. In the first instance the bias is caused by a consistent treatment of particular data items by the market as a whole, and consequently will be reflected in relative share values. Whilst the impact of systematic bias, if present, will affect our models due to our use of the "black-box" approach, we are unable to recognise or quantify such biases. On the other hand, random bias caused by individual analysts treating particular data items in an incon sistent manner is likely to have only a random effect on share prices and therefore is not expected to have any significant effect on our resultant models.

6. Summary and Conclusion

In this chapter in an attempt to lay a theoretical framework for our subsequent analyses we discussed two aspects of the growing body of literature on human information processing, namely information overload and paramorphic representation. The purpose was to emphasize that when investigating the manner in which accounting information is processed by the market it is essential that the methodology adopted is capable of accommodating the way in which humans process information.

The first part of this chapter examined the issue of information overload and the resulting potential problems for the producers of accounting information. It was suggested that the adoption of a data expansion policy, without an understanding of user needs, will lead to less efficient processing by users. Although the concept of information overload is not directly tested in this thesis, we believe that by developing a better understanding of the association between accounting information and relative share values it may be possible to make some general inferences about the complexity of the investor's decision making process and also tentatively suggest areas where a policy of data expansion might be more effective. In addition this examination of the problems of information processing led us to expect that our resultant models of the investor may consist of only a few variables.

The second part of this chapter discussed the paramorphic representation of the judgement process and can be summarised as follows. Firstly, our investigation into the relationship between accounting information and relative share values centres around trying to understand the factors at work within the decision making process of the market as a whole. Furthermore as the market's decision making process may be viewed as simply the sum of all the expert analysts decision making processes, we may expect the market to possess similar human characteristics in its judgement process. However, it was shown that the judgement process is all too often viewed as a mysterious phenomenon, and consequently an understanding of the typical characteristics of an investment analyst could not be obtained by simply asking a group of such experts to describe their decision making processes. The answer to this problem lies in understanding how humans process information and therefore reference was made to the psychological literature.

The empirical evidence from both clinical psychology and the accounting and finance areas revealed that linear additive models can successfully replicate the judgement of experts and furthermore that such models are in many ways more reliable than any single judge. However, such models are not presented as being exact replicas of the decision making process, but are best described as providing a paramorphic representation of the expert's decision making process.

However, despite the conclusive results from such research (see Goldberg,1976), this type of study has provided little insight into the characteristics of the human decision making process which is highly complex and involves interaction between various input cues. Nevertheless, other studies using a different analytical approach (ANOVA) have suggested that it is possible to uncover some configural relationships which may go unnoticed using the conventional linear additive analytical techniques. Whilst the configural models have provided some additional insight into the judgement process in question, they are unable to produce any significant improvement on the preditive accuracy of the linear additive approach. Furthermore, their ability to provide a comprehensive picture of the decision making process is severly restricted due to their inability to examine the data in a holistic way.

The above discussion also revealed several other interesting findings. Firstly, it would appear that experts have a poor understanding of how they combine variables when making decisions, and secondly, there would appear to be little consensus in The judgement of expert judges. Also various heuristic decision rules are likely to be used by the analyst in an attempt to reduce the "cognitive strain" introduced by having to analyse a complex and relatively unstructured decision situation. Although the usual caveats apply about generalising from experimental evidence in one task domain to another and also from laboratory studies to complex and real decision environments there would appear to be no good reason why such biases are not an inherent characteristic of the cognitive "kit bag" of the investment analyst.

In this study we adopt a methodological approach which attempts to overcome some of the deficiences in the studies referred to above.

In the first place we attempt to pick up the configural nature of the market's decision making process by employing a relatively new multivariate statistical technique called Automatic Interaction Detector (AID) which produces a decision tree type model of the factors at work within the market. This technique is able to combine the interactive explanatory nature of the ANOVA approach with the multivariate model building approach of the linear additive techniques. Consequently, we are not restricted to analysing dichotomous variables as in the case of Slovic(1969) and Slovic et al(1972) and can apply the technique to large data bases of information. The end result should be a more exact and complete model of the interactions and interrelationships between accounting information and relative share values. Secondly, by analysing the market as a whole rather than conducting a laboratory type analysis which is restricted to a limited number of subjects and the researcher's own subjective recording processes, we believe that we have been able to reduce the impact of the inevitable biases resulting from the unconscious application of the many heuristics present in any analyst's decision making process. The impact of these heuristics on the market as a whole may be expected to be either random or specific. Whilst we do not expect random bias to have any significant impact on our models we recognise that any specific biases present in the marekt as a whole, which is a result of a majority of analysts allowing the same heuristic to bias their decision making process in the same way, then this should be reflected in the structure of the resultant models but unfortunately it will not be explicitly detected. Overall, therefore, we believe that the models derived by the application of AID to a large data base may lead to more precise paramorphic representations of the decision making process at work within the market.

Despite the potential benefits of the use of AID in understanding how the market processes information, it is important not to disregard the utility of the linear additive techniques completely. By making a comparison between the results derived from the application of AID with those from application of the more traditional analytical techniques it should be possible to establish whether or not the configural approach adds anything to the linear additive approach for our particular purposes. This, we hope, will provide some empirical evidence on the suitability of such models for the description of the information processing process. In this thesis we therefore examine both the descriptive ability of each approach and from a statistical point of view, the explanatory power of each technique.

In the next chapter we continue this inductive argumentative approach to building an analytical framework by examining the theory and extant work on the association between share prices and accounting information.

CHAPTER IV

Accounting Information and Share Prices: A Conceptual Framework

1. Introduction

Our search for a relationship between accounting information and relative share prices is premised upon the not unreasonable assumption that both strong theoretical and empirical relationships exist. In this chapter we examine the issues underlying this assumption by reviewing in detail both relevant theories of share valuation and the extant empirical work to date. The resulting conceptual framework will aid us in the formulation of our models in terms of variable selection and methodology and also in the subsequent interpretation of the theoretical implications of our analyses.

It is unquestionable that accounting information is used in the process of evaluating shares. Most text books on finance discuss the importance of accounting information, and in practice financial statements are a major source of information to the analyst. Parker(1967), a senior partner in a New York stockbroking firm, in fact goes so far as to state that "the financial history and prospects of a corporation expressed in the figures extracted from standard accounting statements are the beginning and end of every professional investment analysis". In this thesis, however, we stress that as accounting information is only a part of the total information set available to the investor, it is wrong to expect any relationship between share values and published accounting information to be absolute.

There exists a large body of empirical research into the behaviour of the stock market, portfolio management and security analysis (see Lorie & Brealey, 1978 for a book of readings) but unfortunately much of this work is devoted to the way in which share prices behave with only a few studies concentrating on the way in which the share price fixing mechanism actually works. As our concern in this thesis is the understanding of this mechanism we shall only concentrate on those studies that fall within our purview. In very broad terms studies into the relationship between accounting variables and share prices can be classified into two groups. The first group contains those studies that have attempted to relate share price movements to accounting numbers. The purpose of these studies appears to be 1) to isolate the factors influential in determining share prices and 2) to assess whether a particular item of information or event has economic value to the investor. The assumption made in most of these studies is that the stock market is efficient in processing information. Market efficiency has been defined by Fama(1970) as "A securities market is efficient if security prices fully relect the information available". Whilst there are criticisms of this definition (see Beaver, 1979), for the purpose of this review these can be treated as semantic. By making the assumption of market efficiency it is possible to accept the premise that if a particular item or event has informational content then share prices will react in sympathy. If, however, no share price movement is found then the conclusion drawn, methodological weaknesses aside is that the new information has no economic value.

The second group of studies to be reviewed contains those studies which have concentrated on factors that determine share values as opposed to share price movements. This type of study attempts to model the decision making process of the investor in order to arrive at an appropriate share price/value. From the practioner's point of view such a model would be used for finding over- and under-valued shares, but from our point of view any relationships uncovered should provide insight into the market's decision making process and a means of empirically evaluating the validity of certain theories of share valuation.

The format of this chapter is as follows. Prior to reviewing the two groups of studies referred to above we present a brief outline of two opposing theories on share valuation. Whilst this brief discussion does not attempt to detail all the various arguments for and against each theory, as these will be examined later, it does provide a useful basis for comparing the results of the extant work. Following this we present our discussion on the two groups of studies relevant to this thesis. This discussion not only serves to build a picture of the empirical evidence for and against the various theories, but also sheds light on the types of relationship to expect in our models and the variables we should include in our model building process. Having presented this broad review of the extant work we then focus our attention on several important theoretical issues. These are the role of dividends and earnings in the share price fixing mechanism, the evaluation of financial risk and its impact on share prices and lastly, the utility of systematic risk measures in the U.K. stock market. Within each of these subsections both theory and the empirical evidence are evaluated and a number hypotheses are formulated.

2. Share Valuation Theory

There are two opposing theories on the valuation of shares. The first is the traditional view taken by Williams(1938) which states that a share derives its value from the discounted value of all future dividends. It is argued that investors in common stocks invest to receive a benefit and that this benefit can only take the form of dividends.

The opposing theory which was presented in the famous paper by Modigliani and Miller(1961) supports the earnings orientated approach to investment. The theory proposes that earnings are all that matter to the investor and that dividends are irrelevant for determining the economic value of a firm. Furthermore, it is argued that dividends are a mere residual and only affect future financing policies. The basis of this theory is that investors have an ownership right to a company's earnings whether they are distributed or not, and that if the investor wishes to receive an income from his investment he can readily sell the portion of his investment that represents the capital growth caused by the retained earnings.

The counter argument to this second doctrine is based on market imperfections and uncertainty. Under conditions of uncertainty investors perceive dividends as a means of reducing their overall downside risk. Furthermore, market imperfections often mean that capital growth cannot be relied upon and therefore the selling of shares to realise cash income may not be practical. Thus we conclude that in reality the market may well be expected to react to both dividends and earnings. The above theories are not presented at length as they can be found in most textbooks on finance. However, they do provide us with a theoretical base for making inferences from the empirical research discussed below.

3. Share Price Movements and Accounting Information

The extent to which accounting numbers influence share prices has been the focus of attention for many studies. It is traditionally accepted that financial statements are used by invesors in share valuation and as such it is argued that changes in accounting numbers may change investor expectations and hence change share prices. By examining the association between accounting numbers and changes in share prices it should be possible to gauge to some extent which are the important numbers in the share valuation process. Studies of this nature are therefore relevant to this study in that they firstly provide some empirical evidence on the validity of several theoretical issues and secondly indicate which variables are likely to be influential in the share price fixing mechanism. The review that follows has been split according to type of methodology. The first is the univariate approach where the emphasis is placed on the impact of a specific event/accounting number on share prices. The second type of methodology is the multivariate approach which adopts a more complex view of the way the market operates and attempts to explain share price movements in terms of a collection of variables. Both types of study are based on the principle that over a period of time there should be some sort of systematic correspondence between share price movements and accounting numbers.

3.1 The Univariate Approach

The aim of most univariate studies has been to establish whether or not certain items of information or accounting methods are of sufficient economic importance to make the market as a whole reassess the value of a share. Most of these studies assume that the market is efficient, at least in the semi-strong form (Lorie & Hamilton, 1975: p.71), which means that 1) all publicly available information is impounded in share prices and 2) that share prices react instantaneously and unbiasedly to new information. Having made this assumption and by using Capital Asset Pricing Model based methodology it is possible to relate specific share price reaction to the release of new information. Gonedes(1973) summarizes why this type of research is important for the suppliers of financial information.

> "The extent to which accounting numbers reflect information that is impounded in market prices serves as a means of empirically evaluating the information content of accounting numbers. Observed market prices may be used as a standard for evaluation in this case because of the observed efficiency of market prices."

Premised upon the above assumptions if it is found that there is an association between the release of new information and abnormal share price movements then it is reasonable to conclude that the new information is of economic value to the investor. On the other hand, if no share price movement is found then either this suggests that the particular item of information is unimportant, and/or that the information does not contain anything new and merely confirms market expectations.

One of the first studies to use the above methodology was by Ball and Brown(1968), who examined the impact of large differences between actual and expected earnings on share prices. They commenced their study by deriving a regression model based upon estimates of the market's expected change in earnings. This expected change was then compared with the actual change and, depending on whether the difference was negative or positive, companies were either classified as producing unexpectedly good or unexpectedly bad earnings.

Ball and Brown then proceeded to create an Abnormal Performance Index for each of these two groups of companies. This index represented "the value of one dollar invested (in equal amounts) in all securities at the end of month -12 (that is, 12 months prior to the month of the annual report) and held to the end of some arbitrary holding period after abstracting from market effects." When the performance of each portfolio was plotted using this index it was clearly shown that companies whose earnings were significantly higher than expected produced significantly above average returns and vice versa. These results led Ball and Brown to conclude that the market forecasts earnings quite well in that most share price movement takes place prior to the preliminary results being released. Furthermore, only 10 to 15% of the total share price movement took place in the month of the announcement indicating that most of the information in the preliminary report had already been discounted.

The Ball and Brown study clearly demonstrated the importance of earnings in the investment decision making process and that the market continually adjusts its forecasts of future earnings by assessing new information as it becomes available. Whilst we can accept Ball and Brown's general conclusions in general it should be noted that certain caveats pertain. Firstly, the results are dependent upon the validity of the regression model used to derive the estimated earnings figures. Secondly, there is an element of bias in the movement of the Abnormal Performance Index which accentuates the returns. (This is however noted by Ball and Brown.)

Beaver(1968) also concentrated on earnings by monitoring both the volume of trading and the share price movements in the weeks surrounding the earnings announcement. In his study on 143 companies over five years, he found that activity was on average 33% higher during this period than in other weeks and that share price movements were also greater. These results confirm the importance of earnings figures for investment decision making, and indicate that new information is discounted very quickly after the announcement. A discussant of the paper, Chambers(1974), states that these results merely confirm that the announcement of the annual accounts affects trading in the market, it does not specifically prove that earnings per se are the cause for the activity.

A further study by Brown(1978) used residual analysis to monitor unusual share price movements for companies reporting a 20 percent change in earnings. Whilst his results confirmed the affect of earnings on share prices, they did cast doubt on the assumption that share prices instantaneously absorb new information. He found that abnormal share price movements could be detected up to two months after the announcement of the new earnings number.

Other researchers have also found that earnings announcements have a strong influence on share prices. Brown and Kennelly(1972) and Kiger(1972), using similar methodologies to Ball and Brown(1968) and Beaver(1968), found that quarterly earnings announcements contained useful information and that they led to a revision in share prices. Gonedes(1978) also adds further evidence on the influence of earnings. To summarise then we can conclude that the above empirical evidence suggests that earnings are related to share prices and therefore are important to investors when making investment decisions. However, the results do not allow us to draw further conclusions regarding whether earnings per se are the key to share values or whether they merely change investor expectations.

The univariate approach has not just been restricted to looking at the impact of earnings. In a recent study be Aharony and Swary(1980) the "informational content of dividends" came under examination. This study involved the monitoring of share price changes for 149 companies which reported their dividends quarterly between 1963 and 1976. The sample was divided into three subsets: a) no change in dividend, b) increases in dividend, and c) decreases in dividend, and for each subset, two new groups were formed based on whether the dividend was announced before or after the earnings announcement.

The returns on each of these subsets of companies were then monitored using the residual analysis approach for twenty days surrounding the announcement date. Aharony and Swary found that:

1) normal returns were generated for the no change subset and that these were not affected by the timing of the announcement

2) positive abnormal returns were generated for the dividend increase subset and again the timing of the announcement relative to the earnings announcement had no significant effect

3) lastly, negative abnormal returns were generated on the dividend decrease subset and again timing of the announcement had no effect.

Aharony and Swary argue that these results confirm that dividends have informational content and that the timing of the announcement relative to the earnings announcement has no significant effect. They concluded from their results that "the quarterly dividend announcment contains useful information beyond that already provided by quarterly earnings numbers." In addition the authors tested to see if the influence of dividends decreased when the effects of earnings changes were taken into account. They found that changes in dividends still generated abnormal returns and thus provided further evidence to support their conclusion. Other studies by Pettit(1972) and Laub(1976) have also found similar results.

It would appear that the empirical evidence indicating that dividends possess informational content is strong. However, other studies by Gonedes(1978) and Watts(1973) on U.S. data and by Brown, Finn and Hancock(1977) and Ball, Brown, Finn and Officer(1979) on Australian data provide conflicting results. Gonedes and Watts both concluded that there was very little information contained in the dividend announcement once the effect of earnings is controlled for. Brown et al, however, point to the existence of various methodological difficulties that they argue, might account for these conflicting results. They suggest that it is in fact very difficult to isolate the marginal informational content of either dividends or earnings and that it is only possible to conclude that there is a relationship between the magnitude of the share price movement and the magnitude of both dividend and earnings changes. Ball et al also emphasize the methodological problems, and although their results are consistent with the information content of dividends theory they go on to suggest that "the observed dividend effect is too large to be explained by the major hypotheses concerning market-wide preferences for or against dividends."

The above studies which have attempted to assess the informational content of dividends provide conflicting results and therefore cannot be interpreted together as either supporting or disputing the Modigliani and Miller(1961) theory on the valuation of shares. This univariate CAPM based approach has not, however, been limited to earnings and dividend studies and has also been used for testing the impact of other events/data items on share prices. Firth(1978a) in the U.K. and Ball, Walker and Whittred(1979) in Australia have both looked at the influence of audit qualifications on share prices. Both studies found that only certain types of qualified audit report contained significant information as reflected in share price movements and that investors react differently to various types of audit qualification. Firth(1977b) has also investigated the impact of capitalisation issues on share prices. He found that the issues themselves have no impact on share prices which merely confirms rational behaviour in the market. Gonedes(1978) found that extraordinary items had no effect on share prices and therefore provides evidence to suggest that such data is not important to investors.

To summarise these univariate studies based upon share price movements we can conclude that it has been empirically demonstrated that certain data items/events do have an influence on share prices and therefore can be considered to be of economic value to the investor. Nevertheless the methodological approach used can be criticised on the following grounds:

1) the empirical evidence is conflicting for certain data items, the impact of dividends is an example. This means that it is difficult to substantiate or reject theory and this might suggest that the methodology may not be totally appropriate for this type of research.

2) even when there is a consensus in the empirical evidence, the

researcher can only make crude generalisations about the impact of an event on the investment decision making process.

3) although this approach does provide some insight into the relationship between accounting numbers and share price movements, all too often the results merely confirm the obvious. Under such circumstances if events/data items were not found to be significant then it would mean questioning the fundamentals of investment practice and infer irrational behaviour in the market.

To conclude then, the univariate approach may be considered to be a very blunt tool for clarifying the impact of accounting numbers on share prices and as such has only provided us with limited insight into the factors that may be important in our model building. However, the multivariate approach may prove to be more useful.

3.2 The Multivariate Approach

The second part of this discussion on empirical evidence into the association between share price movements and accounting information concentrates on multivariate studies. The advantages of this model building approach are that a) it can potentially provide a holistic model of the set of underlying relationships, b) the impact of more than one data item/event can be evaluated in the same model, and c) it produces a greater understanding of how variables inter-relate in a complex environment. Because of the advantages of this multivariate approach to investment research and the general availability of the statistical techniques there have been numerous studies of this nature, especially in the U.S.A. However, in the review that follows we shall concentrate on those studies that are considered to be the most relevant to our purpose and rigorous in their approach.

One of the first studies of this kind was by Benston(1967) who reports on an investigation into "which published accounting data are used by investors as reflected by changes in the market price." The model he proposed was that a change in share price was a function of dividends, earnings, market conditions and accounting numbers such as sales and net income. He constructed numerous regression models relating share price movements in the months surrounding the publication of accounts to various independent variables. However, despite all his analysis he found very little, if any, relationship between share price changes and the independent variables and concludes, "thus, as measured in this study, the information contained in published accounting reports is a relatively small portion of the information used by investors."

Nevertheless, for our purposes, Benston's results suggest that "past annual ratios are not used by investors" and that lagged variables are much weaker variables than contemporaneous variables. Furthermore, by assuming that his results indicate that accounting variables are unrelated to share price movements, he concludes that accounting data does not have any economic value to the investor. He further adds that it is irrelevant which concept for reporting income is used, as all are irrelevant.

Benston's results cannot however be taken at their face value for the methodology employed is suspect. Firstly in his regression models he does not take into account market expectations and forecasts, and assumes that the market reacts to the latest year's report in the months surrounding publication of the accounts. The Ball and Brown(1968) study referred to above indicates that this is not correct and that share prices are continually moving to take acount of new information affecting forecast figures. Furthermore, if we accept the premise that investors are interested in future returns, it is not surprising that lagged models were not as important as the contemporaneous models. We must therefore conclude that the methodology used by Benston was not adequate for the purpose of revealing whether accounting numbers influence share price movements.

A second study by O'Connor(1973) into the relationship between accounting data and share price changes used financial ratios as the independent variables. The reasons for this was that "there is considerable evidence that .... investors use financial ratios in their analyses of published data", and therefore it is reasonable "to assume that financial ratios analysis might well be used for forming expectations about future returns."

The study covered the period from 1950 to 1966, with financial ratios computed for 127 companies being used as the explanatory variables. The dependent variables were the share price movements from the date of announcement of the accounts for holding periods of one, three and five years. O'Connor examined the relationship between the independent and dependent variables on both univariate and multivariate bases. The univariate analysis revealed that ratios used singly were not effective in differentiating between high and low return stocks. With the multivariate analyses it was found that the models explained between .08 and .3 of the variance, which leads O'Connor to conclude that the "explanatory variables have some ability to explain the variation in the explained variable." Further work was performed to test the predictive ability of the models and it was found that they performed no better than a naive investment strategy.

In his final summary of the study, O'Connor suggests that his results cast strong doubts on the utility of financial ratios to investors for predicting future returns. Furthermore, he also states that the usefulness assertion implicit in the textbooks on ratio analysis is questionable.

O'Connors conclusions are so contradictory to accepted theory on investment analysis that his methodology has to be examined more closely to substantiate that his conclusions are valid. If we return to fundamentals we can see that O'Connor's approach has one major flaw. Investors are interested in future returns which presumably are a function of a company's future performance. If a company's performance improves, then stock returns are also expected to increase, and vice versa. Furthermore, if there is no change in a company's performance, then future returns (share price movements) are likely to remain static. It is therefore reasonable to suggest that investors are interested in changes in the level of historic performance and expectations rather than simply the current level of performance. We therefore conclude that O'Connor should have concentrated on changes in the ratio values rather than the absolute values themselves.

If, however, we assume that O'Connor's methodology was incorrect then we must also explain why he was able to explain up to .3 of the variance over a five year period. The reason for this unexpected result could be attributed to the plausible theory that companies with a high performance record are able to maintain their performance over long time periods and therefore their share prices reflect this high growth rate by steadily increasing. On the other hand low performing companies are likely to have equally poor share price movements. A more plausible explanation is that his statistical methodology resulted in both search and sample biases being present leading to an overfitting of his data. This suspicion may be confirmed by the lack of ex-ante predictive ability of his models. However, as O'Connor does not provide sufficient detail in his paper this question remains unanswered.

The third and final study to be examined in this section is by Gonedes(1974). Again this study used U.S. data, and covered the period 1957 to 1967. The methodology adopted was unique and involved the use of multiple discriminant analysis. The first stage in the analysis was to classify the sample of companies into two subsets based upon whether the cumulative average residual (that is the abnormal performance) of the share was positive or negative. Then by using estimated accounting ratios as discriminatory variables Gonedes derived a model to discriminate between the two groups of companies. Next his model was used to classify the sample of companies into their respective groups, that is positive or negative residuals. The returns from these new portfolios were then compared with the original portfolio to test if the model would have yielded abnormal returns. The results showed that a) the multivariate model did appear to have some discriminatory power but this was very weak and b) although some abnormal returns were generated they were very small.

Gonedes concludes that "these results of our multivariate tests assign a high probability to the statement that the numbers do jointly provide information pertinent to assessing equilibrium expected returns." Further analysis, however, revealed that the ability to generate abnormal returns of the multivariate model over a univariate model based on earnings-per-share was minimal and therefore the author goes on to state that "insofar as expected effects are concerned, our results seem to ascribe special importance to the information reflected in the earnings-per-share variable, relative to the other variables examined."

The results of this study again demonstrate the problems of relating accounting numbers to share price movements. Although the informational content of accounting information, especially earnings-per-share, was shown to be important to investors, the results provide very little information over and above that already provided by Ball and Brown(1968). Furthermore, the approach adopted can be criticised for its heavy reliance on the estimation procedures used to calculate the efect of share price movements and the estimated accounting numbers, (see Gonedes and Dopuch, 1974 for a full discusion on this point).

There are several conclusions to be drawn from the studies discussed above, and other studies of this type (eg. Rosenberg and McKibben, 1973; Nerlove, 1968; Klemkosky and Petty, 1973). Firstly, the potential benefits of the multivariate approach in explaining share price movements over that of the univariate approach appear minimal. There is a general methodological problem in relating share price changes to accounting numbers without taking into account changes in those accounting numbers. Moreover, the empirical evidence has not provided any new insight into the characteristics of the share price fixing mechanism and as such is unable to provide us with a better understanding of how published accounting information effects share prices. Furthermore despite a priori reasons for conducting this type of research it might appear that the unpredictable nature of share price movements as suggested by Little(1962) may not lend itself to worthwhile research using this type of framework. In the next section we examine a more positive approach to understanding share price valuations.

4. Share Valuation Models

The research to date into share valuation models has provided somewhat more positive results than those found above. Instead of trying to explain share price movements, the emphasis is more on explaining share prices or, in relative terms, share values. Although, much of this work has been orientated towards creating models for generating abnormal returns in the market, the constituents of themodels provide a means of testing the validity of several finance theories and may indicate variables which are likely to be important in our model building process.

This type of empirical study is particularly relevant here because of the related objectives and methodology of our research, although it is stressed that in this thesis we do not attempt to replicate any of the previous studies directly. In this section emphasis will therefore be placed on both the methodological issues and the contribution of the findings of these earlier studies to the theory of share valuation.

The research into share valuation models is extensive and uses many different analytical approaches and variables. In the review that follows we shall concentrate on the main studies that are believed to be relevant to this thesis. For simplicity these studies have been split into two groups, the first contains those studies that use historical data only and the other contains those studies that were able to use forecast data.

4.1 Historic Data Based Share Valuation Models

One of the earliest studies was by Meader(1935) where the mean 1933 share prices were regressed against five accounting numbers. This study was replicated by Meader(1940) and is reported to have revealed inconsistent results. The main problem with these studies was that the variables were not adjusted for size of company and therefore no useful conclusions would be expected to result.

In order to overcome this problem of scaling most researchers deflate the share price into a measure of relative valuation and the most commonly accepted way to achieve this is to use the price earnings (P/E) ratio or its reciprocal the earnings yield. Another similar yardstick that has been used in this type of study is the dividend yield. Once the measure of relative valuation has been determined then it becomes a matter of trying to explain the reasons for the different valuations in terms of explanatory factors.

One of the first studies into the factors that influence relative share values was by Walter(1959) who used linear discriminant analysis to discriminate between companies with high and low earnings yields. The objective of the study was to "ascertain that linear combination of financial characteristics which best discriminates large industrial companies with low earnings per share to common stock price from those with high ratios." Two subsamples were selected from the largest 500 industrial companies in the U.S., one containing 50 companies with the highest earnings yields and the other containing 50 companies with the lowest earnings yields. The variables used in the discriminant analysis were:

1) the average dividend payout from 1952 to 1955
2) change in earnings before interest to the change in investment from 1952 to 1955
3) average current ratio from 1952 to 1955
4) the average interest cover from 1952 to 1955
5) the change in sales from 1952 to 1955
6) the systematic risk as measured by beta and computed over the previous twelve years

From the analyses it was found that the most important variables were dividend payout and beta, with the remaining variables possessing very little explanatory power. When the model was applied to the original data it was found that it was able to correctly classify 87% of the companies into their original groups. Walter then proceeded to test the model by classifying a sample of sixty companies over the period 1948 to 1951. He fcund that the classification accuracy of the model fell to 80%, and that over time the inconsistencies between the model and the actual earnings yield tended to diminish. Walter concluded his study by suggesting that his model had a large amount of intertemporal stability with the discriminant coefficients remaining "relatively invariant" and therefore "the approach offers possibilities for the discovery of under-or over-valued securities".

However, the use of multiple discriminant analysis in this way has been heavily critcised by Eisenbeis(1977) who argues that certain major assumptions are violated. In particular Eisenbeis is critcal of the methodology used to form the discriminatory groups which is quite arbitrary. Altman(1981) is also critical and states that there is a problem in that the sample is unrepresentative of the population of stocks, that is a majority of stocks are not analysed, and that regression analysis is potentially more appropriate. Also as there is no evidence on the ability of his model to actually find over-valued and under-valued shares forthcoming, Walter's conclusion appear to be possibly a little tenuous. However, these criticisms for our purposes are not sufficient to detract us from the strong underlying relationship found by the model. Perhaps a stonger criticism of Walter's work lies in the choice of using five year averages to compute the variables, which may have the effect of restricting the influence of secondary variables entering the model. In other words the use of averages could dilute the differences between the two groups of companies.

From our point of view these results suggest that dividends might be an important discriminator between companies with high and low price earnings ratios which infers that dividends may influence the rate at which the investor discounts earnings as reflected in the price earnings ratio.

Another study conducted around the same time as Walter's was by Gordon(1959) who tried empirically to prove that the price earnings ratio of a stock is independent of the dividend-payout ratio. On the basis of the results of his study Gordon concluded that dividends were the primary determinant of share values and this was attributed to

"... the financial consequences of retention by a company are more uncertain than the financial consequences of dividends received. Since risk aversion characterises almost all investors, the higher ... uncertainty attached to retained earnings... causes retained earnings to have less value than an equal number of dollars paid out in dividends." (Quoted from Lorie and Hamilton, 1975.)

This study would appear on the surface to confirm the importance of dividends to the investor, but the conclusion reached by Gordon may not be strictly correct in practice due to the inherent assumption made about earnings when analysing price/earnings ratios as we shall see below.

Benishay(1961) tested the hypothesis that the rate of return on corporate equities is a function of a) earnings trend, b) the trend in share price, c) the payout ratio, d) the expected stability of future income streams, e) the expected share price stability, f) the market value of the firm and g) the debt-equity ratio. He conducted a regression analysis using the average values for the independent variables calculated over nine years and the weighted average of earnings over the previous nine years divided by the share price in the ninth year. The cross-sectional regression results revealed that the most important variables were size of company, as measured by the market value, and share price stability. That is the larger the company the higher its share value, and the less stable the share price the higher its relative share value (which is counter-intuitive). Stability of earnings was also found to be significant. The other variables, including the payout ratio, were found not to be important. At first we may be led to believe that these results infer that dividends are unimportant in determining share values. However, the use of nine year averages to compute the variables must have the effect of diluting any possible relationships that might exist between share prices and the independent variables. In fact Benishay's two most important variables demonstrate this by reflecting market trading features rather than corporate financial characteristics. In other words if a stock is actively traded in the market it is likely to have 1) a fairly volatile price relative to stocks which are rarely traded and consequently may possess very stable share prices for a long period and large sparodic movements when trading does occur (this aspect is discussed at length in the following chapter), and 2) a large market capitalisation, with both of these characteristics likely to persist over the nine year period. The importance of this study lies in establishing empirically that the marketability of a share is an important factor in influencing share values.

Another attempt to build a share valuation model was made by Martin(1971). In this study the emphasis was placed on the relevance of accounting information for making investment decisions. Regressions of the earnings yields in 1965 and 1967 were run against independent variables for the corresponding years. Further analysis was conducted using the independent variables lagged by one year. The general conclusion reached was that accounting information reported to shareholders through published financial statements constituted decision relevant data. More specifically it was found that the historical earnings growth ratio, operating margin and book return on capital appeared to be the most important variables. The absence of the dividend payout ratio seems to support the earnings orientated approach to investment.

A closer examination of Martin's methodology, however, reveals that no attempt was made to take out from his sample of 98 companies those companies with very low earnings and therefore very high price earnings ratios. Normally a high price earnings ratio can be interpreted as indicating that the company is relatively highly valued. However, when earnings are very low the price earnings ratio becomes meaningless and impossible to interpret. Furthermore as the ratios for these companies are likely to be outliers in the price earnings ratio distribution they could easily corrupt the results. In fact a closer look at one of Martin's conclusions, that a high price earnings ratio is associated with a low return on capital, could be interpreted as confirming the potential corruption of his sample by the few meaningless observations in the sample.

The final study we shall review that relates accounting information to price earnings ratios is by Shick and Verbrugge(1975). In this study the authors use discriminant analysis in the same way as

Walter(1959), discussed above. Here attention was focussed upon the banks with high and low price earnings ratios and in total sixty six banks were analysed over a six year period. The authors found that their five variable model was quite effective in classifying companies into their respective groups but it would seem from the variables entering the model that the financial characteristics influencing price earnings ratios for banks were different from the industrial companies models we have reviewed so far. It is interesting to note, however, that the marketability of a share and the earnings growth rate were influential factors and that the absence of dividends from the model, methodological considerations apart(see Walter, 1959 discussion above),suggests that they may not be very important to investors in banks.

So far the evidence presented above has concentrated on the price earnings ratio as the relative measure of market valuation. Although this ratio does appear to be generally accepted as the key to share valuation it does introduce a problem which possibly may not have been fully appreciated by the above researchers. In essence any study that searches for factors that lead to differences between relative price earnings ratios automatically assumes that earnings are the prime factor in determining share values. In other words the question being asked by these studies is that once earnings have been taken into account what are the other factors that influence share prices? This approach therefore implies that, ceteris paribus, the rate at which earnings are discounted by the market should be constant and consequently does not allow for differences in the quality of the earnings to be taken into account.

This problem inherent in using the price earnings ratio was overcome in a study by Ryan(1974), who used the book value of the ordinary capital as the deflator instead of earnings believing that this would overcome "the possibility of spurious correlation arising from the presence of both high-priced and low-priced stocks in the sample." The analysis was conducted on 60 U.K. companies using 1970 data and produced the following model:

$$P/OC = -22.7 + 15.9\ D/OC + 9.9\ (E-D)/OC$$

$$R = .717$$

where P = Market Value E = Earnings

D = Dividends OC = Ordinary Capital

This model proposes that the dependent variable, which is a relative measure of how the stock market values the firm's equity, is a function both of the level of dividend paid and the amount of retained earnings. Ryan points out that although it would seem that dividends are more important than retained earnings in the regression model this could possibly be caused through a potential bias which

> "stems from the possibility that stocks, which, because of their relatively high risk, are capitalised at a lower rate than other stocks. Thus the lower capitalisation coefficient on retained earnings in the equation could well reflect the existence of a risk premium attached to such stocks, rather than a true preference for dividends as such."

In an attempt to try to overcome this bias Ryan introduced into his analysis several other variables covering risk, profitability, size, growth and dividend cover. The effect of this was not to improve the importance of the retained earnings variables but to reduce it. It was found that sales growth had a positive relationship with share value. A more likely explanation for this apparent dominance of dividends stems from the misinterpretation of the regression equation. It should be remembered that it is the earnings figure before dividends that is believed to be the key to share valuation not retained earnings, according to Modigliani and Miller(1961) and Durand(1959), and that the empirical evidence of Ball and Brown(1968), Brown and Kennelly(1972) and Kiger(1972) demonstrates the fundamental importance of earnings and earnings expectations. As such it is not surprising that the dividend variable was picked up by the regression analysis. A careful look at table 1 in Ryan's study reveals that 87% of the companies in his sample paid out over 50% of their earnings in dividends and therefore the regression analysis found the variable that was more heavily correlated to earnings. In fact if the equation is transformed into a simpler form as follows it can be seen that earnings are more important than dividends and that retained earnings are no longer in the equation.

$$P/OC = -22.7 + 15.9\ D/OC + 9.9\ (E-D)/OC$$

$$= -22.7 + 6.\ D/OC + 9.9\ E/OC$$

$$= -22.7 + (6D + 9.9E)/OC$$

Although this study does contain certain serious statistical and methodological problems such as potential surious correlation between the variables due to the common denominat and collinearity it does reveal the benefit that might potentially be obtained through similar analysis using a different dependent variable other than the price earnings ratio and a more robust methodology. In addition to these criticisms Ryan can faulted in two other ways. Firstly, in Ryan's reworking of his original model he does not deflate his variable by the book value of the equity. Because of this it is not surprising he obtained very high R-squared values of .98 which clearly reflects the corruption caused by heteroscedasticity in the data. Furthermore, it is difficult to attribute the strength of the dividend variable over that of the retained earnings variable to a risk premium on growth stocks which could only at the very most account for a small part of his total sample.

The above studies and others such as Bower and Bower(1969) and Gordon(1962b) demonstrate that there may well be benefits to be found by using this approach for explaining share values. Nevertheless we have also seen that fundamental problems reside in both the methodology and the statistical analyses. These can be summarised as follows:

1) the use of the price earnings ratio as the dependent variable has the inherent disadvantage in assuming a constant discount rate for earnings and therefore it does not provide an insight into whether the quality of earnings has an impact on relative value.

2) very often studies have used the price earnings ratio without taking into consideration the potential difficulties caused by very low earnings, or at least no mention of this problem is made. The use of averages over several years is presumably supposed to avoid such problems, but this presupposes that companies with very low earnings do eventually recover during the period under examination.

Although we cannot prove that such problems were present in the studies discussed, it does seem highly likely that the inclusion of low earnings companies into the data sample could introduce some sort of bias.

3) most studies have adopted the use of variables computed by taking the mean of several years data, the purpose being to derive a "normal" variable value. The problem with this approach is that it will tend to average out the unusual annual observations which may have caused a temporary change in price. For example it is feasible that a company with high gearing in one year may be marked down by the market as a whole until the gearing has returned to a more acceptable level. If we average out such observations we reduce the explanatory power of the model and thus the ability to uncover the subtleties of the secondary factors in the share price fixing mechanism. Furthermore, the use of averages also means averaging out the effects of economic cycles. It is feasible that in a depression low geared companies will stand at a premium in the market but by averaging this effect will be severely reduced.

4) the use of multiple regression or discriminant analysis may be criticised for the way in which a linear additive model is imposed on the data. Whilst these techniques provide an adequate means of revealing the important variables in the share price fixing mechanism, they may well tell us little about the way in which the variables interact with each other.

Whilst there are problems in this area of research the results of the cross-sectional model building approach have proved to be more informative about the share price fixing mechanism than the time series analyses. We would argue that by concentrating on the factors underlying share values, rather than share price changes, it is possible to become closer to replicating the way in which the market operates in practice. After all traditional investment analysis, excluding such dubious techniques as chartism, is based upon relative share valuation assessments at one point in time and not upon time series correlations. Furthermore by deriving a cross-sectional model of investor behaviour it is implicit that changes in the constituent elements of such a model are likely to change share prices. Consequently, we see this type of approach as the most fruitful method for research and as such it forms the basis for the empirical analyses reported in subsequent chapters. In the share valuation models developed in this thesis we believe that we have been able to improve our methodology by overcoming most of the problems found with the previous studies. In the first place the models are not restricted to using the price earnings ratio as the sole measure of relative market valuation. By using both the price earnings ratio and the dependent variable employed by Ryan(1974) discussed above, which from now on will be called the valuation ratio (Marris,1967), we are able to 1) compare the benefits and disadvantages of both variables and 2) assess the influence of earnings and dividends separately.

Secondly, in this thesis we do not use averages for either the dependent or independent variables and we restrict the cross sectional analysis to a period of one year. By adopting this approach we believe we will be able to model better the characteristics of the share price fixing mechanism.

Finally, as we shall be applying a new technique for analysing the data that has the ability to reveal interaction between variables we hope to be able to form a more complete picture of the utility of accounting information to the investor. However, it would be wrong to ignore the traditional approaches of regression and discriminant analysis as they possess some benefits in certain areas over the interactive approach and therefore they are also used to analyse the data. The benefit from using several analytical techniques in this way is that it is possible to 1) establish that the key variables are not subject to statistical bias and 2) make comparisons between the techniques to establish which is the most suitable from a methodological point of view.

Before leaving this section on valuation models using historic accounting information it is important to distil from the above studies the key factors that appear to be important to the investor in making his investment decision. These can be summarised as follows:

1) EARNINGS - Although most studies use the price earnings ratio as the dependent variable and therefore inhibit the use of this variable per se in the models formulated, it has been demonstrated above that they are nevertheless taking into account the effect of earnings via the use of surrogate measures.

2) DIVIDENDS - The evidence on dividends is slightly conflicting with the studies by Walter(1959) and Gordon(1959) suggesting their importance and other studies by Benishay(1961) and Martin(1971) denying it. However, on balance the evidence does tend to tip towards the theory that dividends are an important part of the share price fixing process or at least the hypothesis is worthy of further empirical investigation.

3) MARKET FACTORS - The marketability of shares as measured by asset size or market capitalisation(see Benishay, 1961 and Shick and Verbrugge, 1975), indicates that factors not related to the financial characteristics of a company but to general market interest may be important to share valuation.

4) EARNINGS GROWTH - Martin(1971) and Shick and Verbrugge(1975) found earnings growth to be an influencial variable although historic earnings variability did not prove to be significant.

The general conclusion to be drawn from these historic data based share valuation studies is that the above factors appear to be important in determining share prices although a more precise and informative model is required before it is possible to make inferences about how the investor processes accounting information. It is interesting to note that despite the established theory on the use of various risk measures in the share valuation process, none were found to be significant explanatory variables in the above studies. As this is such an important omission and implies that risk per se is not important to investors we shall discuss this separately latter in this chapter.

4.2 Share Valuation Using Forecast Data

This second section on share valuation models reviews the literature that has taken a more dynamic approach to the problem of understanding share values. The motivation behind these studies resides not so much in assessing but understanding the share valuation process. Obviously, the main operational benefits of such an approach are that the models once constructed are able "to value hundreds of shares quite quickly and they are unbiased, objective and consistent" (Firth, 1977).

The major difference between these studies and those previously discussed is that they use forecast data to develop their models. The reason for doing this is that as share prices can be defined as representing the discounted value of all future expectations, it is important to take into account these future expectations. Furthermore, it is not possible simply to relate accounting numbers to the previous year's share prices as this will only reflect actual outcomes rather than those expected at the share price date.

One of the first and best known studies to adopt this methodology was by Whitbeck and Kisor(1963) who proposed that a company's "normal" price earnings ratio was a function of expected growth in earnings, the expected dividend payout ratio and the expected standard deviation of earnings about a trend line. The model was developed using the forecast data obtained from a New York bank's trust department for 135 U.S. companies in June 1962. The rationale behind choosing these variables was that investors desire high levels of earnings growth, high dividends and low variability in earnings growth.

Having created their model, the authors then proceeded to test the model for its ability to find over- and under-valued shares covering four different time periods. They used the principle that if a company's price earnings ratio was significantly different from its estimated price earnings ratio then this was a temporary phenomenon, and therefore the share price should move back into line in time. They claimed to have found that when a company's ratio differed by 15% from the estimated ratio, then the over-valued companies under-performed and vice versa. However, the extent of this abnormal performance must be regarded as weak as it ranged from only 1% to 12% over the four, three monthly periods covered. Further work was performed by Malkiel and Craig(1970) to test on an ex-ante basis the predictive ability of the model, but again similar weak and unstable results were obtained.

These findings show that some benefits from this approach may possibly be obtained but as such should not be over emphasized. Furthermore the evidence presented provides little insight into the strength of the regression model and avoids a full discussion on the details and stability of the portfolio returns.

A second study is that of Ahlers(1966), whose model contained different variables, namely estimated earnings growth, current dividend yield and the variability of earnings. The model was derived using a small sample of 24 companies issuing quarterly data from 1964. Ahlers claimed that with this model he was able to outperform the market by a substantial amount and that his success rate was higher than that of an analyst. However the evidence supporting this claim is not given, and therefore it is not possible to critically appraise the results for ourselves.

Both the above studies suggest that benefits may be derived from using forecast models but, like most of the research in this area, they are based on U.S. data. One of the few British studies to be conducted was by Weaver and Hall(1967) who developed a model which was subsequently reported to be in active use by their employers, a firm of stockbrokers. Unlike the other studies discussed so far they developed a model to estimate the dividend yield on a share rather than the price earnings ratio. The explanatory variables employed were 1) the payout ratio, 2) the forecasted short term earnings growth, 3) the forecasted long term dividend growth, 4) earnings variability, and 5) the historic earnings growth rate. The authors found that they were able to explain 58.7% of the variance in the dividend yield and that when used for investment the model managed to outperform a simple buy and hold policy. It is reported that this model is still in use, although it has undergone various changes.

Weaver and Hall can be criticised on two main points. The first is the selection of the dividend yield as the relative market valuation measure. By doing this they are automatically assuming that dividends are all that matter to investors which, as we have seen from the empirical work reviewed above, may not be correct. The second point really stems from the first. In the article the authors reveal that the dividend payout ratio was the most important explanatory variable ie:

$$D/P = f(D/E)$$

where D = Dividend

P = Price

E = Earnings

From this it is easy to see that if the effect of dividends is taken from both sides of the equation, then the share price becomes a function of earnings and in these circumstances the model is prone to serious bias. Thus the authors have produced what must be considered to be an inappropriately formulated model for estimating share values. However, it could be argued that the value of enforcing a formal model for analysis on investment analysts is an important benefit from such a model.

Nevertheless, the above studies, despite their methodological flaws, have at the very least not contradicted the notion that forecast data might be used effectively for investment purposes, although the potential benefits may appear to be small. The obvious disadvantage from this approach is that it requires a team of analysts to continually revise the forecasts. These studies do however emphasize the point that share prices are based on future expectations of growth in earnings and dividends.

In this thesis we do not use forecast data for building share valuation models but instead we use a database based on historic information. The reasons for adopting this approach are as follows:

1) the use of forecast data limits the number of variables in the analyses to those that are produced by the analysts.

2) the number of companies included in the database has to be limited to

the number that can be feasibly analysed by the analysts.

3) there is the possibility of imposing a judgement model on the data unless many analysts are employed and all agree on the various definitions of the variables. In practice this is not feasible.

4) the use of historic data lends itself to unbiased analysis on a large scale.

5) although share prices are based upon investor expectations, there has to be some point in time when expectations are compared with actual performance. We believe that it is generally accepted that the day of reconciliation is the date of publication of the accounts, that is when forecast accounting numbers can be compared with the actual. Furthermore, if we accept that the market is efficient, at least in the semi-strong form, we can argue that the share prices on the day of publication (or the day after allowing for the assimilation of the information) will have adjusted to this new information. If in addition we accept that the best estimate of future expectations on this day is provided by the latest actual results, or that future expectations may take time to be reassessed in light of this new information, then we argue that this particular date is the one point in time when historic information is best reflected in share prices.

Benston(1981) in a review of relevant U.S. studies refers directly to this issue of which date should be compared with which prices. He concludes that averages computed over the latest three or five years and expected figures computed from the averages reported by other companies were not as useful for this type of research as the most recent annual figures.

6) there is a major difference in the objective of this study and those that have employed forecast data. In this study we are trying to model the market's decision making process by using an exploratory type of methodology. In contrast the forecast data type of study simply imposes a normative model on the market and presupposes that this model is correct. The Weaver and Hall(1967) paper clearly demonstrates the drawbacks inherent in this approach in that the original variables and

even the structure of the model may need to be revised when the models appear to be inaccurate.

5. The Influence of Earnings and Dividends

Perhaps the most important issue in this area is that concerning the relative importance of dividends and earnings in the share price fixing mechanism. At the beginning of this chapter we briefly discussed the arguments supporting the two extreme points of view. On the one hand there is the Williams(1938) dividend orientated model and on the other the Modigliani and Miller(1961) dividend indifference theory supporting earnings. The empirical evidence above has not been able to clearly ratify either one of these extreme theories. On balance it would seem reasonable to suggest that earnings may be the key factor in determining share prices and that dividends, although important, are secondary. It is interesting to note that Benston(1981) in concluding his review paper on the use of accounting numbers by investors emphasizes the importance of earnings as follows:

> "Reported earnings provide, at the least, a crude historical (if not predictive) representation of the economic performance of companies, as measured by share prices."

The empirical question that needs to be answered is, how much influence do dividends have in the share evaluation process and why do investors, if they do, perceive them as important? The first part of this question can only be answered by empirical research, but the second part has been well discussed in the literature. A full examination of the theories can be found in Van Horne(1977), Meyer et al(1970) and Lorie and Hamilton(1973). Briefly they suggest that:
1) the level of dividends is an indication of management's future expectations, that is it contains information. A change in dividend "may alter investor's expectations about the future and effectively change the risk class of a share"(Meyer et al 1970,p35). This argument is recognised by Modigliani and Miller who suggest that

changes in dividends merely reflect future earnings expectations and therefore in their own right are not important.

2) dividends may be viewed as reducing the uncertainty in equity investments. Every investor knows that capital gains are not as certain as dividends and cannot be relied upon to generate future income. Van Horne(1977:p271) refers to this as follows: "The critical question is whether the 'quality' of a dividend payout is greater than the 'quality' of the capital gain."? Again Modigliani and Miller have a reply in that they argue that there is no difference in quality. In the words of Van Horne this theory is 'tenuous' at best.

Renwick(1969) discusses this aspect of the influence of dividends in terms of future growth prospects. He suggests that there is an inverse relationship between the size of dividends and the rate of growth of earnings and that there are two stable (normative) states within the stock market defined as follows:

a) companies with relatively high growth potential pay relatively small dividends because of the opportunity cost of distributing funds which can be utilised effectively within the business.

b) companies with relatively low growth potential pay relatively high dividends because of the need to compensate investors for the lack of future growth.

From the point of view of this theory Renwick suggests that companies lying outside these two states are unstable as they are not optimising their asset value, that is their share price. In other words, companies with relatively low growth and low dividends, or vice versa, will not be optimising the personal utility of the company to the investor and will therefore eventually change policies to enter one of the stable states. This theory does not suggest that companies in either state will be equally valued as this depends on the utility of dividends versus the utility of rate of potential growth. Only when there are conditions of equilibrium and indifference between these two controlling factors will the value of companies in either state be equal.

3) there are transaction costs associated with selling stock as proposed by the Modigliani and Miller theory and therefore capital gains are not a perfect substitute for dividends. However as dividends can be subject to higher tax rates than capital gains this reasoning does not necessarily hold true for all investors.

4) the demand for dividends is not totally controlled by theoretically sound investment policies, and in certain circumstances they may be sought for their dividend value alone. It is not uncommon for a fund manager to guarantee that a specific percentage of his fund be received in dividends which therefore must have the effect of making some fund managers seek high yielding stocks for no other reason than to receive dividends. If this preference for dividends is found to be on a sufficient scale to influence share values, then high yielding stocks will command a premium over low yielding stocks. If on the other hand there is an overall dislike of dividends by investors, possibly for tax reasons, then the reverse will be true. It is relevant to note that during the period covered by the analyses conducted in this thesis there were dividend restraints imposed on the market and the effect of this may well have been to create a premium for high yielding stocks.

The nature of this study is such that although we may be able to demonstrate the influence of dividends on market prices, we are unable to suggest which of the above theories is the best description of the cause of this phenomenon. However, the second theory that dividends reduce investor uncertainty, and the fourth theory concerning the impact of restrictive investment practices, would intuitively appear to be better explanations for the investors interest in dividends.

From this discussion we propose the following hypotheses be tested using our derived descriptive model of the market's decision making process:

HYPOTHESIS 1 - Earnings are the dominating factor in determining relative share values.

HYPOTHESIS 2 - Dividends are influencial in determining relative share values but take second place to earnings.

6. Share Valuation and Investment Risk

So far in this chapter very little has been said about the influence of risk in the assessment of share values. The reason for this can be attributed to the lack of significance of such measures in share valuation models to date which may possibly infer that risk is not perceived to be important be investors. However, most basic text books on investment usually advocate the need to evaluate both risk and return in any investment project, and therefore it would seem that some measure of risk should influence relative share values. One explanation for the absence of such a variable from the extant valuation models is that the methodology, which we have criticised above, may not be capable of detecting the influence of risk, either through reasons of mis-specification of the measure or the inability of the statistical techniques used to isolate its true affect. As there appears to be a gap between theory and empirical evidence it is necessary to look closer at the arguments for and against the use of risk in share valuation. Conventionally there are two types of investment risk namely financial risk and systematic risk.

6.1 Financial Risk

The financial risk of a company, often referred to as fundamental risk, describes the internal gearing and is usually measured by the debt/equity ratio. Firth(1975) explains why gearing is important as follows, "Highly geared companies will have more volatile profits performance than similarly placed firms with little fixed interest borrowing and will be a more risky investment." Based upon this argument it would seem reasonable to expect financial gearing to adversely affect share values as it changes the risk class of an investment. Modigliani and Miller(1958) support this line of argument but their theory is based on the net operating income model.

Their reasoning is that shares generating the same net operating income will have the same market valuations regardless of the financial structure and that the effect of arbitrage will cause highly geared companies to have lower share prices. In other words shareholders will adjust their capitalisation rate in line with changes in financial risk.

The opposing line of thought is often referred to as the Net Income Valuation Model(Weston and Brigham, 1979) and suggests that earnings after interest are all that matters to the investor. Renwick(1969) reconciles the two theories by suggesting that gearing is only important when there is a risk of bankruptcy. He goes further to suggest that gearing can be beneficial to investors in certain circumstances and therefore should not be adversely interpreted all the time. The normative model Renwick proposes is that gearing and expected returns interact to form two stable states within the market as follows:

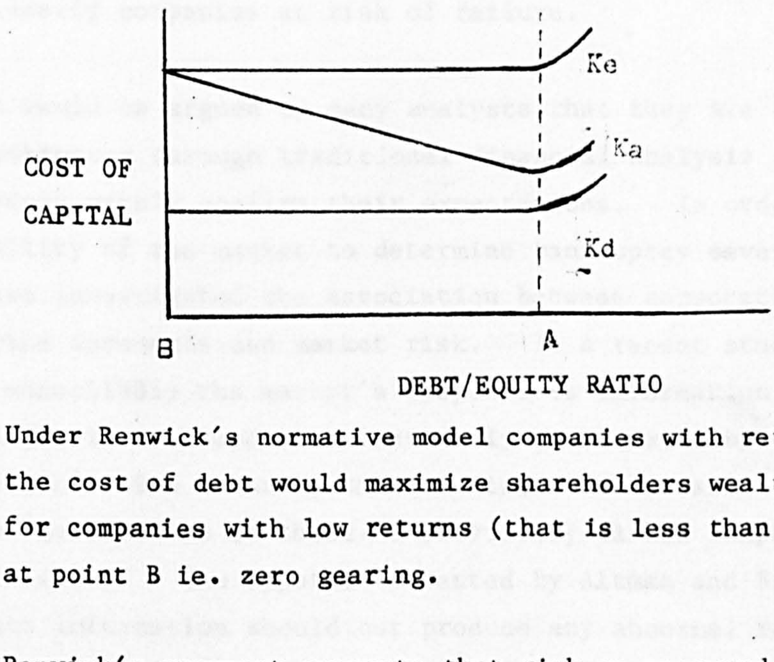
a) companies with low expected returns should have low gearing.

b) companies with high expected returns should have high gearing providing the probability of default remains low.

Any other combination of these factors is an unstable state and does not maximise the investor's risk return profile. For example a low return company with high gearing has a high probability of default and therefore must be considered to be risky. In such circumstances it is argued that management should take action to either increase expected returns or reduce gearing to enable the company to reach a stable state. On the other hand if a company has high expected returns and low gearing then it is possible to increase shareholder profits by adopting a policy to fund expansion by debt rather than equity. Obviously, the only circumstances when the benefit from gearing is obtained is when the expected return is greater than the interest on debt. Under these conditions risk of default is nil, and the expected dispersion of future income is optimised. This relationship can be clearly shown with the use of a graph. Figure 4.1 presents the relationship between the cost of capital and the traditional debt equity ratio. Under the Net Income Valuation model the cost of equity(Ke) and the cost of debt(Kd) remain constant as the level of gearing increases, until a point is reached, A, where the risk of bankruptcy is considered too great, whereupon both Ke and Kd increase. The impact on the average cost of capital(Ka) is a decline until point A and then a rise. The net effect of this decline in the average cost of capital is to increase the amount of income available for distribution to shareholders, and providing Ke remains constant the market value of the firm should increase.

FIGURE 4.1

The Net Income Valuation Model



Under Renwick's normative model companies with returns greater than the cost of debt would maximize shareholders wealth at point A and for companies with low returns (that is less than the cost of debt) at point B ie. zero gearing.

Renwick's argument suggests that risk as measured by the debt/equity ratio cannot be interpreted without reference to overall profitability. As this line of thought is believed a priori to be the most likely model of investor preferences we propose that the following hypothesis be tested:

HYPOTHESIS 3 - Financial risk, as measured by the debt/equity ratio, does not adversely affect share values unless the risk of default is high.

A second type of financial risk which in theory is very relevant to investors is the risk of bankruptcy. When bankruptcy does occur the effect is for the investor to lose his total investment in that particular stock. This type of risk is therefore probably as important, if not more so, than the risk caused by operational gearing discussed above. However, despite the serious effect bankruptcy can have on portfolio performance, it has to date been given only cursory attention in most finance texts which probably stems from the difficulty in determining whether or not a company is at risk of failure. Empirical work by Taffler(1981a) and Altman(1968) in the area of bankruptcy prediction has revealed that it is possible by the use of statistical models to accurately classify companies at risk of failure.

It would be argued by many analysts that they are able to predict bankruptcy through traditional financial analysis and that such models merely confirm their expectations. In order to test the ability of the market to determine bankruptcy several researchers have investigated the association between corporate failure, share price movements and market risk. In a recent study by Altman and Brenner(1981) the market's response to information about firms whose future is assessed to be extremely problematic by application of Altman's 1968 z-model, that is firms that possess similar financial characteristics to those of previously failed companies, was monitored. The hypothesis tested by Altman and Brenner was that such information should not produce any abnormal returns because the information obtained by the use of the model should be digested before or upon the publication of the annual report. In contrast to this hypothesis it was found that deterioration in the firm's share price adjusted for market risk persists up to 12 months after the date of publication of the accounts. Because these results were considered "perplexing and contradictory to much evidence concerning market efficiency", Altman and Brenner subjected the data to more tests which proved inconclusive. So, although there may be some evidence to show that new information conveyed by Altman's z-model may not have been picked up immediately by investors further investigation is required to confirm Altman's and Brenner's preliminary results. One possible reason for these inconclusive results could be due to the problems associated with using "failing companies" as opposed to actul bankruptcies.

Aharony, Jones and Swary(1980) used a different methodology to test the impact of impending bankruptcy on share prices. In this study the share price movements of 45 bankrupt and 65 continuing companies were compared over a period of 390 weeks prior to failure. From a cross-sectional analysis of the weekly returns it was found that, although the systematic risk for each portfolio was not significantly different, the variance of returns was significantly different. The authors suggest that this implies that this difference is caused by firm specific factors rather than market factors. The time series analysis further revealed that there was a significant negative cumulative return for the bankrupt portfolio which started approximately four years prior to bankruptcy and which becomes increasingly negative as bankruptcy approaches.

Aharony et al conclude that investors were adjusting continuously for the declining solvency positions of these firms over about a four year period, and that even near the point of bankruptcy "the market did not fully expect that these firms would soon file bankruptcy." Finally, a study by Arbel, Kolodny and Lakonishok(1977) attempted to test the impact of default risk by monitoring the returns of portfolios with different financial risk. They reported that in general there were no abnormal returns generated by high risk portfolios. However, their methodology can be severely criticised for using bond ratings as a means of defining the degree of financial risk as this implies that bond ratings are accurate predictors of the risk of failure, which was not empirically demonstrated in the study and therefore questionable.

Our overall conclusion from the empirical evidence is that whilst investors have a fundamental interest in knowing the risk of bankruptcy present in their portfolios, it appears that they may not be able to recognise the signs with a sufficient degree of accuracy. This conclusion is rather controversial for it implies inefficiency within the market. As such we propose that the following hypothesis expressed in conventional form is tested:

HYPOTHESIS 4 - Financial risk, as defined by the risk of bankruptcy, adversely affects share values when the risk of default is high.

6.2 Systematic Risk

The other risk measure which theoretically should be used in investment appraisal is beta. Beta is a measure of systematic risk which is that element of investment risk that cannot be reduced by simple diversification, and represents the risk relative to the market as a whole (Franks and Broyles, 1979). As some companies are more susceptable to changes in the economy and therefore the market, they will possess higher risk or betas. If we also assume that investors are risk adverse and require an additional expected return for incurring additional risk then this leads to the conclusion that the greater the risk, the greater the expected return to compensate for the risk. Thus, if all other things are equal, companies with greater systematic risk should be valued less than companies with less risk. This simple theory on systematic risk is well documented in several text books (Lorie and Hamilton, 1973, Firth, 1975, Franks and Broyles, 1979 for example) and therefore we do not examine the theory in more detail. The empirical evidence to support the theory is plentiful in the U.S.A.(see Foster, 1978 for a review). However the same cannot be said for the U.K. where the empirical work has been far less voluminous. One of the early studies is by Briscoe, Samuels and Smyth(1969) who examined the risk-return performance of 14 unit trusts from 1953 to 1963 with a view to substantiating the applicability of the capital asset pricing model in the U.K. The results revealed that "the risk aversion hypothesis which holds for United States mutual funds must be rejected for British unit trusts." The authors add that "The British investor does not appear to differentiate between unit trusts on the grounds of risk."

A later study by Moles and Taylor(1977) reported that unit trusts in general gave a return of 1% above a simple buy and hold policy. In this study the returns of 86 unit trusts over the period 1966 to 1975 were examined. Moles and Taylor found that

1) there was no relationship between "beta" and the risk class attributed to each unit trust.

2) the beta for the period 1966 to 1970 was not a good guide for the beta of the subsequent period.

3) beta gave a poor showing, appearing totally unstructured and apparently completely random in its behaviour.

Besides stating that these results should be interpreted as meaning that the CAPM is not applicable in the U.K. stock market, Moles and Taylor conclude that

> "One must be wary of a blind application of modern investment techniques without a proper analysis of their validity."

However, in a review paper on the U.K. stock market Henfrey, Albrecht and Richards(1977) dispute this claim by Moles and Taylor and make strong criticisms of their methodology. In summary, whilst we recognise that there may be some empirical evidence inconsistent with the view that systematic risk has utility in the U.K., we propose the following hypnothesis:

HYPOTHESIS 5 - Systematic risk as measured by beta is inversely related to share values, the higher the risk the lower the relative share value.

7. The Focus of this Study

The above survey of the literature into the factors influencing share values has revealed very mixed and sometimes conflicting results. In the first place we saw that the empirical studies relating accounting numbers to share price movements on a univariate basis were only, at best, able to contribute broad generalisations about how a limited set of factors influenced share prices. Furthermore, all too often these generalisations merely confirmed relationships which are all too obvious to those involved with share valuation.

In order to investigate whether the limitations of the univariate approach could be overcome we examined some of the multivariate time series studies. Despite the potential benefits from this approach it was found that the methodology was fraught with problems and the resulting models provide little insight into how share prices react to accounting information. These negative results were unexpected in light of the strong theoretical grounds for relating accounting information to share price changes and may well indicate that either the analytical techniques or the methodology employed may not be appropriate for uncovering the true relationships.

The second class of study examined concerned the development of share valuation models. By using a cross-sectional approach several researchers have attempted to explain share valuations using financial characteristics. These studies were generally more helpful in relating accounting information to relative share values but unfortunately there was little consensus in the variables forming the resultant models which could possibly be attributed to the different methodologies employed. Several cross-sectional studies that used forecast data to explain relative share values were also discussed. Unfortunately for our purposes here the methodologies employed imposed valuation models on the data and consequently were unhelpful in providing new insights into the factors at work within the share price fixing mechanism.

The conclusion drawn from this review is that further research needs to be conducted into understanding the relationship between accounting information and share prices. We suggest on the evidence presented above that the cross-sectional approach using share valuation models based on historic accounting information is likely to be more fruitful than the time series approach. We further suggest that part of the reason of the inconclusive results has been the restrictive methodology employed which has in general 1) concentrated on analysing the price earnings ratio, 2) employed linear additive techniques for analysing configural relationships, and 3) diluted the resultant models by the use of normalised ratio values. In this study we attempt to overcome these problems as follows: in the first place we do not restrict ourselves to the price earnings ratio but also work with an alternative measure that overcomes certain of the problems inherent in the use of price earnings ratios and is arguably more theoretically defensibly, namely the valuation ratio. Secondly, we overcome the problems of the linear additive approach by adopting a new analytical technique called Automatic Interaction Detector which has the ability to search for and reveal any configural relationships present in the data (the importance of this was discussed in chapter 3). Lastly we avoid the problems of normalised data by using data computed from the latest available information.

In order to crystalise the relationships we may expect to find in our share valuation models, we then examined both the theory and empirical evidence on several finance issues. This led to the formulation of five normative hypotheses on the roles of earnings, dividends, financial risk, bankruptcy risk and systematic risk in the share price fixing mechanism. It is unfortunate that these hypotheses cannot be tested against more of the extant work, and this only emphasizes the large gap between the theory and practice of finance. We thus hope that this thesis will have potential value from a methodological vantage point and also in so doing may provide a contribution towards enhancing our understanding of certain important issues in the thoery of finance.

CHAPTER V

THE DATA AND RELATED ISSUES

1. Introduction

This chapter presents the data that was used in the building of the models which are presented in the following chapters. The data consisted primarily of financial ratios which can be split into two groups. The first contains the dependent variables based upon market values and the second group contains the independent variables computed from the annual accounts of the companies in the data base.

In this chapter we report on the following:

1) the criteria upon which the companies were selected

2) an examination of the variables included in the analyses, both independent and dependent

3) the definitions of the ratio elements and the adjustments made to the accounting data

4) the tests performed on each ratio distribution in order to ascertain the extent of non-normality and where necessary the adjustments made to make the data more amenable to statistical analysis

5) an examination of the dimensionality of the independent variables by using the multivariate technique of factor analysis. The pupose being to identify the different financial characteristics measured by each ratio.

2. The Criteria for Selecting Companies

The accounting data used in these studies were extracted from the

EXSTAT computer tape, which contains the balance sheet and profit and loss account items for over 2,000 companies including approximately 1,200 U.K. quoted industrial companies, approximately the largest 70% quoted on the London Stock Exchange. Consequently the first criteria for inclusion in the data base was that the company had to be on the tape. Although, this restricted the sample size, it was felt that the results would not be adversely affected. The reason for a subset of quoted companies only being availabe on the tape is that the tape was compiled with similar coverage to that of the Extel Analysts Card Service which only covers those companies that are thought to be of interest to the financial community. The quoted companies not on the tape are in general small and rarely traded. It is resonable to assume that had these companies been included in the analyses then the error term in the data might have been potentially greater as their share prices are unlikely to have fully reflected the market's true perception of their value due to lack of trading.

2.1 <u>The Industries</u>

The data included only manufacturing companies or companies that were predominantly manufacturing. Specifically the following industries were excluded from the data base:

1) retail and rental

2) distribution and transport, including warehousing and stockholding

3) importers and exporters (traders)

4) service industries eg. launderies, financial services, etc.

5) hotels and leisure activiites

6) property developers

7) financial trusts and investment companies

A full list of the industries included in the data base is given in appendix D. (The industry definitions are those given by the Institute of Actuaries.) Screening for manufacturing companies in the leisure and miscellaneous industry classes was also undertaken with the result that thirteen additional companies were found and included in the data base. From the EXSTAT tape as at 1st September,1977 a sample of 689 companies was initially obtained. This is slightly less than we expected but, unfortunately, companies with financial year ends in May, June and July had not yet reported their latest accounts and therefore did not meet our time period constraint. A further detailed check was then made using the Extel Card Service to ensure that every company in the sample was;

i) predominantly manufacturing, that is more than 50% of its turnover was from this activity.

ii) not a subsidiary.

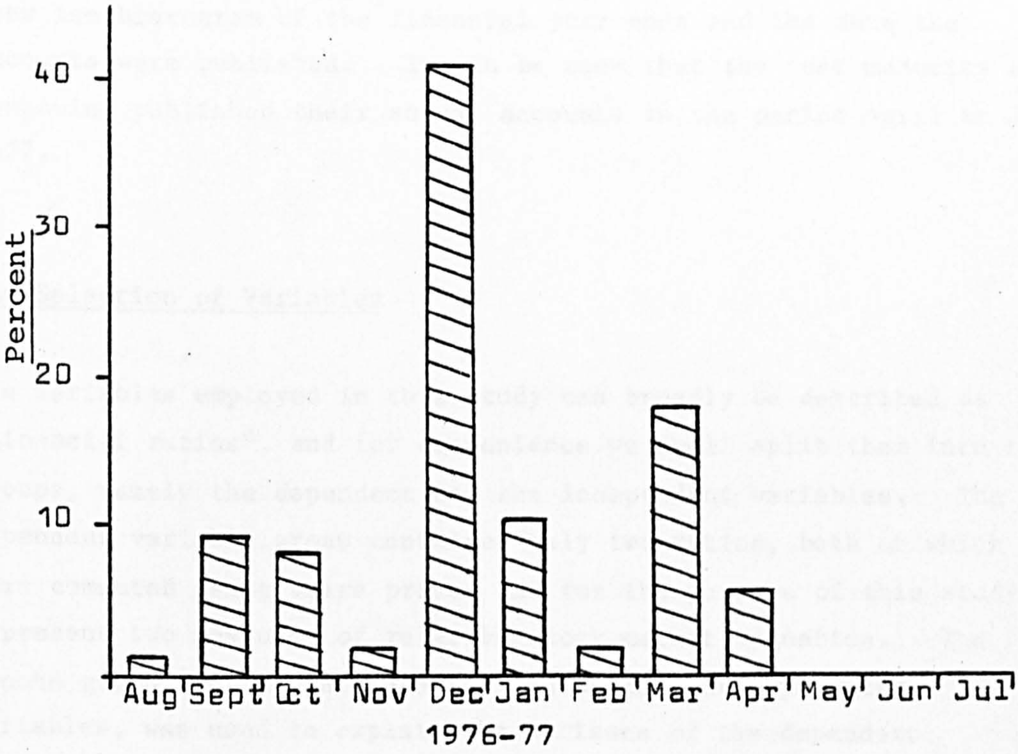
iii) not in liquidation.

iv) quoted on the U.K. Stock Market with a share price readily available.

After vetting and checking that the data on the EXSTAT tape was free from errors the final sample consisted of 547 companies. Of the 142 companies excluded 19 were found to be either in liquidation or had their listing suspended, seven had errors in their data and 3 were subsidiaries. The remaining 113 companies were found not to be predominantly manufacturing. It was thought that this final sample was a homogeneous group of manufacturing companies and large enough to enable thorough analyses to be undertaken. A full list of companies is presented in appendix K.

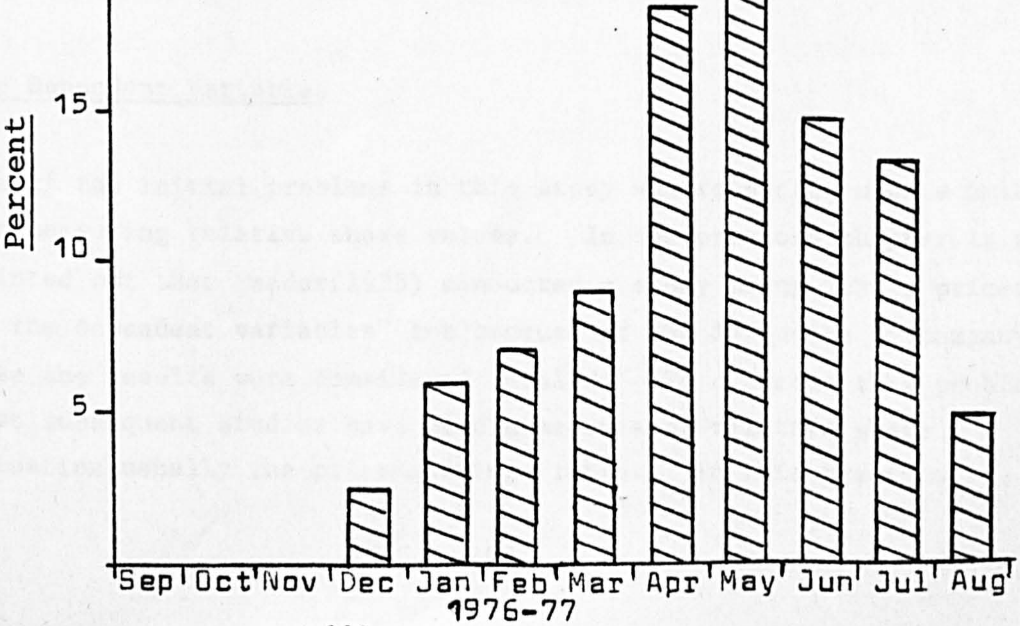
HISTOGRAM OF FINANCIAL YEAR ENDS

Figure 5.1



HISTOGRAM OF THE DATE OF PUBLICATION OF THE ANNUAL ACCOUNTS

Figure 5.2



2.2 Time Period

The time period covered by the analyses is from 1st August, 1976 to 31st July, 1977. Companies reporting their annual accounts during this period were included in the data base. Figures 5.1 and 5.2 show the histogram of the financial year ends and the date the accounts were published. It can be seen that the vast majority of companies published their annual accounts in the period April to July 1977.

3. The Selection of Variables

The variables employed in this study can broadly be described as "financial ratios", and for convenience we shall split them into two groups, namely the dependent and the independent variables. The dependent variable group contained only two ratios, both of which were computed using share prices and for the purpose of this study represent two measures of relative stock market valuation. The second group, which contained the independent or explanatory variables, was used to explain the variance of the dependent variables. This second group differed from the first in that all the variables were derived from data extracted from published accounts and thus can be described as "externally stable variables" as opposed to the "market based valuations" of the first group. In essence the difference between the two groups was that the dependent variables were based upon values determined by investor preferences whilst the explanatory variables were based upon "objective" historic data.

4. The Dependent Variables

One of the initial problems in this study was to decide upon a method for measuring relative share values. In the previous chapter it was pointed out that Meader(1935) conducted a study using "share prices as the dependent variables" but because of the influence of company size the results were considered invalid. To overcome this problem, most subsequent studies have used a measure of relative share valuation usually the price earnings ratio. In this thesis we comply with this traditional approach by adopting the earnings yield (the reciprocal of the price earnings ratio) as a dependent variable. However, this variable has been criticized by many, as we shall see, and therefore it was considered appropriate to adopt another measure of relative share valuation, the valuation ratio. By analysing these variables in parallel and comparing the results it was thought that a more complete picture of the rationale behind the share price fixing mechanism might be found.

4.1 The Earnings Yield

The earnings yield or its reciprocal the price earnings ratio has been used extensively in the empirical studies into share valuation. In the previous chapter studies by Walter(1959), Gordon(1959), Benishay(1961), Martin(1971) and Shick and Verbrugge(1975) were discussed at length and, although the results in general were poor, the authors were consistent in their use of this relative share price measure as the dependent variable. Other major studies that have concentrated on the characteristics of this ratio over time are Beaver and Morse(1978), Basu(1978) and Basu(1977). However, as all of these studies focus upon the Capital Asset Pricing Model, it is not considered appropriate to discuss them at length, especially in a thesis which does not have a special emphasis towards testing the C.A.P.M. For our purposes it is sufficient to demonstrate the academic interest in this measure of share valuation.

Most financial analysts would appear to use the earnings yield, or its reciprocal the price earnings ratio, to relate forecasted earnings to share prices and to help decide a share is over- or under-valued(see Firth, 1977a for a detailed discussion). Quite simply the earnings yield is the earnings per share expressed as a percentage of the share price and is analagous to return on capital. Larcier(1977) suggests that the concept of the price earnings ratio is similar to that of the "payback" method used by industrial finance managers. The definition of earnings often varies from analyst to analyst but in this study we have used the "Net (Actual) Earnings" definition which has been recommended by the Institute of Chartered

Accountants. This definition of earnings only takes into account the ACT (recoverable and non-recoverable) on dividends actually paid by the company. The ratio is calculated:

$$\text{Earnings Yield} = \frac{\text{Earnings Per Share}}{\text{Price Per Share}}$$

This ratio can be best interpretated if Table 5.1 is considered.

TABLE 5.1

A Comparison of two Earnings Yield Ratios

Company	EPS	Share Price	Earnings Yield
A	21p	200p	10.5%
B	21p	100p	21.0%

From this table we can see that although company A has the same earnings per share as company B, company A has a higher price and therefore a lower yield. This can be interpreted as meaning that investors value the earnings of A more than they do B. There are several possible reasons for this. It could be that A:

1) has greater growth potential than B, and the market is therefore expecting a higher return in the future.

2) has temporary depressed earnings and the market expects a return to a higher more normal yield in the current year.

3) has a less volatile earnings record than B and is therefore thought to be less risky than B.

4) has a greater net asset per share than B and therefore offers more asset cover to the investor.

5) has a more marketable stock than B.

6) has a lower debt/equity ratio or is less likely to fail than B and therefore can be described as possessing less fundamental risk

The major problem when using this ratio is that its interpretation is extremely difficult especially at the lower end of the distribution. A company with normal profits, but considered to have high upside potential, will have a low yield caused by a high share price. However, a company with little or no profits will also have a low yield as there is a limit as to how far the market is willing to let the share price fall. Obviously the value of the underlying assets will prohibit share prices falling to zero.

In order to avoid the problems with companies generating low returns and therefore not possessing meaningful earnings yields, it was decided to exclude these companies from the earnings yield analyses. The rule of thumb adopted for this purpose was that if a company was generating a return on capital of less than 5% and had an earnings yield value of less than 7%, then it was excluded from the database. It should be noted that of all the 43 companies with yields less than 7%, only 2 were not associated with a very low return on capital. The end result was a reduced sample of 506 companies.

It has been suggested by Whitbeck and Kisor(1963), that in order to aid interpretation of the ratio, earnings should be normalised. This, it is argued would overcome the problem of temporary high or low earnings in the current year. Normalising would take the form of averaging several years earnings figures in order to produce a normal earnings figure. Although there is substantial agreement that this type of adjustment is necessary, there is little agreement on the best way to do it(Lorie and Hamilton 1975:133). The implication of this type of adjustment is that earnings have a cyclical nature. However this is not supported by the findings of Little and Rayner (1966) who tested earnings growth for secular trends, cyclical changes and seasonal variations only to find no significant relationship between succesive earnings figures.

In this study we make no attempt to normalise earnings for several reasons. The first and the most important is that the use of normalised or averaged variables has the effect of diluting any cause and effect relationships that may be present between the dependent and independent variables. For example, it is conceivable and in fact probable that temporary changes in a company's financial characteristics might cause a temporary change in its share price. However, by using normalised or averaged variables it is plausible that this cause and effect relationship may easily be lost in the resultant model's error term. The second reason is that during the two year period prior to 1976 the U.K. economy was in a recession and suffering from high inflation. As a result company profits were substantially reduced and therefore any attempt to normalise might introduce a general downward bias. Finally, we would argue that one of the strengths of this thesis lies in relating the latest historic accounting data to share prices on the day after the day that the accounting data was released to the public. If one accepts the premise that share prices reflect future expectations then at this one point in time the historic earnings yield is likely to be the closest to the expected yield. Obviously as time progresses from this date revised earnings forecasts will be calculated but these will probably take time to be fully reflected in the share price(for evidence to support this argument see Brown, 1978 and Latane and Jones, 1977). Our conclusion is that any attempt to normalise earnings is likely to weaken rather than strengthen the relationship between relative share values and historic accounting data.

A further area of controversy surrounding the use of the earnings yield as a yardstick for share valuation lies in the definition of "earnings". Several critics (eg. Sibley, 1979 and Larcier, 1977) have used the basic reasoning contained in SSAP 16 on inflation accounting to argue that the "earnings" number is not a "true measure" of a company's income and therefore any ratio that uses this misleading figure is invalid. Furthermore, other critics such as Brealey(1976) and Lawson(1980) argue that cash flows are all that matter and therefore earnings are not an appropriate number for share valuation. However evidence from a study by Govindarajan(1980) reveals that investment analysts view earnings information to be more useful than cash flow information. Consequently, whilst it would be true to say that these criticisms have a growing body of support at the present time, as yet no replacement scheme has been introduced and accepted by the market as an acceptable substitute for the traditional method of calculation. Thus, although we recognise that the earnings yield is not a perfect measure for share valuation, there is no generally acceptable substitute, and therefore because it is so widely used in its current form it is considered to be a relevant measure for use as a dependent variable. (It is interesting to note that a study by Moore, 1980 revealed that from a macro-economic point of view there was little difference between inflation adjusted and unadjusted earnings figures.)

4.2 The Valuation Ratio

The valuation ratio measures the relationship between the stock market's valuation of a company's ordinary share capital and the book value of its underlying equity assets. The ratio has been used in several empirical studies eg. Singh and Whittington(1968), Ryan(1974), Kamath(1980) and Moore(1980) and is often referred to in the more academic finance literature (eg. Marris, 1967). In practice the ratio is usually only referred to in take-over or liquidation situations. It is calculated as follows:

$$\text{Valuation Ratio} = \frac{\text{Book Value of Equity}}{\text{Market Value of Equity}}$$

In pure economic theory terms if the book value of equity were the same as the economic value of the assets, and given certain theoretical assumptions, then it is postulated that this ratio would always be equal to one. Nevertheless, theory does not hold in practice and rarely will the ratio equal one. The higher the ratio, the less the market values the earning power/risk profile of the assets. The lower the ratio the more the investor is willing to pay for the assets, which should mean a higher risk adjusted earnings potential. Table 5.2 shows the calculation of this ratio for two companies with the same Net Assets per share. It can be seen that the market has a higher regard for the assets of A than it does for B.

Table 5.2

A Comparison of Two Valuation Ratios

Company	Net Assets Per Share	Share Price	Valuation Ratio
A	50p	100p	.5
B	50p	50p	1.00

The ratio is far easier to interpret than the earnings yield as it does not suffer from temporary variations in the numerator. The numerator of the valuation ratio, the book value of equity, is relatively stable although it can be criticised for problems associated with asset valuation. However, the current trend is for companies to regularly revalue their assets and therefore this problem may be possibly more apparent than real. In any case, faute de mieux, in the absense of any more accurate valuation information we are forced to use the published book value figures. Also our prime interest was in the relationship between published accounting information and relative share valuations.

A further point of interest is that this ratio is free from the criticisms voiced about the definition of the earnings figure used in the calculation of the earnings yield. Thus a further attribute of the valuation ratio is that it measures the economic value of the assets as perceived by investors and therefore does not implicitly assume traditional accounting profit measures to be correct for measuring economic income.

The valuation ratio is not used regulary by analysts or referred to by the press except in takeover situations but as we have seen in the previous chapter it has been used quite effectively by Ryan(1974) for share valuation. In conclusion, despite its problems, we believe that this ratio provides a valid alternative measure of share valuation.

A final point worth clarifying is that the share prices collected for the calculation of the two dependent variables were the middle prices taken from the Stock Exchange Daily Official List on the day after publication of the accounts. It is interesting to note that only a few companies had no deals marked on this day which suggests that their share prices were likely to be reflecting the market feeling on the basis of latest accounting information available. Any prices found to be "ex div" on this day were adjusted by adding to the price the net value of the dividend to be paid. This was considered important due to the possible impact of the dividend restraint policies in force at this time. The F.T. 500 All Share index was also collected for the same dates and subsequently all the share prices were adjusted for any movements in the index. This was undertaken as it was believed that when using a six month time period, prices could be influenced by various market fluctuations. The adjustment made was as follows:

$$\text{Revised Price} = \frac{\text{Share Price X Average Index}}{\text{Index at Date of Publication}}$$

During the period examined the movement of the market ranged from 139.4 to 223.0, the average was 197.8. No attempt was made to adjust the prices for any industry specific movements as the majority of the share prices collected related to a short time period (3-4 months), and because of the difficulties of classifying companies into a relevant index.

5. The Independent Variables

The independent (explanatory) variables used in this study are mainly financial ratios that can be computed using the "EXSTAT" database. One problem faced in this study was that of selecting the accounting ratios. The objective adopted was to obtain a set of ratios that had the greatest likelihood of including most of the measures that might be expected to be useful to investors and investment analysts. In general terms the selection criteria were:

1) the popularity of the ratios as cited in the financial statement analysis literature

2) the previous success of the ratios in earlier studies

3) the occurrence of the ratios in the information services supplied to the investment community

The initial source of ratios was from Taffler's(1976) thesis which contains a thorough review of the literature in this area. In addition to producing a list of 80 conventional financial ratios, Taffler also evaluated the use of 71 four year trend measures and found that they had "no coherent form ... with large numbers of outliers, however the ratios were transformed, and thus they were dropped from the analysis"(p145). It was therefore decided to exclude similar trend measures except for two. These were growth in "Net Capital Employed" and the change in "Profit before Interest and Tax" over the latest year. The author is of the opinion that more complicated trend measures are not frequently used in practice and would therefore not have much, if any, influence on share prices. The Benston (1967) study which was discussed at lenght in chapter 4 provides some empirical evidence to support this line of thought.

Taffler's list of 80 ratios was thoroughly reviewed with the result that 29 ratios were considered to be redundant. Other ratios which were considered to be of potential utility were found in Weaver and Hall(1967), Firth(1977a), Van Horne(1977), the Extel Analysts' Service and in the many articles reviewed in the previous chapter. These new ratios were added to the set to give a total of 85 financial ratios which included the two trend measures referred to above.

In addition to the above set of ratios five other variables were included, namely z-score, beta, a measure of the market liquidity and two size measures. The z-score is the result obtained when Taffler's(1977) discriminant function is applied to four ratios. Essentially it is a measure of solvency, with the lower the z-score the less the solvency. However, recent empirical research (Taffler, 1981a) has found that not only does the model provide a means to distinguish between bankrupt and non-bankrupt companies, it also provides a measure of overall economic performance and because of this it was thought that it might be useful.

The beta and the market liquidity measures were kindly provided to the author by the London Business School. The betas were calculated over the three year period from January 1975 to December 1977 using monthly observations. The market liquidity factor was based on the number of deals marked during this three year period. A five point scale was used, one indicating the most liquid, increasing to five where trading was infrequent. Whilst it is recognised that the period over which these two measures were calculated overlap the period of this study it isnot considered important for two reasons. Firstly, it can be seen from figure 5.2 that the overlap is only one month, ie. December 1976 and only affects a few companies. Secondly, even if the overlap problem was more accute evidence from Marsh and Dimson(1980) suggests that betas are relatively stable over time and therefore it is unlikely any significant bias is present.

A full list of the independent and dependent variables is given in appendix A, with an index to the abbreviations used in appendix B. It is not the author's intention to review these ratios individually at this point in this thesis as many will be seen to be redundant. Nevertheless, the ratios that are found to possess significant explanatory powers will be discussed in later chapters.

6. The Ratio Definitions and Accounting Data Adjustments

In the previous section the ratios utilised in the analyses were discussed and reference was made to appendices A and B where a full list of the ratios and their definitions can be found. Whilst deciding on the ratios it was also necessary to standardize the definitions of the elements that constitute the ratios. We shall in this section briefly discuss the necessary adjustments made to the accounting data on the EXSTAT tape. Based on the authors past experience in analysing sets of accounts, it was decided that these adjustments were necessary in order to avoid "window dressing" and certain other accounting misrepresentations. Possibly in certain cases the adjustments made may have been overcautious, but it was felt that when analysing a data base of 547 companies it was far better to be conservative. Briefly the adjustments were as follows:

(i) the bank overdraft and cash figures were offset against each other.

(ii) quoted investments were included at their market value at the balance sheet date instead of book value. The excess (or short fall) over book value was added to (or subtracted from) the shareholders' equity.

(iii) intangible assets were excluded from the balance sheet, the value being deducted from the shareholders' equity.

(iv) the deferred tax account was included as part of the shareholders' equity.

(v) corporation tax payable was classified as a current liability.

(vi) a quarter of the long term bank loans and H.P. loans outstanding were included in the current liabilities and called medium term finance. The reason for this unusual adjustment is that most bank loans and all H.P. loans are repayable by instalment and it was felt that the amounts repaid during the eighteen months after the balance sheet date were not long term loans but medium term and therefore should be treated as a current liability.

(vii) Government grants received were classified as long term debt rather than shareholders' equity. It is believed that this is a more valid treatment as the grant is not classed as equity until it has flowed through the profit and loss account.

(viii) Value Added was calculated by adding together employees' wages, earnings before interest and tax, and depreciation, less any other income. This definition does not exactly reconcile with the normal textbook definition but it is the best that could be obtained from the limited information on the EXSTAT tape. One further problem with this measure is that many companies do not report their overseas employees' remuneration. It is believed, however, that the effect of this omission on the calculated measure may not be too great as most of the companies analysed were predominantly U.K. manufacturing.

The above adjustments constitute the major changes made to the EXSTAT accounting data. In addition the ratios were constructed in such a way that like was always compared with like, this prevents the use of some meaningless return on capital ratios often seen in the literature eg. net income to total assets. Only one ratio of this nature was included, that being profit before tax to net capital employed, and the reason for this is that many investment analysts quote this measure as a good indicator of return on capital. Some of the obvious pitfalls inherent in published accounts such as off balance sheet financing and under valuation of the fixed assets of course will have remained after the above adjustments but as no figures are available on these factors, no adjustment could be made to accommodate them. A full explanation of the ratio elements is contained in appendix B and a set of the standardised accounts are presented in appendix C.

7. The Ratio Distributions and Transformations

It is necessary when using the multivariate statistical techniques employed in this thesis to have a knowledge of the distributions of each of the indpendent and dependent variables. In the past there has been a tendency in this area of research to avoid this particular issue and all too often it has been assumed that the data is approximately normally distributed. The reason for this common assumption is that the alternative would be to employ nonparametric statistics which, although in theory are statistically more valid, do not provide the same degree of predictive accuracy (see Chen & Shimerda, 1979 and Lev & Sunder, 1977). In this study all of the financial ratio distributions have been examined for normality, skew and relative flatness, and where necessary transformations have been made to improve the shape of the ratio distributions.

A similar exercise was performed by Deakin(1976) who examined the distributions of 11 ratios for 19 years using a population of 1,114 companies. From this data base, Deakin found that only one of the eleven ratios examined appeared to be normally distributed, although he found that transforming the data improved normality. These results do not, however, prohibit the use of ratios in this area of research, a point which Deakin refers to in the conclusion of his article:

> "Finally, one can conclude that while probability statements from models based on financial accounting ratios may be subject to question because of the distributions of the data themselves, a user could be better off with a ball park estimate than no estimate at all. Thus the ultimate test of the value of such a model lies not in its adherence to certain data assumptions, but rather in its adherence to its usefulness in decision making."

In the U.K., a study by Bougen and Drury(1980) examined the statistical properties of the seven ratio distributions computed from 700 companies. By using the chi-square test they found that the distributions were non-normal and that this characteristic persisted in an analysis of industries containing thirty or more companies. They conclude their study as follows:

> "The overall impression therefore, is that the U.K. empirical evidence for the distribution of financial ratios seems to indicate non-normality caused by varying degrees of skewness and the existence of extreme outliers. The results adhere to most overseas findings and provide an empirical framework for further U.K. research."

The importance of the above results to this study is that they emphasize the need to understand the underlying characteristics of the ratio distributions. This understanding was obtained by calculating the following statistics for each of the 91 continuous variables in our data base:-

(i) Chi-Square Test for departure from normality.

(ii) Skewness. This statistic takes a value of zero when the distribution is symmetrical, a positive value indicates that cases cluster more to the left of the mean with the extreme values to the right and vice versa for a negative value indicates clustering to the right.

(iii) Kurtosis. This is a measure of the relative peakedness of a distribution. The greater the value above zero the more peaked, the lower the value below zero the flatter the distribution.

(For an expanded explanation of each of the above tests see Clarke and Schkade, 1974).

In addition to the above tests observations outside 3.1 standard deviations from the mean were brought into 3.0 standard deviations. This principle was employed to reduce the extreme values in the data, which were usually caused by some anomaly in the raw data and have a disproportionate effect on the distribution of a variable. This type of adjustment is discussed at length by Lev and Sunder(1977) who refer to it as "Winsorization", named after Charles P. Winsor. They argue that winsorization makes the data more amenable to statistical analysis than the more usual method of trimming the outliers. It was found that in general the number of outliers on this basis was low, usually less than 1% per ratio.

The above statistics were calculated for each ratio using both the raw ratio and each of the following transformations:

- (i) The Reciprocal
- (ii) The Natural Log
- (iii) The Square Root
- (iv) The Square Root of the Reciprocal

Winsorisation took place after each transformation but prior to the calculation of the statistics.

The results of the computer program used to compute the transformations and tests are shown in appendix E. These results were used to select the best transformation for each ratio based on the following rules of thumb:

(i) the lowest chi-square value, or

(ii) if chi-square values similar, the least skewed, or

(iii) if chi-square values and skew values similar, the least number of outliers (column A on appendix E), or,

(iv) if all the above measures produce similar results, the lowest kurtosis value.

The final transformations used are presented in appendix A together with the mean, standard deviation and number of outliers for each ratio. The log transformation was used on 42 of the ratios with the reciprocal, square root and square root of the reciprocal transformations being used on 3, 20 and 6 ratios respectively. The remaining 20 ratios were found to give the best distributions when left untransformed. The high proportion of ratios using the log transformation indicates a skewness in the distributions which is to be expected from this type of data. A summary of the results obtained from the use of the three tests is shown in table 5.3. The chi-square results tended to agree with Deakin's, in that a majority of the ratios had distributions significantly different from the theoretical normal distribution. (In fact only 32% of the ratios had normal distributions at the 5% level of significance.) However, these results are vastly better than those of Deakin(1976) although the bringing in of the outliers could account for this improvement. From the chi-square tests it is also possible to detect those ratios that have unusual distributions. A list of these ratios is given in table 5.4 and will be discussed below.

Table 5.3

SUMMARY OF THE DISTRIBUTION TEST RESULTS AFTER TRANSFORMATION AND WINSORIZATION

	TEST													
	CHI-SQUARE		SKEWNESS						KURTOSIS					
Level of Significance			Positive		Negative		Total		Positive		Negative		Total	
	No. of Ratios	% of Total	No.	%	No.	%	No	%	No.	%	No.	%	No.	%
>5%	28	31.8	27	29.7	26	28.5	53	58.2	16	17.8	-	-	16	17.8
<5% > 1%	13	14.3	9	9.9	4	4.4	13	14.3	26	28.9	1	1.0	27	29.9
<1%	50	54.9	16	17.6	9	9.9	25	27.5	38	42.2	10	11.1	48	53.3
TOTAL	91	100.0	52	57.1	39	42.9	91	100.0	80	88.9	11	12.1	91	100.0

The results of the other two distribution tests were far more positive. The skewness results indicated that 73% of the ratios were not significantly skewed at the 1% level and what skew there was tended to be positive (to the right). These results provided evidence that, although the data may not be normally distributed, it was after transformation in general symmetric. The kurtosis test revealed that at the 1% level of significance 53.3% of the ratios had distributions that were either exceptionally peaked or flat. In general the distributions were peaked (89%) or "leptokurtic" rather than flat or "platykurtic", indicating a high concentration of values around the mean.

TABLE 5.4

The Ratio Distributions with Chi-Square Values > 100

No	Ratio	Chi-Square	Skew-ness	Kurtosis	Transformation
28	CF/AQFA	459.20	1.05	4.44	NONE
46	DEBT/QA	152.77	-0.08	-0.21	SQARE ROOT
53	DEBT/INW	133.18	0.34	0.25	SQUARE ROOT
54	DEBT/TCE	169.29	0.54	-0.05	NONE
57	COS/INV	221.41	1.05	1.28	NONE
73	EDIV/OSNI	112.46	0.46	0.75	NONE
77	DEBT/TA	149.95	0.58	-0.02	NONE
78	DEBT/CA	120.34	0.83	0.48	NONE
85	PROFIT GROWTH	126.75	0.19	2.04	LOG

Table 5.4 lists the ratios that had chi-square values greater than 100, a limit thought to be large enough to indicate an unusual distribution. The histograms of these nine ratios were visually examined in order to determine the reason for their high chi-square values. Five of the ratios were measuring the level of debt and the histograms revealed that the distributions were heavily skewed due to a high number of companies with zero debt, with a tapering off as the gearing increased. Each of the four remaining ratios was found to have exceptionally high peaks indicating a narrow distribution with a

high concentration of observations around the mean. These ratios would be questioned if they were to enter any of the models, however, if they proved to be significant with no close substitute then they would have to be accepted as important explanatory factors.

8. The Dimensionality of the Independent Variables

It will be noted from our discussion above that our independent variable set is quite large consisting of 90 different measures. The reason for this large number is that many previous researchers and financial analysts have tended to derive their own measures for analysis often claiming their particular definition to be more valid than other similar measures. Obviously one of the major drawbacks when analysing a large database of this nature is that many ratios will be measuring the same underlying financial characteristic, albeit in slightly different ways. The high correlation between variables infers that there is a considerable amount of redundancy in the ratio set chosen. Horrigan(1965) refers to this problem as follows:

> "The presence of collinearity is both a blessing and a curse for financial ratio analysis. It means that only a small number of financial ratios are needed to capture most of the information ratios can provide, but it means that this small number must be selected very carefully."

The possible impact of collinearity on the models developed in this thesis is two fold. Firstly, both in the application of regression analysis and automatic interaction detection high correlation between variables can have serious implications on the stability and statistical significance of the resultant models(see Koutsoyianis, 1977 and Songuist and Morgan, 1963). Secondly there is the problem of interpretation of the results which is made difficult if there are a number of highly correlated variables present in a model. For our purposes of clarifying the relationships at work within the share price fixing mechanism, ease of interpretation is considered to be an important and necessary characteristic of any derived model.

In order to overcome the problems caused by collinear variables a principal component analysis (PCA) was employed to aid in the identification of the basic dimensions of the data based on their intercorrelations. The benefit from using this approach to explore the data is that we are able to uncover the main dimensions of information being measured by the ratios in the data base. Chen and Shimerda(1981) discuss this as follows:

> "One of the functions performed by PCA is to group variables into a few factors that retain a maximum information contained in the original variable set. This tool is a useful step for subsequent analysis. The use of PCA, along with other statistical methods, produces a more powerful and basic analysis."

The procedure adopted by this study was to firstly establish a set of orthogonal factors from the data using PCA. (See Harman, 1976, Child, 1969 or Rummel, 1970 for further details of PCA.) The technique works by examining the data for uncorrelated groups of variables which possess high internal homogeneity and high external heterogeneity. The results of this varimax-related orthogonal PCA are shown in appendix G.1 where it can be observed that eleven factors were found to be present. These factors can broadly be reified as measuring profitability, financial gearing, working capital structure, short-term liquidity, asset turnover, debt position, value added, size, debtors position, dividend payout and overdraft dependence. However, if these factors are carefully examined some of the ratio groupings are not intuitively appealing. For instance the separation of the debt-based ratios from the other gearing ratios does not seem to be justified on a priori grounds. Furthermore, several ratios appear to be loaded quite highly on two or more factors, eg. AQA/PDOE, S/TCE, leaving us in a slight dilemma as to what they are measuring. Nevertheless this type of result is to be expected as it is unreasonable to assume orthogonal relationships in natural data (Cattell,1978,p224). At this first stage of the analysis a model had simply been imposed on the data rather than the natural dimensions being established empirically.

OBLIQUE ROTATED PRINCIPAL COMPONENTS LOADINGS MATRIX

Ratio	Principal Component No. 1	2	3	4	5	6	Factor
FF/AVTA	.81						Profitability
FF/AVTCE	.82						Profitability
EBIT/AVTA	.82						Profitability
EBIT/AVTCE	.83						Profitability
PBT/AVTA	.76						Profitability
PBT/AVTNW	.88						Profitability
PBT/AVTCE	.79						Profitability
PBT/AVNCE	.84						Profitability
TNI/S	.74						Profitability
TNI/AVTA	.86						Profitability
NI/AVNW	.99						Profitability
TNI/AVTCE	.90						Profitability
TNI/AVNCE	.94						Profitability
CF/AVTCE	.82						Profitability
CF/AVNCE	.84						Profitability
OSCF/AVOSE	.86						Profitability
EDIV/OSFI	.76						Profitability
TNI/AVTNW	.99						Profitability
CL/CR		.84					Overdraft dependence
FA/TA			-.78				Working Capital Structure
WC/TNW			.91				Working Capital Structure
WC/NCE			.90				Working Capital Structure
CA/TA			.84				Working Capital Structure
INV/CL			.74				Working Capital Structure
Variance Explained	29.6	1.2	13.1				

Ratio	Principal Component No. 4	5	6	7	8	9	10	Factor
CA/S	.75							Asset Turnover
S/AVTA	-.83							Asset Turnover
QA/CL		.84						Short-Term Liquidity Sufficiency
WC/INV		.72						Short-Term Liquidity Sufficiency
INV/CA		-.81						Short-Term Liquidity Sufficiency
QA-CL/PDOE		.84						Short-Term Liquidity Sufficiency
QA/TA		.73						Short-Term Liquidity Sufficiency

Ratio	Principal Component No. 4	5	6	7	8	9	10	11	
VA/S			.77						Value Added
VA/AVTA			.94						
VA/AVTCE			.84						
VA/AVNCE			.84						
VA/ER			.76						
TA/ER			.99						
Debt/QA				.83					Gearing (Long Term)
Debt/TNW				.96					
Debt/TCE				.97					
Debt/TA				1.00					
Debt/CA				.91					
TL/TNW				.61					
TA/TNW				-.61					
Log TA					.86				Size
Log NCE					.88				
Mkt Liq					.74				
Beta					-.60				
EDIV/OSEI						-.75			Dividend Payout
EDIV/OSNI						-.86			
DR/CA							.92		Debtors Dependence
Daysdrs							.74		
CL/TA								.55	Gearing (Short-term)
CL/TNW								.49	
Variance Explained	6.9	8.1	3.1	17.3	2.5	1.5	2.1	5.4	

NOTES:

1. Only the highest loadings are shown.
2. For an expansion of the ratio descriptions see appendix B
3. Delta = O.

The second stage of the analysis involves removing the rigidity imposed by the orthogonality condition with a view to possibly identifying the underlying natural clusters more clearly. This type of analysis is called an oblique rotation. The best results from this rotation were found when delta = 0, and the factor pattern and structure matrices are shown in appendices G.2 and G.3. Table 5.5 gives a summary of the ratios with the highest pattern loading on each factor. We can observe that, although the number of factors is the same as in the orthogonal analysis and the broad description of each is generally unchanged, the factors appear to be easier to interpret and consequently more acceptable. For instance we can see that the debt position and gearing factors have been altered to form two new factors namely long-term gearing and short-term gearing. A further interesting observation is the constituents of the size factor namely two size measures, market liquidity and beta. It would appear that companies that are large have a high amount of trading and a higher level of systematic risk. However, at this stage it would be wrong to try and draw any inferences from these loadings. From a statistical point of view these eleven factors were able to explain 90.8% of the variation in our data base. The amount explained by each factor is shown in table 5.5 and ranges from 29.6 for the profitability factor to 1.2 for the overdraft dependence factor.

In table 5.6 a comparison of these results is made with the results of four other recent studies that have employed factor analytic techniques, namely Sudarsanam(1981a), Taffler(1977), Pinches et al(1975) and Johnson(1979). At first sight, examination of these results appears to suggest that the results are as diverse as the ratios themselves. Different factors can be found in different studies. However, a more detailed review reveals that these factors vary in name only. Chen and Shimerda(1981) comment:

> "To a great extent, the diversity of factors reported in the literature can be attributed to the difference in variables included in the P.C.A."

A COMPARISON OF RECENT FACTOR ANALYTIC STUDIES USING FINANCIAL RATIOS

Table 5.6

	This Study	Sudarsanam (1981a)	Pinches et al (1975)	Taffler (1977)	Johnson (1979)
1.	Profitability	Profitability	Return on Investment	Profitability	Return on Investment.
2.	Overdraft Dependence	B	Cash Position	Creditors Position	Cash Position
3.	Working Capital Structure	Short-term Assets Intensity	B	Working Capital Position	Inventory Intensiveness
4.	Asset Turnover	Asset Turnover	Capital Turnover Inventory Turnover	Activity	Capital Intensiveness
5.	Short-term Liquidity Sufficiency	Structural Liquidity	Short-term Liquidity	Current Asset Breakdown	Receivables Intensiveness
6.	Value Added	Labour Intensity	A	Value Added	A
7.	Long-term Gearing	Long-term Solvency	Financial Leverage	Financial Leverage	Financial Leverage
8.	Size	Size	A	A	A
9.	Dividend Payout	Dividend Payout	A	A	A
10.	Debtor Dependence	B	Receivables Turnover	B	Receivables Intensiveness
11.	Short-term Gearing	Short-term Solvency	Short-term Liquidity	Financial Leverage	B

......./Continued

Table 5.6 continued

	This Study	Sudarsanam (1981a)	Pinches et al (1975)	Taffler (1977)	Johnson (1979)
No. of Factors	11	11	7	7	8
No. of Ratios	89	87	48	80	61
No. of Companies	547	570	221	92	306
% of Variance Explained	90.8%	87%	92%	93.5%	81%
Country	U.K.	U.K.	U.S.A.	U.K.	U.S.A.

NOTES:

A = Ratios on this dimension not included in the study

B = Dimension not identified by study although ratios representing it were included.

We would further add that this diversity might also be partly attributable to different sample sizes, different methodology and differences in the economic and financial enviroments, for example, between the U.K. and U.S.A. studies. Despite these differences, however, it can be seen that our financial dimensions display the same underlying characteristics as both of the U.S.A. studies (Pinches et al, 1975; Johnson, 1979) although in both cases we have more factors. As we might expect the closest agreement is observed between our study and the two U.K. studies (Sudarsanam, 1981a; Taffler, 1977). Although there are some inconsistences in the table, we would conclude that the underlying financial characteristics in this type of data base are fairly stable and that our results may not be sample sensitive.

The implications of this analysis for this study are firstly that the PCA results have clearly demonstrated the considerable redundancy in the use of ratios in traditional financial analysis. It would seem that our 89 measures could be reduced to a set of 11 carefully selected variables without the loss of a significant amount of information. Secondly, we can use these results as an objective means of combining several ratios in an analytical model. The principle employed in subsequent chapters will be to allow only those ratios loaded on separate factors to enter any of the models derived. In this way not only do we minimise the possible problems of multicollinearity, although careful monitoring of intercorrelation is still necessary, but also it should make interpretation of the models easier for we can now relate each variable to a distinct financial characteristic and understand better what it is measuring.

9. Summary and Conclusions

This chapter has described the data employed in the model building processes presented in the following chapters. In broad terms this data consists of accounting ratios and measures of relative share valuation for 547 manufacturing companies computed as at the date of publication of the annual report during the period 1st August, 1976 to 31st July, 1977.

Two measures of relative stock valuation were employed, namely the earnings yield and the valuation ratio. It was pointed out that the earnings yield is a common yardstick for share valuation and has been used in several previous empirical studies. However, it is by no means perfect as there are problems of interpretation of very low yields and there is mounting criticism of its dependence upon accounting based earnings as opposed to "true earnings". In view of this it was considered appropriate to use a second measure of relative share value, namely the valuation ratio, which although rarely employed in the market has been employed in one or two empirical studies to date. This second ratio quite simply measures the extent to which the market values company assets. In other words it is perceived as a measure of the earning power of the underlying assets and therefore should reflect the inherent quality of the company's management.

The independent or explanatory variables were decided upon after a detailed review of the standard text books on investment analysis, the extant literature and the information services used by investment analysts. The final set of variables consisted of 83 financial ratios computed from the annual accounts, a measure of market liquidity, beta, z-score, two growth variables and two size measures. In the author's opinion this list is likely to include most of the relevant financial measures that could be conceived to be useful to the investor in his decision making processes.

Before the empirical analyses could begin it was necessary to gain an insight into the underlying characteristics of the data and where necessary make adjustments so that it would be more amenable to statistical analysis. In the first instance the variable distributions were transformed, where necessary, to improve normality and any extreme observations were brought into 3.0 standard deviations. The second stage involved the use of principal component analysis to identify the underlying patterns in the data based on its intercorrelations. The end result was a set of eleven factors that when taken together explained almost all the variation in the original data. The purpose of the PCA was to provide a means of objectively assessing the underlying financial dimension being measured by each variable and thus providing a means for ensuring a non-tautological and parsimonious combination of variables in our resultant models. The principle employed was that only variables loaded on separate factors could be combined in one model.

In the next chapter we analyse this data using two linear additive techniques with a view to providing our first insight into the market's decision making process.

CHAPTER VI

AN INTIAL INVESTIGATION INTO THE MARKET'S DECISION MAKING PROCESS

1. Introduction

The research presented in this thesis is essentially an examination of the decision making processes at work within the market's share price fixing mechanism. Historically there have been two types of approach to this area of research. The first type of approach is to monitor in detail the way in which investment analysts process information (Slovic et al, 1972; Clarkson, 1966) and then to analyse these descriptive records to build a picture of the decision making process. Unfortunately this approach has the major drawbacks of firstly being dependent upon the researcher's ability to monitor the detail of the decision making process and secondly, the ability to obtain a large enough sample of analysts to enable rigorous statistical analysis to be conducted. As a result the empirical evidence from this type of study has been very inconclusive and has provided little insight into the judgement process (see chapter III).

The second type of approach is to treat the investor's decision making process as a 'black box' about which very little is known other than the input cues and the output ie. the decisions made. By analysing the input to and the output from this 'black box' for correlations it is possible to form a model of the decision making process from which inferences can be made as to how the judge values and utilises the input cues. It is stressed that this type of model is not an actual representation of how the information is used by the user but merely a 'paramorphic' representation (see chapters III and IV).

It is this paramorphic approach to understanding the value of accounting information to the investor which forms the basis of this thesis. In terms of the model presented above, the market's decision making process forms the contents of the 'black box', the input cues are the financial ratios computed from the annual accounts and the outputs from the black box are share prices which reflect the value placed on shares as a result of the market's judgemental process. It is important to emphasise that by adopting this paramorphic approach we are analysing the market as a whole and not simply analysing the idiosyncratic models of a few investment analysts. Figure 6.1 shows this relationship in pictorial form and clearly indicates that any model of the market is a concensus of all investors or at least an average of their competing views on share values. From this type of model we should be able to make inferences about the characteristics of the decision making process in question and thus attempt to verify the validity of certain share valuation theories. As a by-product of this analysis, we should also be able to make inferences about the utility of accounting numbers to investors.

In this chapter we present our initial investigation into the market's decision making process which involves employing two traditional analytical techniques to build linear additive models of the relationship between accounting information and relative share values. This preliminary investigation should provide us with an insight into the likely variables used by the market and thus aid us in the next stage of our analysis where we attempt to build a more realistic model of the market's information processing system. Moreover, the relationships found in these linear models will also serve as a means of testing our five hypotheses developed in the previous chapter. More specifically this chapter takes the following format:

1) a review of the broad issues under examination in this thesis

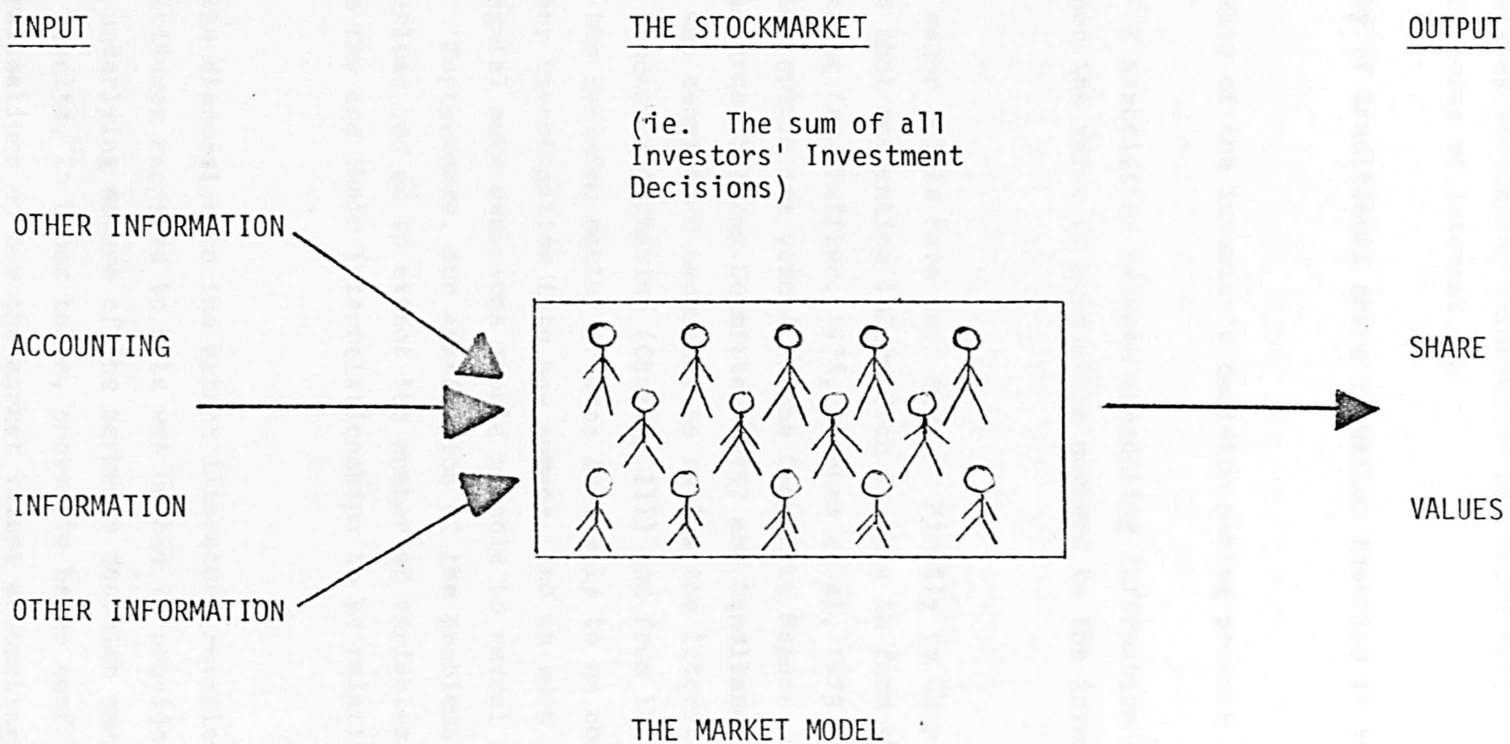
2) the empirical results from both the earnings yield and the valuation ratio analyses including a detailed discussion of the theoretical implications

3) a comparison of the regression results using the two measures of relative share value

4) a summary of the main points and the conclusions to be drawn from the analyses

PARAMORPHIC MODELLING OF THE INVESTOR'S DECISION MAKING PROCESS

Figure 6.1



2. A Restatement of the Main Issues

As stated above the approach adopted by this thesis is to represent paramorphically the market's share valuation process by analysing the relationship between accounting information and share prices. More specifically our areas of interest are

1) the validity of traditional share valuation theories in the U.K. Stock Market

2) the complexity of the investor's decision making process and

3) the degree of association between accounting information and share values, and hence the value of accounting numbers to the investor.

So far several major points have been made. Firstly in Chapter II it was established that accounting information is able to form the basis for decision making (see Taffler, 1976, Pinches et al, 1973 inter alia) despite the criticisms voiced in the Corporate Report (1976), Accounting Standards Steering Committee (1975) and Sandilands (1975). In addition it was considered necessary to review the literature on the way humans process information (Chapter III) and from this we concluded that the decision making process is likely to be configural and therefore any investigation into how humans (and as such the market in aggregate) make decisions should be able to reveal such relationships. Furthermore, our examination of the problems of information overload led us to expect the number of variables used by investors to be few and their interrelationships to be relatively simple.

In Chapter IV the discussion on the extant literature revealed that the empirical evidence reported to date was unable to provide a clear picture of the underlying nature of the market's decision making process. The results, in broad terms, proved to be so conflicting that even generalisations on how the market values accounting information could be questioned. Our conclusions from this review of the extant work were that earnings, dividends, tradeability and earnings growth seemed to influence investors but unfortunately no further insight as to how these factors influence share prices or how they interact with each other was forthcoming. By contrasting the results of this review with the various theories of share valuation, it became apparent that there appears to have been little empirical testing of different theories. As a result five hypotheses on the role of earnings, dividends, financial gearing, default risk and systematic risk were proposed for subsequent testing.

One reason postulated by this thesis for the lack of consensus in the results of the empirical work to date is that the analytical tools employed were not appropriate for the task at hand. In addition fundamental flaws in the research designs in many instances called into question the value of the results reported. It is argued in this thesis that the use of techniques with linear additive alogorithms is incorrect as they are unable to allow for the configural way in which variables are combined by the decision maker. Goldberg(1968) and Slovic(1969) argue that if we are to obtain a greater knowledge of a particular decision making process then it is necessary to employ an analytical technique that reveals interaction between decision variables. Thus it would seem plausible that linear additive techniques may not be totally appropriate for the cross-sectional analysis proposed in this thesis.

However, there is evidence to suggest that the linear additive approach to building models of the expert judge has proved to be very successful in several studies (see Chapter III for discussion; Dawes, 1971, Libby, 1975 are just two examples). Moreover these models of man have been seen to be able to out-perform the decision maker by making consistent and more accurate decisions. So, not only can these models replicate man, they also appear to be better processors of information. It is argued that the reason for this phenomenon is due to the model not suffering from fatigue, headaches, off days etc, all of which impede man's decision making performance (see Libby and Lewis, 1977 for a detailed discussion).

It therefore appears that there are two diametrically opposed lines of thought. On the one hand the linear additive approach is criticised for its inability to adequately describe the way in which variables are combined in the decision making process and to a certain extent this is attributed to be one reason for the lack of consensus in the empirical evidence on share valuation. On the other hand it has been shown that in certain circumstances the linear additive technique is very accurate in replicating man's decisions and therefore, if this is the case, then one must conclude that the variables making up the model are fundamental to the decison process under examination. The balance of consideration between whether the linear additive approach is appropriate or not for this type of research is very fine and the empirical evidence to date provides no clear indication as to which way constructive analysis should be conducted.

The overall picture that emerges from this discussion is that the lack of consensus in the extant work can be attributed partly to the use of possibly inappropriate analytical techniques and partly to methodological issues. In this study we have placed great emphasis on ensuring that the methodology is appropriate and in understanding the underlying characteristics of the data to be analysed. However, as the appropriate analytical technique is not clear we have employed a number of alternative approaches, all of which have various disadvantages and benefits. Consequently, we would hope that the models we derive of the decision making process using accounting data are defensible.

In the following part of this chapter the results obtained from the first stage of a two stage analytical process are presented. This first stage concentrates on the linear additive approach to building share valuation models, and is split into two parts, the first covering the earnings yield analyses and the second the valuation ratio analyses. Within each of these the results obtained from using two analytical techniques namely Multiple Regression Analysis (MRA) and Linear Discriminant Analysis (LDA) are presented. In addition the implications of these models for traditional theories are examined in some detail. From this analysis it may be possible to gain an insight into the following:

1) the extent to which the linear additive approach is able to help us understand the way in which variables are utilised in the market's judgement process

2) the key variables that are likely to be important in the second stage of analysis presented in the following chapter and

3) the strength of the relationship between accounting numbers and relative share values and thus the value of accounting information to investors

3. The Earnings Yield Analyses

In Chapter IV where the extant work on share valuation theory was reviewed at length, it was revealed that most of the empirical studies into share valuation models have concentrated on trying to explain the variation in the earnings yield. It was also shown that these studies usually employed multiple regression as the analytical tool (see Bower & Bower, 1969, Gordon, 1959, Whitbeck and Kisor, 1963, Martin, 1971 and Benishay, 1961), although multiple discriminant analysis was used by Walter(1959) and Schick and Verbrugge(1975)). In this section it is not considered necessary to examine the results of these previous studies again in detail, it is sufficient to simply restate our general conclusion that these studies provide no clear picture of how the share price fixing mechanism operates and often propose conflicting theories on share valuation.

In this study both multiple regression and discriminant analysis were used to analyse the underlying relationships between accounting information and relative share values. The results of these analyses are presented below in two subsections, each containing a general discussion of the principles employed and the resultant models obtained. Following the presentation of the models a discussion on the theoretical implications proposed by the underlying relationships in the models is provided. It is emphasized, however, before the analyses are considered in detail, that the multiple regression approach is the more appropriate of the two analytical techniques due to the inherent problems in using linear discriminant analysis on our data (Altman,1981; Eisenbeis,1977).

3.1 Multiple Regression Analysis

Several studies in the finance area, discussed in chapter IV, have employed multiple regression analysis. The technique attempts to explain the variation in the dependent variable, in this case the earnings yield, in terms of the independent or explanatory variables and takes the following form:

$$y = b_0 + b_1x_1 + b_2x_2 + \dots b_n$$

where y = the dependent variable

(bi) = the regression coefficients

(xi) = the independent variables

It can be seen that with MRA the purpose is to try to explain the variation in the dependent variable, in terms of a linear function of a set of independent variables. Providing certain statistical assumptions are adhered to and given the model is correctly formulated, then it is usual to find that only a proportion of this variation can be explained by the model. The remaining unexplained variation is often referred to as the error term. Obviously, the objective of this type of analysis is to maximise the variance explained which automatically reduces the error term. This brief introduction is probably sufficient to introduce the reader to the utility of MRA. A more detailed explanation of the principles, assumptions and significant tests employed in this study is presented in appendix F.

The earnings yield model derived from applying stepwise MRA to the data from the sample of 506 companies, that is the reduced set of companies containing only those companies with meaningful yields (see chapter V), is as follows:

$$\overline{\text{Log (EY)}} = 2.99 - 1.41 \times \text{DIV/NI} + 0.36 \times 1/\text{NCE}$$

The model proposes that the earnings yield is primarily dependent upon two factors, namely the dividend payout ratio and the size of the company. This suggests that given two companies with the same earnings per share, the company with the higher payout ratio will have the higher share price. Secondly, it would appear that investors value large companies relatively more than small companies, thus the bigger the company the higher its relative share price.

Before the relationship proposed by the model is discussed, it is important to put the model into perspective by reviewing the statistics of the model and in Table 6.1 the main statistics obtained from the stepwise MRA are presented. Perhaps the most important figure is the "adjusted R-squared" which represents the amount of variance explained by the model. For this model it is only .263, leaving the majority of the variance unexplained.

This low amount of variance explained indicates that the model is weak and infers either that some stronger explanatory variables have been omitted from the model, that the regression algorithm is unable to decompose the data for interaction effects or that the model is incorrectly formulated. In the first case it seems unlikely that any significant financial variables have been excluded from the data base, although it is realised that we are only considering a subset of the total information available to the investment analyst. If the other factors could be quantified it is plausible that items such as forecast earnings and dividends would be more influential, but, as we have stressed before, by using share prices as at the date of publication of the annual accounts we have attempted to ameliorate this problem. It is interesting to note that Weaver and Hall(1967) were able to explain 58% of the variance in the dividend yield although there were some statistical problems with their model, such as spurious correlation. Other authors in this area seem reluctant to disclose the amount of variance explained eg. Gordon(1959) and Ahlers(1966), which could suggest a low R-squared. In the second case it does seem plausible that the variance unexplained could be due to numerous factors interacting and affecting share prices in different ways, and therefore it could be suggested that the unexplained variance is unexplainable using a global type of analysis

THE EARNINGS YIELD MULTIPLE REGRESSION MODEL

Table 6.1

"MODEL CHARACTERISTICS" "VARIABLE CHARACTERISTICS

Step No.	Independent Variable	B	Std Error of B	Beta Coefficient	F Value	R^2	F to Enter	Correlation With Dependent Variable
1	DIV/NI	-1.41	.1106	-.487	162.5	0.226	147.5	-.441
2	NCE	0.36	.0691	.201	27.7	0.266	27.8	
	CONSTANT	2.99	.0357	-	7055.0	-	-	.156

F-Value for model = 91.53

Adjusted R^2 = 0.263

Multiple R = 0.516

Std deviation of residuals = 0.297

ANALYSIS OF VARIANCE TABLE

Source	D.F	Sum of Squares	Mean Sum of Squares
Regression	2	16.2123	8.106
Residual	503	44.5442	0.088
TOTAL	505	60.7565	8.194

like MRA on the earning yield distribution. It is of interest to observe from a scattergram of the earnings yield and the regression residual (see Appendix J) that there is some heteroscedasticity present, especially at the lower end of the earnings yield distribution. Although we used a reduced sample to avoid companies with meaningless earnings yields, this may imply that there could well be other companies which possess distorted earnings yields in the distribution but to a lesser extent than the rejected group. From a statistical point of view the presence of heteroscedasticity has the effect of reducing the accuracy of any predictions based on the model and invalidates certain significant tests (Koutsoyiannis, 1977).

Table 6.1 also provides the "beta coefficients" (sometimes called the standard partial correlation coefficients) which indicate the respective influence of each variable in the model. It can be seen that the beta coefficients are .48 and .20 for DIV/NI and NCE respectively, thus indicating that the dividend payout ratio is approximately 2.5 times more influential than the size measure. The overriding importance of dividend payout is ratified by its F-ratio and its higher correlation with the dependent variable .

From a statistical point of view the model is statistically significant in all respects at the 99.9% level of confidence. Furthermore the correlation between the two independent variables is very low, about 0.09, which is not surprising as each of the two variables measures a distinct financial characteristic as determined by the principal component analysis of chapter V, viz: dividend payout and marketability. This low correlation indicates that problems of multicollinearity are unlikely to be present in this model.

One criticism of the model could be that the relationship between the dependent variable and the major independent variable, namely dividend payout, is caused by spurious correlation. The basis for this criticism is that both variables contain a common factor, namely earnings, and therefore the model may be picking up a relationship not caused by a systematic link between the earnings yield and the payout ratio. Whilst we accept that there is a small possibility that this argument is correct, evidence from Sudarsanam(1981b) and Kuh and Meyer(1955) suggests that the relationship is unlikely to be spurious. In fact Sudasanam argues that if the existence of common denominators/numerators has any effect, it is to reduce the correlation coefficient between the two ratios.

From a theoretical point of view this evidence suggests that the rate at which earnings are discounted by the market is determined by the size of the dividends paid from those earnings and the size of the company. In the case of the influence of dividends these results would appear to be contrary to the established Modigliani and Miller(1961) theory on the irrelevance of dividends in share valuation. We saw in Chapter IV that this type of result had been obtained by other researchers (Aharony and Swary, 1980, Pettit, 1972 and Laub, 1976 and Gordon, 1959 are examples) and the reasons proposed to explain this effect revolve around the established arguments against the Modigliani and Miller theories, namely the informational content of dividends, the clientele effect, the reduction in uncertainty, and transaction and taxation costs. Whilst we cannot provide empirical evidence to support these arguments we can try to build a picture of the likely reasons for this relationship appearing to hold. However, as a further set of analyses was conducted it would be premature to attempt explanations at this particular stage.

As for the influence of size on relative share values, this can be interpreted in two ways. The first is that investors may perceive that large companies possess less downside risk and therefore are willing to pay a premium for this type of security. This type of reasoning may possibly be explained by investors assuming that large companies have more stable earnings or even that there is less risk of bankruptcy due to the underlying size of the company. Whittington(1971) provides some evidence to support this line of thought. The second interpretation of the size variable is that it represents a surrogate measure for marketability, that is the amount of market interest in the share. If the principal component analysis presented in Chapter V is referred to, it will be seen that the size variables are loaded on the same factor as market liquidity and thus we conclude that size is measuring the same underlying characteristic.

Consequently our interpretation of the relationship posed by the model is that the higher the market interest in a share the higher the relative share value. This relationship can be readily explained in terms of dealing preferences. If the market for a share is large and active, then it is easy to deal in large quantities with fairly stable share prices, whereas if the market is very thin it is more difficult to match buyers and sellers and as a result the share prices of low market interest stocks are likely to demand some sort of risk premium as compensation. This type of influence was also found by Benishay(1961) and Shick and Verbrugge(1975).

3.2 The Linear Discriminant Analysis

A second approach to examining the factors that influence relative share values which has been used by other researchers in this area eg. Walter(1959) and Shick and Verbrugge(1975), is linear discriminant analysis (LDA from now on). LDA differs from MRA in that it looks at the problem from a slightly different angle and makes different assumptions about the underlying nature of the data analysed.

LDA is a technique which is able to analyse the different characteristics of two or more groups and creates a model based on those characteristics that best differentiate between the groups in question. The end result from using the technique is a model that transforms a set of characteristics into a single variable, normally called a z-score. Once the z-score for an observation has been computed then it is compared with a predetermined z-score cutoff value and depending on whether the computed z-score is greater or less than this cutoff value, the observation is then categorised as belonging to a particular group. This technique has been widely employed, although in the finance area most of the work has concentrated on discriminating between failed and healthy companies eg. Taffler(1976), Altman(1968), Deakin(1972) and Edminster(1972). (For a full review of these and the other topics for which LDA has been used see Foster, 1978). An introduction to the technique and the tests employed in the analyses are provided in Appendix H.

In this study LDA has been used to discriminate between high and low valued companies on the basis of their financial ratios. The purpose was to find a linear combination of financial characteristics which best discriminated between the high and low valued companies and thus indicate the salient features used in the share valuation of extreme cases. The major difference between this approach and MRA is that LDA focuses on the differences between the extreme valuations rather than explaining the variance of the whole distribution. From a statistical point of view LDA overcomes the problems of assuming homoscedasticity and normality in the distribution of the error term (Taffler,1976).

The way in which LDA is used in this thesis has, however, been criticised by Eisenbeis(1977) and more recently Altman(1981). Both critics dislike the use of a segmented continuous variable as the criteria for forming the groups to be analysed, which after all is based upon the whim of the researcher. They would argue that we are violating one of the principles of LDA by not investigating discrete and identifiable groups. As the views of these critics cannot be dismissed lightly, we present a detailed examination of their arguments and our counter-arguments for the use of LDA in this thesis in appendix H. In broad terms their main criticism concerns the subsequent use of such a model which under normal circumstances would be for reclassifying cases into one group or the other with the aim of predicting a certain event. In defence, however, we would argue that the use of LDA in this thesis is to aid clarification of the influences present within the dependent variable distributions and that the differences between the extremes provides some insight into the factors as work. We do not attempt to predict in any way whatsoever. Altman(1981) would seemingly sympathise with our approach as he states

> "This would be fine (that is the use of LDA as we advocate) if the analysis stopped simply with a study of the original sample and did not ascribe to predictive elements."

We therefore stress the point that our use of LDA is simply to gain further insight into the factors at work in the share price fixing mechansim.

The methodology adopted in this study is the same as that employed by Walter(1959). Two groups of companies were formed, one containing sixty companies with the highest earnings yields and the other containing sixty companies with the lowest earnings yields. The following model was created from the data:

$$Z = -1.28 + 8.05 \times DIV/NI - 1.15 \times \text{Market Liquidity}$$

The model indicates that the two main variables that distinguish high and low earnings yield companies are dividend payout and market liquidity which in this analysis was simply a 0,1 variable with 0 = highly traded and 1 = infrequent trading. (The detailed statistics relating to this model are contained in appendix H.) The most important features are as follows:

1) the payout ratio contributed 87.5% to explaining the difference between the groups whereas market liquidity contributed only 12.5% (based on Mosteller and Wallace, 1963).

2) the misclassification matrix showed that 79.2% of the original observations were correctly reclassified, this compares to the 50% expected by chance alone.

3) the Lachenbruch holdout test revealed no bias to be present in the model.

These results indicate that dividend payout is clearly more influential than market liquidity, which is a similar finding to the MRA. Furthermore the overall accuracy of the model is quite weak, the 79.2% is considered to be low especially when the arbitrary manner by which the groups were formed is taken into account, indicating that the model is not that effective in discriminating between the two groups. This percentage compares unfavourably with the 87% found in the Walter study.

One final statistic which provides a measure of how well this model explains the variance of the earnings yield distribution is the

Spearman's rank correlation coefficient (Yeomans,1968:302). In this instance the coefficient squared was .253, which is not very different from the R-squared of .26 found in the regression analysis. (Further tests and analysis are presented in appendix H.)

The interpretation of this model is very similar to the MRA model with dividend payout appearing to be the key factor that influences the rate at which earnings are discounted by the market. Again the higher the payout the higher the relative share value.

The second variable in the model, market liquidity, is different from the second variable in the MRA model, namely size. However, the principal component analysis presented in chapter V revealed that these variables are measuring the same underlying characteristic namely tradeability. Again the more tradeable a share, apparently on the evidence of the model, the higher its relative share price.

4. Theoretical Implications of the Earnings Yield Models

Before we consider the results obtained from the analyses conducted on the valuation ratio it is essential to evaluate the theoretical implications of the earnings yield analyses and to contrast these findings with the five hypotheses proposed in chapter IV. At the outset of this evaluation it is stressed that any conclusions or inferences made in the following discussion must be considered as broad generalisations that need to be replicated in other time periods on different data. It is also relevant to note that a policy of dividend restraint was in force at the time of these analyses and that this may have caused some sort of bias in the results. These results are therefore by no means definitive due to the limitations of drawing conclusions from one research study and even if this were possible, the low amount of variance explained indicates the models are weak and therefore infers the relationships established are also weak. However despite these strong reservations the results are statistically significant and therefore it is essential to examine their implications. We shall now consider each of these in turn.

4.1 Dividend Payout and the Value of the Firm

If we make the assumption that two companies are the same in every respect, except that one has a higher payout than the other, then our results infer that the higher payout company will have a relatively higher share value. If we then translate the payout ratio into the benefit to the shareholder, the inference is that shareholders prefer high dividends and are willing to pay more to receive them.

As previously stated this result does not agree with the MM theory on the irrelevance of dividends, nor does it agree with the results of several empirical studies which tend to confirm the Modigliani and Miller(1961) theory (eg. Gonedes, 1978; Benishay, 1961; Martin, 1971; Pettit, 1972). Nevertheless, this type of result was found by Walter(1959), Gordon(1959), Ryan(1974), Aharony and Swary(1980), Pettit (1976) and Laub(1976) (all of which are discussed in Chapter IV) and therefore there appears to be some support for these results. The arguments in favour of the theory that dividends influence share prices revolve around trying to invalidate the main assumptions of the established MM theory. Most of these arguments are discussed at length in the finance text books (eg. Van Horne, 1977 and Franks and Broyles, 1979, and Richards, 1976 who presents an excellent review on the evidence with respect to the U.K. stockmarket) and therefore we shall concentrate only on those aspects which seem to have a bearing on our results. Obviously in a study of this nature it is not possible to be definitive about the reasons behind this type of investor behaviour. We may only postulate a case that explains our results.

One of the major causes for confusion to the investment practioner in understanding the MM theory is that dividend announcements are often associated with movements in share prices and therefore it is easy to see how he could be led to believe that dividends influence share prices. However, this reaction is explained by MM who argue that the change in dividends conveys information to the investor about future earnings and thus the share price movement is not caused by the dividend per se but from the informational content reflecting a change in management policy. The time series studies into this theory (see chapter IV) suggest that dividends are influential but as Ball et al(1979) point out it is very difficult to isolate the marginal informational content of dividends from a change in dividends per se. In a study by Black and Scholes(1975) this issue was investigated only to find that the return on a stock was not related to dividend yield. This therefore implies that it is not possible to tell the effect a change in dividend policy will have on a corporation's stock price.

However, the informational content argument revolves around relating share price movements with dividend changes, that is time series analysis, and cannot be applied in the same way to the share valuation model type of research which is cross-sectional. If dividends enter a share valuation model, as they have above, this should be interpreted as meaning that the level of dividend per se influences share prices rather than any change in dividend policy. As the theory of the informational content of dividends implies a dynamic model of dividends which cannot be tested by cross-sectional analysis we can neither reject or accept any such hypothesis on the basis of our model cross-sectional formulation.

A second line of argument against the pure MM theory is that dividends help reduce the uncertainty attached to equity investment and therefore investors are not indifferent between dividends and capital gains. They prefer dividends. Gordon(1962a) who strongly supports this line of argument, contends that "uncertainty on the part of investors increases at an increasing rate with the distance in the future of prospective returns." If it is assumed that investors are risk adverse then the discount rate used on future earnings will rise with the length of time in the future. Gordon continues this line of thought by suggesting that investors prefer an early resolution of uncertainty and are therefore willing to pay a higher price for the stock that offers the greater current dividend, all other things held equal. Our results are consistent with Gordon's arguments. It is interesting to note that at the time of this study inflation in the U.K. was particularly high and therefore this argument of uncertainty was reinforced still further.

Several arguments have been made against Gordon's dividend orientated theory (eg. Van Horne, 1977:270). The first is that investors can manufacture "home-made dividends" by selling a part of their investment to realise the capital gain, if they so desire. If these "home-made dividends" are a perfect substitute for cash dividends then Gordon's theory would not seem to hold. However, we would argue that the selling of capital is not a perfect substitute for cash dividends. Firstly there are transaction costs involved and therefore selling of stock could be a more expensive alternative, although this may be compensated by a lower tax rate. Secondly, and probably more important, investors perceive selling capital as unsatisfactory especially as there is no certainty that share prices will rise in the future and therefore they may perceive the selling of stock as consuming capital rather than generating income. Furthermore such trading activity would cause short term fluctuations in the market price.

In a review of the literature on dividend policy Richards(1976) puts forward two further arguments against Gordon's conclusions on the influence of dividends. Firstly Richards argues that Gordon's results are spurious and caused by companies with temporary reduced earnings maintaining the same dividends and thus "low earnings would cause both a high level of payout and a high price-earnings ratio and this would not be evidence of a causal relationship." This criticism does appear to be tenuous and whilst we cannot defend Gordon's methodology due to its lack of published detail, we can defend the same type of result produced by this study. For Richard's statment to be valid the number of companies with that particular phenomenon would need to represent a high percentage and in our sample of 506 companies this was not the case. Furthermore, as our analysis specifically excluded the very high earnings yield companies with low returns on capital, which could have been caused by temporarily depressed earnings, this bias, if it exists in a statistical sense, could only be, at most, very weak.

A second and even more tenuous argument put forward by Richards is that gearing could also produce bias. He proposes that highly geared companies adopt a conservative dividend policy and vice versa. Thus a highly geared company would have a low market rating to reflect its high risk and as a result a low payout ratio becomes associated with low relative market valuation. This argument implies that dividend policy is a surrogate measure for financial risk and again, although we cannot defend Gordon's study, the results of this study clearly suggest that Richard's theory of bias is unfounded. In the first place had gearing been the main cause for the difference in earnings yields then this measure would have entered the regression model prior to dividends. Secondly, if this bias postulated by Richards were present the correlation between dividend payout and gearing would be expected to be quite high. In this study the correlation coefficient between these two variables is -.034, suggesting no relationship whatsoever exists. If we assume that this low correlation could have been found by Gordon, and without any evidence to the contrary this assumption is not too unreasonable, although perhaps simplistic as we are assuming that the UK enviroment is similar to that of the USA, it appears that Richard's arguments are based on weak hypothetical reasoning.

Evidence from Lewellan et al(1976) who conducted a study into the investment strategies and behaviour among individual investors in the USA, suggests that an average 41% of investors' portfolios are allocated to securities designed primarily to produce dividend income. This in itself does not confirm the theory that dividends reduce uncertainty, but further analysis of their results suggest that those investors with experience in the market and who are not termed as speculators, allocate a greater proportion of their portfolio to dividend income stocks. If we accept the premise that experience provides the best basis for forming an optimum risk/return investment policy then this preference for dividends could be interpreted as a means of reducing uncertainty. Furthermore, the evidence revealed that even the speculators had a policy of investing at least 20% of their portfolio in dividend securities. In conclusion the theory that dividends reduce uncertainty would seem perfectly acceptable and given a dividend restraint policy in force at the time of this study, this bias, if present, is likely to be accentuated.

Van Horne(1977) postulates several other theories on why dividends can be seen to influence share prices. One such theory is the "clientele" effect whereby certain investors may prefer dividends and others may prefer capital gains. In the Richards(1976) article an example is presented showing how low marginal tax payers would be attracted to high payout firms and high marginal tax payers would be attracted to low payout firms. Thus the quality of a dividend payment versus the quality of a capital gain varies from one investor to the next and is dependent upon their individual tax position. Any imbalance between the frequency distribution of investor preferences for either capital gains or dividends and the existence of those preferences in the market will lead to a situation whereby dividends influence share prices.

Nevertheless, supporters of the MM theory argue that in a perfect market no systematic preference for dividends will be found, providing the two distributions are equal. In such circumstances each corporation will attract a certain type of clientele preferring a particular payout and therefore dividends per se would not affect share values in any way other than the eventual reduction in the terminal value of the company. Van Horne suggests that, at best, this theory is tenuous and that such a policy of specialisation could lead to poor diversification and thus investors would suffer in other ways.

Even if we accept Van Horne's argument that the distribution of investor preferences does not equal the market distribution, in order to apply this argument in support of our finding it is necessary to demonstrate that there is a preference for dividends over capital gains. If, for example, the clientele effect was such that the majority of investors preferred capital gains then companies paying a dividend would stand at a discount in the market. As our evidence suggests that dividends stand at a premium we must ask why there is this imbalance in the UK Stock Market. In other words what are the possible causes for a preference for dividends?

In his article Richards(1976) points out that if the main body of investors making up the market has a marginal tax rate lower than 54% then high payout stocks would be preferred and vice versa. One problem that immediately arises is how to estimate the marginal rate of tax for all investors in the market and not simply the pension funds or certain individuals. Richards suggests that it is approximately 50% and therefore proposes that the effect of taxation on share prices is approximately neutral. Brealey(1975) and the Royal Commission on the Distribution of Income and Wealth (1975) support this argument and therefore it cannot be used for reinforce our results.

A further feature of the UK stockmarket that may explain this preference for dividends is the legal requirement for many investment funds, which account for over 70% of the ownership of equity (source Franks and Broyles, 1979) to have a minimum cash income in the form of dividends. The extent of this requirement is unknown although it is often referred to in the text books on the technical side of fund management. Obviously, the presence of this systematic bias towards dividends will cause high dividend payout companies to stand at a premium. In addition if there are other investors who seek dividends as a form of regular income, such as pensioners, then these too will tend to create more of an imbalance. The study of Lewelan et al(1976) referred to above provides some evidence to support this latter argument. They found that investors over 55 years of age allocated a very high percentage of their portfolio to income stocks which was interpreted as indicating that these investors required a regular income stream. In recent years, and during the period examined by this thesis, the influence of dividend restraint in the UK stockmarket may well have accentuated the clientele effect and caused investors to seek high payout companies more than under normal circumstances.

In conclusion it would seem that the results of the earnings yield models are theoretically defensible. On the one hand there is a strong case for accepting that dividends provide a means for reducing uncertainty and that a £1 paid out is valued more than a £1 retained. Furthermore the argument that investors can generate "home-made dividends" by selling stock is in practice an inconvenient and expensive way of realising an income. On the other hand, there is the clientele effect theory which proposes that a majority of investors seek dividends for a number of diverse reasons, some of which may not be justifiable from an efficient use of funds point of view, and thus cause an imbalance in the market in favour of high dividend payout companies.

The above analysis provides a basis for arguing that dividends are influential in the UK stock market. However, in any study of this nature it is important to corroborate results with those of other studies. One such study that provides evidence on the influence of dividends in the UK stock market is by Moore(1980) who investigated the valuation of earnings and dividends over the period 1961 to 1977. He found that although earnings had been maintained after adjusting for inflation, share values had fallen over the 16 year period. He suggests that if the MM theory is applied, then equities are undervalued by 50%, and this large discount can only be attributed to greater uncertainty attached to inflation, which Moore proposes is unrealistic. Further investigation by Moore revealed that dividends had not kept up with inflation which in part was attributed to dividend restraint policies, and this lead him to the conclusion that this was the primary reason for equities failing to maintain their real values.

The Moore study therefore provides further evidence to support our finding that dividends are influential in determining relative share values at least over the time period covered by our study. From this we conclude that management can influence share prices by paying a higher dividend. However it is stressed that in the models presented above a linear relationship between the rate at which earnings are discounted by the market and dividend payout is assumed which in practice is unrealistic and contrary to established theory. This point will be discussed at length later in this chapter and in the following chapter.

4.2 Marketability and the Value of the Firm

The Earnings Yield model presented above suggests that the rate at which earnings are discounted is a function of dividend yield and marketability. This second factor, marketability, apparently has a far less important role to play in the share price fixing mechanism, but according to our models a significant one. In our two different models it entered in the form of the size variable as measured by NCE and via the market liquidity measure, which was derived from the average number of deals marked in a month over a three year period. From the results of the principal component analysis it was possible to deduce that both variables were measuring the same underlying characteristic, namely marketability.

The tentative inference to be drawn from our results is that the more marketable a share the lower its earnings yield which means, ceteris paribus, that the share price is higher. The logic behind this relationship is really quite simple. The less the market interest in a share, which may generally be caused through insufficient tradeable stock in the market, the lower the demand for the share and hence the lower the relative share price. Problems with low market interest stocks range from having a wide spread between the buying and selling price of the stock and the inability to trade relatively small amounts of stock without moving the price appreciably. Benishay(1961) also found this relationship to be strong and postulates that the more marketable a share that is the easier it is to trade, the greater the demand. Benishay goes on to argue that size (which was his measure of marketability) may be used as a surrogate for risk and as such the market prefers large to small (more risky) companies. However, he does not provide any underlying empirical support for this line of reasoning. Evidence from Whittington(1971) and Samuels and Smyth(1968) indicates that although average profitability is independent of company size "the inter-firm dispersion of profitability was greater among smaller firms" and "the variability of profitability over time was also greater among small companies" (Whittington, 1971:72). Consequently there is a strong argument for supporting Benishay's line of thought in the UK Stock Market. As we did not include a measure of past variability of earnings in our database for reasons given in chapter V we are unable to make a direct comparison between size and this measure of risk. However, included in our database was beta, which is argued to be a function of the variability in earnings (Rosenberg and McKibben,1973; Beaver et al,1970; Castagna and Matolcsy,1978) and therefore an indirect link can be assessed. It was found that beta had a correlation coefficient of -.37 with the size variable (note the size transformation was the square root of the reciprocal) and was found to be loaded on the same factor in the PCA. At first sight it would seem that size and risk are related. However, the relationship proposed in this study was that the larger the company, the greater its systematic risk, which is contrary to a priori expectations. In chapter VIII we examine possible reasons for this relationship but at this stage it is sufficient to suggest that size, at least in this study, appears to be a measure of tradeability and is not a surrogate measure of risk.

The model presented above provides clear evidence that marketability is of importance to investors and according to this study is an attribute of share valuation. Yet marketability,as such, is rarely referred to in the literature on share valuation which is rather surprising given the marked impact it has in the UK Stock Market. Where research has been conducted in this area it is normally concerned with beta analysis and improving beta estimates (Dimson,1979; Oldfield & Rogalski,1980; Fisher,1966). Williams(1938) does address this issue of marketability but dismisses it as not being part of "the meaning of investment value" and this is a plausible reason why it is not given much weight in share valuation theory.

Williams presents the argument that marketability should be divorced from the concept of investment value. Whilst he accepts risk to be important, he disregards marketability on the grounds that it is confusing and difficult to interpret: "for instance, an investment can be both cheap and liquid, not that it is cheap because it is liquid and so much to other factors". The distinction Williams makes is that investment value is determined by future dividends and is not a function of saleability. In other words an investment is purchased for an income stream and not for resale in the short term.

In this thesis we do not agree with William's rejection of this factor from the concept of security valuation. From the investor's point of view, if marketability is ignored it is feasible that he would expect a greater return over a particular time period than was actually forthcoming. If a share price is known to be depressed due to the inability of investors to deal in large quantities in the stock then it is unlikely that this discount is going to change over the short and probably the long term. Consequently, future returns have to be adjusted for the continuity of this market characteristic. If one takes into account future earnings variability then why not also assess the likely capitalisation rate of the earnings which is a function of marketability. If we accept the William's logic on intrinsic value he would say a share was cheap and illiquid, but under our definition this could mean that the share is not cheap once liquidity is taken into account.

Our line of reasoning is that given the earnings yield for a given company we could apply the regression model using simply the payout ratio alone and conclude that this company was over or under-valued. So far Williams would probably agree with us. But apparently in our analysis a better estimate of share value is achieved by including marketability in the model. Essentially we have quantified the impact of marketability whereas Williams could not. Possibly this inability to quantify the effect inhibited Williams from including it in his model.

In conclusion, it may be said that marketability should be permitted to enter into the meaning of the term investment value. On the one hand it is a factor that influences the market's valuation of a share and secondly it may be argued that it is likely to influence the future share price as well and therefore expected returns.

4.3 Summary of the Earnings Yield Analyses

The main conclusions to be drawn from the analyses can be summarised as follows:

1) the primary factor influencing relative earnings yields is dividend payout. Plausible reasons put forward to explain this systematic bias were a) that dividends may be perceived as reducing

uncertainty and b) the clientele effect created by institutions and other investors seeking dividends for legal or tax reasons, which may have been accentuated to some extent by the dividend restraint policy in force at the time of this study.

2) the secondary factor in influencing share values in terms of relative earnings yields is marketability which is a surrogate measure for market interest (tradeability); the less the market interest the less the relative value.

3) the overall explanatory power of the models are weak and therefore the relationships proposed above are merely generalisations on how two factors appeared to affect share prices in the market during the period examined.

Having established a plausible theoretical framework it is possible to apply our preliminary results to consider the five hypotheses proposed in chapter IV. The first hypothesis concerning earnings was not tested as it was automatically assumed by adopting the earnings yield as the dependent variable. Essentially the above analyses accepted that earnings dominate share valuations and the question posed was "what are the other factors that determine the rate at which the market discounts earnings?" The second hypothesis which proposes that dividends influence share values, but are secondary to earnings, was supported by the influence of the payout ratio in the models.

The third hypothesis stating that financial gearing does not affect relative share values was not rejected by our results in that it did not prove to be a significant explanatory variable. However, to conclude through its absence that this hypothesis is correct would be quite wrong. We can only say that our results provide no evidence to contradict this hypothesis. The remaining hypotheses concerning the roles of bankruptcy risk and systematic risk in the market were also unsupported by our results. The absence of both Z-score and beta from the models is not consistent with our hypotheses but again we stress their absence should not be interpreted as rejecting these hypotheses, merely that it is non-confirmatory.

For our purposes these results are dissappointing in that they present a very simplistic and weak model of the market's decision making process. There are several plausible reasons for these poor results. It could be argued that there are several non-financial variables such as growth potential and management quality which if included in the analysis may have improved the model's explanatory power. However, whilst we recognise that our database contained only a subset of the total information available to investor's, the extent to which these other factors influence share values over and above financially determined measures might be arguable.

Perhaps a more suitable explanation may be that the model has been defined incorrectly, that is by using MRA to analyse the variance in the earnings yield may not be a valid methodology. Firstly, it is possible that linear additive techniques are unable to search and explore interaction between variables and therefore incapable of coping with the complexities of the decision making process. Secondly, despite the numerous studies that have used the earnings yield as the dependent variable, it may be that this measure is not a sufficiently sensitive surrogate for measuring relative share values and therefore is not amenable to this type of analysis. For instance it may be argued that our model basically proposes that the rate at which earnings are discounted by the marekt is a function of the dividend payout ratio eg. E/P = f(D/E). If then the impact of earnings per se is taken from both sides of the model the result is that share prices become mainly a function of dividends. However, this conclusion would be quite wrong as it proposed that earnings have no impact on share values, which is contrary to findings in the previous chapter and therefore requires further examination. Nevertheless, as we do not, at present, have any evidence to support these possible explanations, we must conclude that our analysis so far has taught us very little about the market's judgement process. Furthermore any inference we might make on the basis of these results for traditional share valuation theory must be considered to be very tentative and broad generalisations and no more. It remains to be seen whether the valuation ratio analyses are more informative.

5. The Valuation Ratio Analyses

In this section the results of the valuation ratio analyses are presented. As we stated in the previous chapter this ratio is used only rarely by investment analysts, and as a result has not received the same amount of attention in the extant literature as the earnings yield. The only study known to the author that has used the valuation ratio for building share valuation models is by Ryan(1974) but as we pointed out in chapter IV his methodology is suspect and therefore provides no yardstick against which we can compare the results of our analyses.

This section follows the same format of that of the earnings yield analyses. Firstly, the results from applying the MRA and LDA techniques will be presented. This will then be followed by a discussion on the theoretical implications and finally a summary of the conclusions to be drawn from the analyses will be presented.

5.1 The Multiple Regression Analysis

Before the model is presented it is important to restate what the valuation ratio is measuring and what we are trying to explain. The valuation ratio is a measure of how the market values the assets of a company and the question we are asking is "What are the key financial characteristics that determine whether a company's assets are valued highly or lowly by the stock market?" In other words this is a measure of the earning power of the assets which reflects directly the ability of management to utilize the assets under their control.

The model created by understanding MRA on the full database of 547 companies is as follows:

$$
\begin{aligned}
\text{Log (VR)} = -1.42 \; & -1.46 \times \text{Log(PBT/AVTNW)} \\
& +0.58 \times \text{Log(Profit Growth)} \\
& -0.37 \times \text{DIV/NI} \\
& +0.09 \times \text{Market Liquidity} \\
& -0.06 \times \text{Log(TL/TNW)}
\end{aligned}
$$

where VR = Valuation Ratio

PBT/AVTNW = Return on Net Worth

DIV/NI = Dividend Payout Ratio and

TL/TNW = Financial Gearing Ratio

The model proposes that the valuation ratio is primarily dependent upon five factors, namely the return on capital, profit growth, the dividend payout ratio, market liquidity and financial gearing. Furthermore, the signs of the coefficients indicate that the higher the return on capital, dividend payout and financial gearing, the lower the profit growth and the greater the market liquidity, then the lower the valuation ratio (ie. the higher the relative share price).

Before examining the implications of these results in more detail it is essential to put the model into perspective by reviewing the statistics presented in table 6.2. The amount of variance explained by the model is 53% of the total variance in the valuation ratio (the adjusted R-squared is .53). Although a direct comparison between this model and the earnings yield model cannot be made due to the different dependent variables the higher level of variance explained represents a considerable improvement on the earnings yield model (this aspect is discussed at length later). Whilst, a variance explained of 53% does not signify a powerful model, it is generally considered respectable and indicates that the most influential variables in the model can be interpretated as more than just broad generalisations. It is of interest to note that the scattergram of the valuation ratio with the regression residuals (see appendix J) reveals little heteroscedastic tendencies as was the case with the earnings yield model.

The relative importance of each variable is also shown in table 6.2 by the beta coefficients. Clearly the return on net worth variable can be seen to be the most influential, over four times the next most important variable, profit growth. A further indication of the importance of this return on capital measure is that alone it is able to explain .469 of the variance, compared with .534 for the whole model. The remaining four variables are considered to be fairly weak

THE VAULATION RATIO MULTIPLE REGRESSION MODEL

Table 6.2

"MODEL CHARACTERISTICS"

"VARIANCE CHARACTERISTICS"

Step No.	Independent Variable	B	Std Error of B	Beta Coefficient	R^2	F Value	F to Enter	Correlation With Dependent Variable
1	PBT/AVTNW	-1.46	0.062	-0.749	0.469	566.9	482.3	-.685
2	Profit Gth	0.58	0.101	0.181	0.504	32.8	38.6	-.057
3	DIV/NI	-0.37	0.094	-0.119	0.517	16.0	14.6	-.034
4	Market Liq	0.09	0.030	0.096	0.528	10.5	12.5	.184
5	TL/TNW	-0.06	0.025	-0.079	0.534	7.3	7.3	-.094

F Value for model = 124.4

Adjusted R^2 = 0.530

Multiple R = 0.731

Std deviation of residuals = 0.325

Analysis of Variance Table

Source	D.F.	Sum of Squares.	Mean Sum of Squares
Regression	5	65.811	13.162
Residual	541	57.250	0.105
TOTAL	546	123.061	13.267

adding only a further .065 to the unadjusted R-squared of the whole model. Also shown on this table are the correlations between each of the independent variables and the dependent variable, and these provide further evidence on the high influence of the return capital variable and the relatively low impact of each of the other variables.

With a five variable model the scope for multicollinearity is increased substantially. Once again by allowing only one variable per factor to enter the model it was possible to keep this problem to a minimum. Table 6.3 presents a correlation matrix for all the independent variables and it can be seen than the highest correlation coefficient is between return on net worth and profit growth at .34. This value is well below the accepted rule of .60 and below the overall explanatory power of the model (ie. Klein's rule) and therefore it is reasonable to assume that multicollinearity is not a problem in this model. Again, as with the earnings yield model, some critics may suggest that the common factor of net worth in the dependent variable and in the most powerful independent variable, return on capital, is a cause for concern. However, as we stated before, this is likely to be more a perceived problem than an actual problem in practice. The empirical evidence of Sudarsanam(1980b) clearly demonstrates that any potential spurious correlation of this nature is not likely to lead to major bias.

TABLE 6.3

Correlation Matrix of the Valuation Ratio Model's Independent Variables

PROFIT GROWTH	.340			
EDIV/NI	.120	-.162		
MKT LIQ.	-.102	.002	-.019	
TL/TNW	-.024	.023	-.081	-.105
	PBT TNW	PROFIT GROWTH	EDIV NI	MKT. LIQ.

The rationale proposed by this model is that the relative value of the valuation ratio is affected in the following ways:-

1) the greater a company's return on capital the more investors value the company's assets (ie. the lower the valuation ratio). This means that the primary factor within our data that would appear to determine the market's valuation of a company's assets is the earning power of those assets, and obviously the higher the earning power the higher the relative share price.

2) a low profit growth is associated with a high share value inferring that investors prefer low historic growth rates. A plausible reason for this is that high growth companies possibly possess more downside risk due to the difficulty of maintaining a high growth rate. On the other hand, low growth companies may be considered more stable and thus able to maintain their current growth rate or at least maintain their current earning power. It seems quite reasonable that once an investor has taken into account the earning power of the assets, he then considers the stability of the return.

3) ceteris paribus, the higher the dividend payout ratio the lower the valuation ratio which infers that a company is valued relatively more if it distributes a higher proportion of its earnings. This type of relationship was also found in the earnings yield model.

4) the higher the frequency of trading in a share, the higher the relative share valuation. Again this relationship was found in the earnings yield model.

5) the final and least influential variable in the model is TL/TNW which is a financial gearing measure. The model suggests that the greater the gearing then the higher the relative share price. This implies that investors have a preference for gearing, after taking all the other main factors into account, and does appear to be rather an unusual relationship as it infers that investors have a preference for risk.

The implications of these relationships proposed by the model will be discussed at length after the LDA has been reviewed. Before leaving the MRA we can conclude that the model has a reasonable explanatory power and that the five variables are all statistically significant at the 99.9% level of confidence (see appendix F for a detailed discussion of these tests).

5.2 The Linear Discriminant Analysis

The technique of linear discriminant analysis (LDA) was applied to the valuation ratio data in much the same way as with the earnings yield analysis. In this analysis the sixty top and sixty bottom companies in the valuation ratio distribution formed the two groups. The model produced was as follows:

$$Z = 0.62 + \text{Log PBT/AVTNW}$$

The model indicates that the best discriminator between companies with high and low valuation ratios is the return on net worth. The statistics relating to this model are presented in appendix H, where it can be seen that this one variable model was able to classify correctly 95% of companies back into their original groups. This high success rate suggests a very accurate ex post classification model even though it is based on one variable.

It is interesting to note that this one variable, return on net worth, was the only significant variable to emerge from the 90 independent variables in the analysis. If this model is compared with the five variable MRA model then the implication is that the relationships between the four variables missing from the LDA model and the valuation ratio may not apply across the whole distribution of valuation ratios. In other words we must be careful in making normative statements about dividend policy, earnings growth etc., as we are unable to define more specifically the complexity of the underlying interaction between these variables. One final statistic worth mentioning is the Spearman rank correlation coefficient (squared) between the model when applied to the whole database and the valuation ratio which was .47. This is very similar to the variance explained by the return on capital measure in the regression model.

6. The Theoretical Implications of the Valuation Ratio Models

As the results of the LDA added very little additional insight, if any, we shall concentrate only on the theoretical implications of the five variables entering the regression model. At the outset of this evaluation it is stressed that the arguments that follow are normative as it is only possible to make some general and tentative inferences about the market's decision making process on the basis of our results. The main benefit from LDA was to show that the relationships found in the regression model were possibly not consistent across all companies which emphasises the need to be careful in interpreting the results. The purpose behind the valuation ratio analyses was to establish the factors that influence whether a company's assets have a high or a low value in the stock market and to aid us in our model development. The MRA model revealed that return on capital was the primary factor, and that earnings growth, dividend payout, market liquidity and financial gearing were secondary contributing only a further 7% to the variance explained. We shall now consider each of these in turn.

6.1 Return on Capital and the Value of the Firm

The relationship proposed by the model, that a company's assets are valued more the higher the return on those assets, is hardly surprising. Quite clearly this implies that the primary factor in determining a share value is the earnings that accrue to that share. This is a result that has been found by other researchers using different methodologies eg. Ball and Brown(1968), Kamath(1980).

Although there is little controversy in this finding, unlike the influence of dividends on share values, there are two important theoretical issues that need to be considered. The first concerns the implications of these results for the applicability of the Modigliani and Miller(1958) theory based on the net operating income approach to investment in the UK Stock Market, and the second is the matter of the appropriate accounting number for measuring income.

The MM theory on the Net Operating Income model for share valuation postulates that earnings before interest and tax is the correct accounting number for valuing a firm. This theory is presented at length in many finance text books (eg. Van Horne, 1977, or Weston & Brigham, 1979) and therefore it is inappropriate to present the detail of the MM reasoning here. The main conclusion of the MM argument is that the rate at which earnings after interest are capitalised in the market is proportional with the rate at which financial gearing increases. They argue that, in an efficient market, if two companies only differ in the way in which they are financed and have different market values, then investors would sell the overvalued firm's shares and buy the undervalued firm's shares. Furthermore, if these differences persist it would be possible for investors to "gear up" and increase their financial returns without increasing their financial risk.

In contrast to the MM theory there is the Net Income model of share valuation (see Durand, 1959 for an extended discussion) which argues that the cost of debt and cost of equity are independent of the capital structure, but because the weighted average cost of capital declines with the increased use of gearing, the value of the firm (equity plus debt) rises. There are obviously limits to the extent that debt can be increased without affecting the capitalisation rate of earnings eg. when the risk of bankruptcy becomes high, but for the purpose of this analysis we shall ignore this as our empirical results do not allow us to make inferences on this more specific issue.

The results from our analyses reveal that a variable based on profit before tax was apparently more powerful than any of the other return on capital variables based on earnings before interest and tax, cash flow, or trading profit. This result may infer that the Net Income Model of share valuation, which is based on an after interest profit figure, could be a better model of reality than the MM model. By the way the above analyses were conducted whereby the technique was allowed to find the most significant explanatory variable, if the MM model was a more realistic representation of the market, then a ratio based on earnings before interest and tax would have been expected to enter the model. However, it is stressed that as these ratios are highly correlated any conclusions drawn from this variable preference are very tentative.

It is feasible, however, that a combination of a return on capital ratio based on profit before tax and a gearing ratio would have a compensatory influence in the regression model and thus may provide some support for the MM theory. However, despite gearing entering at the fifth step in the MRA the sign of the coefficient is in the wrong direction for us to draw any conclusions along these lines of thought.

The second theoretical issue that our results have some bearing upon is the most appropriate accounting number for assessing the "true income" of a firm. It has been argued by several academics (Lawson, 1980 and Brealey, 1976 are examples) that the measurement of corporate profitability should be based on cash flow rather than the traditional accounting profit presented in the annual accounts. Furthermore, criticism has been made that this traditional profit figure is incorrect because it does not show the effects of inflation (see Sibley, 1979 and Lacier, 1977).

Whilst we cannot comment on the use of inflation adjusted profit figures versus unadjusted numbers as no inflation adjusted measures were included in the data set, we may draw some tentative conclusions on the cash flow line of thought. Based on the same logic as that for discussion of the MM theory above, it could be argued that if cash flow was perceived by investors to be a better measure for evaluating performance then a variable based upon this number would have been seen to be more powerful than a profit before tax number. We cannot conclude that cash flow is inferior to traditional accounting numbers for measuring performance, but we can suggest that at the time of these analyses the market as a whole appeared to prefer the use of traditional accounting numbers. This possibly infers that there is a need to educate analysts and investors on the benefits of cash flow based assessments (a conclusion that is conveyed by Lawson, 1980 and Govindarajan, 1980 but by using different methodologies). Once again we need to stress that the cash flow variables are highly correlated with the profit before tax variables and therefore conclusions on investor preferences are tentative.

6.2 Profit Growth and the Value of the Firm

The relationship proposed by the regression model is that lower profit growth is associated with higher share values which infers that investors prefer a low historic growth rate. At first this appears to be irrational as one might expect growth over one year to be continued and therefore high growth companies would stand at a premium over low growth companies.

Evidence from Singh and Whittington(1968:136-9) provides some support for this unexpected relationship. They argue that investors should not expect the earnings per share of the average company to grow at a steady rate over successive periods. This type of conclusion is consistent with the results of Little and Rayner(1966) who found that growth followed a random pattern.

In Whittington's(1971) book on the prediction of profitability it is reported that there was a tendency for returns to regress "towards the mean at a constant proportionate rate". If a company has a higher than average rate of return then it may be expected to tend to fall more into line over time and vice versa. The author further concludes

> "that we should not expect any strong systematic tendency for relative growth of earnings per share to be a persistent characteristic of an individual firm. This does not mean 'growth' stocks do not exist; it merely means that they are atypical and that a general rule of 'growth breeds growth' would not be a successful means of picking out those companies which will achieve a high future growth of earnings per share."

Thus, although at first the inverse relationship between profit growth and relative share valuation appears counter intuitive, the extant work provides some support for this finding. The empirical evidence suggests that growth trends do not tend to continue in general and on average there is a tendency to regress towards the average. If we assume that investors are aware of this, it is plausible that companies with high growth rates stand at a discount due to the problems of maintaining the high growth levels, on the other hand, low growth companies could be considered more stable and thus more able to maintain current earnings or change their earnings growth in line with the average rate of growth. However, due to the age of the supporting evidence and the lack of further confirmatory evidence we emphasise the need for caution in the interpretation of this variable.

6.3 Dividend Payout and the Value of the Firm

The model proposes a similar relationship to that found in the earnings yield model as a higher dividend payout is associated with a relatively higher share price. As we have discussed this relationship at length already in this chapter we shall not repeat the detail of the underlying logic implied. It is sufficient to say that it is believed that this phenomemon is a result of the investor trying to reduce his uncertainty in equity investment decisions and the clientele effect.

6.4 Marketability and the Value of the Firm

The variable market liquidity was also found in the earnings yield analyses and again the inference to be drawn from the sign of the regression coefficient is that the more marketable a stock, the higher the relative share price. The arguments supporting this relationship are the same as those presented in the earnings yield analysis and revolve around the ease with which investors can deal in stocks. Obviously the more difficult or awkward to deal, the lower the share price.

6.5 Gearing and the Value of the Firm

The final variable that entered the valuation ratio regression model was TL/TNW, a measure of financial gearing. The model implies that the greater the gearing the lower the valuation ratio, that is the higher the relative share price. This infers that investors have a preference for gearing.

This reasoning is directly opposed to the Modigliani and Miller(1958) theory where it is argued that gearing has an adverse impact on share prices. Furthermore Firth(1975) argues that companies which are highly geared will have more volatile profits performance than similar firms with little fixed interest borrowing, and will constitute more risky investments. The counter arguments on gearing (see Durand, 1958 and Renwick, 1968) are that providing the risk of default is low then gearing is an effective way of increasing the return on the shareholders' investment. The difference between the two lines of thought lies in the issue of whether investors change their rating of a company in line with the amount of gearing.

Our results would at first sight tentativealy lend support for the net income model of share valuation in that we could justify the investor's preference for gearing in terms of additional return. However, a closer look at the model reveals that the first and most influential variable to enter the model is return on capital based on a profit after interest figure. This might indicate that the influence of gearing in generating additional returns to the shareholder may have already been taken into account and therefore other reasons for this relationship might usefully be explored.

In a recent study by Drury and Bougen(1980) the level of gearing in UK companies in 1977 was investigated in terms of profitability, industry, size and sales enviroment. This study provides some very interesting findings such as that the level of gearing (measured by the debt/equity ratio) was not significantly associated with a company's sales enviroment and industry norms. On a more positive note it was found that in general highly profitable companies had low gearing and vice versa. Furthermore it appears that small firms are likely to have less gearing than large firms with 46% of the smaller companies compared with 15% of the larger companies operating with gearing of less than 20%. However, 20% of the smaller companies compared with 25% of the larger comapnies operated on high gearing ratios.

Whilst there are some problems in relating the results of Drury and Bougen to this study in that they used the debt/equity ratio and in our model we used TL/TNW, (although both are measuring the same characteristic, see chapter V), their findings may suggest a plausible explanation for the apparent preference for gearing proposed by our model might be that gearing is acting in some way as a surrogate for size. However, the correlation between size and gearing is very small and therefore this line of argument is at best tenuous.
Thus although the variable TL/NW would appear to convey additional information we may conclude that we are unable to interpret the relationship in an economically meaningful way. As such we have problems in interpreting what this variable is conveying about how the investor processes information.

6.6 Summary of the Valuation Ratio Analyses

The main tentative conclusions to be drawn from the analyses can be summarised as follows:

1) the primary factor in determining relative valuation ratios is return on capital and this clearly supports the theory that earnings are the primary determinant of relative share values.

2) earnings growth is inversely related to relative share valuation. This finding may possibly be partially explained by the overall expectation of growth rates regressing towards an average.

3) as was seen in the earnings yield analyses dividend payout influences the relative valuation ratio. This infers that investors have a preference for dividends which is caused by a systematic bias in the market.

4) the degree of market interest also has a bearing on relative share

values; the greater the marketability the higher the relative share price.

5) the effect of financial gearing could not be intuitively explained with any degree of conviction.

If these results are now compared with the five hypotheses set up in chapter IV we find that both hypotheses 1 and 2 are supported. The models clearly show that earnings are the primary financial determinant of relative share values as measured by the valuation ratio and that dividends are influential, although secondary to earnings.

The third hypothesis which states that financial risk does not influence share values unless risk of default is high has been ratified to a limited extent. The model does show that financial risk has a small amount of influence but as we have stressed the underlying rationale for the relationship proposed is not strong. Thus although we cannot conclude that these results support this hypothesis, we can state that we have not found any strong evidence to reject it.

The remaining hypotheses concerning default and systematic risk are however unsupported as neither z-score nor beta entered any of the models. Consequently we suggest that our results are not consistent with the theories that default risk as measured by z-score or systematic risk as measured by beta are of major importance to investors. Again we stress that the absence of any positive result is not to be interpreted as rejecting the hypotheses.

These results clearly show a more complex picture of the investor's decision making process than was found with the earnings yield analysis and therefore provide a more complete picture about the market's decision making process.

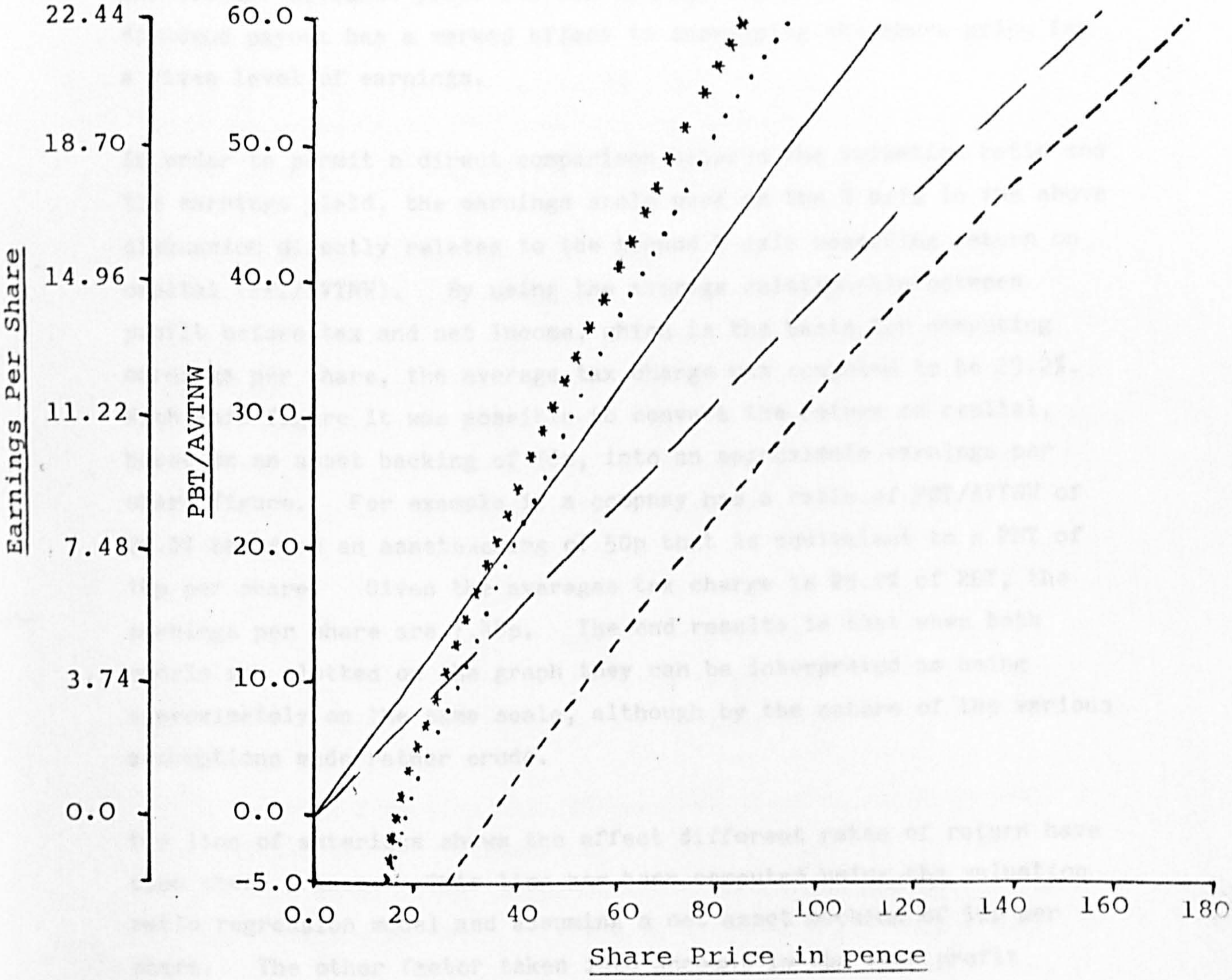
7. The Link between the Valuation Ratio and the Earnings Yield Models

One surprising result from the analyses was that the earnings yield model only explained 26% of the variance, whereas the valuation ratio explained 53%. Prior to conducting these analyses it was expected that the earnings yield, which is a ratio constantly used by investment analysts, would be easier to explain than the rarely used valuation ratio. One plausible reason for this phenomenon might have been the influence of companies with meaningless earnings yields corrupting the model, but as care was taken to exclude this type of company we must look elsewhere for the explanation.

As both independent variables are a function of share price and an accounting number, namely earnings and net assets, the explanation for the difference in the two models must lie in the way these accounting numbers interact with share values. A way of examining the difference between the two models is to compare the effect a change in each of these accounting figures has on share prices. In figure 6.2 the earnings yield and valuation ratio regression models are plotted on a graph which allows a direct comparison of the two models to be made. The x axis is the share price in pence and the y axises are earnings per share for the earnings yield model and return on capital for the valuation ratio model. From this graph it is possible to see the impact a change in earnings, or profitability, has on the share price.

The solid black line represents the earnings yield model. This line is computed by using the constant term in the regression model, that is the discount rate for earnings is 19.88% when all other things are held constant. This straight line clearly demonstrates the assumption made when analysing the earnings yield using MRA of a linear relationship between earnings and share price. Moreover, it clearly shows the major drawback with the earnings yield approach in that when earnings are zero, the share price is also expected to be zero, suggesting that the company is worthless (although in reality this could not happen). A point worth noting is that when the earnings yield regression model was computed, companies producing a low return on capital were excluded from the analyses and therefore the extrapolation of this line to zero is not strictly correct. However, as there is no hard and fast rule for determining the point

A GRAPHICAL PRESENTATION OF THE DIFFERENCE IN THE EARNINGS YIELD AND VALUATION RATIO MODELS



Legend

Line	Regression Model	Variables
———	Earnings Yield	Constant
—— ——	Earnings Yield	Constant and average dividend yield
********	Valuation Ratio	Constant, Return on Capital, Average Profit Growth
....	Valuation Ratio	Constant, Return on Capital, Average Profit Growth and Average Dividend Yield
- - - - -	Valuation Ratio	Constant, Return on Capital.

where the level of low earnings produces a meaningless earnings yield it is not possible to know where to stop this line. To illustrate the impact dividends have on the rate at which earnings are discounted (ie. the earnings yield) a second earnings yield regression line has been drawn (long dashes) on the graph. This line is computed using the average dividend yield for all companies and clearly shows that dividend payout has a marked effect in increasing the share price for a given level of earnings.

In order to permit a direct comparison between the valuation ratio and the earnings yield, the earnings scale used as the Y axis in the above discussion directly relates to the second Y axis measuring return on capital (PBT/AVTNW). By using the average relationship between profit before tax and net income, which is the basis for computing earnings per share, the average tax charge was computed to be 25.2%. With this figure it was possible to convert the return on capital, based on an asset backing of 50p, into an approximate earnings per share figure. For example if a compnay had a ratio of PBT/AVTNW of 20.0% based on an assetbacking of 50p that is equivalent to a PBT of 10p per share. Given the averagae tax charge is 25.2% of PBT, the earnings per share are 7.48p. The end results is that when both models are plotted on the graph they can be interpreted as being approximately on the same scale, although by the nature of the various assumptions made rather crude.

The line of asterisks shows the effect different rates of return have upon share prices. This line has been computed using the valuation ratio regression model and assuming a net asset backing of 50p per share. The other factor taken into account is the mean profit growth, all other variables in the model have been omitted. The reason for including profit growth in this way is to provide a far more useful comparison to be made between the models. (The short dashed line shows the result when this factor is ignored.) The interesting aspect about this line is that it is slightly curved and that when the earnings are zero the share price is approximately 18p. Thus this graph clearly demonstrates that companies are far from worthless at this low return on capital level and suggests that the investors take into account the asset value of the share when assessing relative share values. It should be noted that even with the valuation ratio, companies with zero profits are at a very large discount compared with their asset backing. In this instance the share price represents only 36% of the book value of the assets.

Also shown on the graph is the impact of dividend payout in the valuation ratio regression model. In contrast to the earnings yield model the impact on share price is relatively small. The reason for this can probably be attributed to the instability of the earnings yield model due to the low variance explained.

From the above discussion it is implied that there is a link between the earnings yield and valuation ratio regression models. Whittington(1971) in a discussion on how investors should value investments proposes that when choosing between two companies these two measures should be compared. Whilst he also proposes two simple rules for investors he presents the relationship that the rate of return on capital is equal to the valuation ratio divided by the price/earnings ratio:-

$$E/A = \frac{P/A}{P/E}$$

where E = earnings
A = assets
P = Share Price

This equation indicates that the link between the earnings yield and the valuation ratio is return on capital. The graph of the regression models clearly demonstrates this point and reveals that it is particularly relevant in the area where earnings become very low.

In conclusion the above discussion reveals that the reason for the earnings yield model explaining less variance than the valuation ratio model is due to its inability to accommodate the problems associated with low returns on capital. The valuation ratio, on the other hand, starts a step further down the valuation hierarchy and adjusts the share value by the quality of the earnings entering the model, the quality being assessed by the return on capital variable. This difference between the models can also be expressed in terms of the regression residuals. As earnings are the prime determinant of relative share values, at least according to our valuation ratio results, by using the earnings yield as a dependent variable we are trying to explain a residual of a previous process and consequently the variance explained will be less. Because of this it is difficult to be conclusive about the additional explanatory power of the valuation ratio model, but we would suggest that these results indicate that the valuation ratio is a better dependent variable for this type of analysis simply because it takes into account the effect profitability has on share values and does not simply concentrate on examining the residuals.

8. Summary and Conclusion

Having discussed at length the theoretical implications of the earnings yield and valuation ratio models, and the relationships that exist between these two dependent variables, it is important to draw together the main points and to assess the overall ability of these analyses to aid us in our search for an understanding of the market's judgement process and its use of financial information.

In the first set of analyses conducted on the earnings yield it was found that both dividend payout ratio and marketability had an influence on share prices. The discussion that followed provided us with the general conclusions that investors prefer dividends and that, the more the market interest in a stock, the higher its relative share value.

The second set of analyses conducted on the valuation ratio proved to be more complex with five statistically significant variables entering the regression model. The most dominant explanatory variable was return on capital, this was followed by profit growth, dividend payout, market liquidity and financial gearing in order of contribution to the model. The discussion on these variables revealed that at least for the time period covered by this study investors had a preference for earnings, low growth in profits, higher dividend payouts and more marketable shares. The fifth factor, financial gearing, could not be interpreted in a meaningful way.

The overall conclusion to be drawn from these analyses is that although inferences about the association between accounting numbers and relative share valuations may be attempted, it is very difficult to be more specific. Consequently, it appears that these linear additive models provide us with only vague generalisations about the share price fixing mechanism. We have seen that all of our arguments for supporting the relationships proposed by the models are normative and, although interesting from a theoretical point of view, are very limited in clarifying the conditions under which certain variables are more important than others. For example the valuation ratio regression model proposes that a high dividend payout is preferred at all levels of return on capital, but there are strong arguments for suggesting that when the return on capital is either very high or very low investors may not prefer dividends (see Lintner, 1962).

The problems from using linear additive techniques have been discussed at length in the cognitive psychological literature. Shanteau and Phelps(1977) specifically note that the use of multiple regression as a normative model is different in emphasis from the descriptive applications of the technique. In this study the descriptive application of multiple regression has been concerned with summarizing the market's (that is the sum of all analysts) decision policy in a linear equation. The output from this has been a model composed of only those characteristics that made significant and unique contributions to predicting the overall judgement. However, it is important to carefully examine exactly what has been achieved. Shanteau and Phelps(1977) comment on this topic as follows:

> "A frequent mistake, however, had been to assume that the judges use only these few characteristics. Instead, these characteristics are the only ones needed to describe the judges decision ... Thus multiple regression analysis may seriously underestimate the number of characteristics actually used by the judge."

Consequently, it is to be recognised that the model and the underlying judgement process are not the same, the models merely "paramorphic represent" the judge (Hoffman, 1960). Shanteau and Phelps(1977) add that:

> "Unfortunately, this distinction is frequently overlooked by many users of descriptive models who believe that they have somehow also described the process. Too often, a close correspondence between the predictions of a model and of a judge is taken to mean that the judge must somehow share the basic properties of the model."

This point is further emphasized by Dawes and Corrigan(1974) who have shown that there is little loss in predictive ability when the weights in such models are changed from statistically optimal values to random values. Thus, although we can conclude that in many instances the linear additive models of the judgement process can be very accurate in their predictive ability (see Dawes, 1971; Goldberg, 1968; Lewis, 1975), it is inappropriate to conclude that such models are an accurate description of the judgement process. If we apply this line of reasoning to the results reported so far in this thesis, it is apparent that we must be careful in interpreting the models as accurate descriptions of the investor's decision making process. Consequently, we can conclude that our normative models only provide broad generalisations and are therefore unable to provide descriptive evidence concerning actual usage of financial information.

Slovic(1969) also recognises this problem and suggests a possible cause as follows:

> "While their techniques (referring to previous studies using linear additive techniques) have been quite successful in describing how individual items of information are weighted and combined by a judge, they have not been successful in describing complex patterned or configural use of information, that is, the process whereby an item of information is interpreted differently from one time to the next, depending on the nature of other available information. Since experts generally claim that they use information configurally, it is important that techniques used to describe judgement be sensitive to such processes".

Slovic further proposes that the ANOVA technique is more appropriate for quantitative description of both configural and nonconfigural use of information in judgement. Slovic concludes his analytical study into stockbroker decision processes by stating "it is now clear that substantial configural processing of information does occur and can readily be detected by the ANOVA technique." Other studies in this area (see Libby and Lewis, 1977 for a detailed review) have also reached this conclusion in different areas and therefore the ANOVA methodology might appear to be a useful approach for describing the configural manner in which information is processed.

In summary if we accept the premise that the way in which information is processed by the decision maker is configural by nature, then it would seem essential in a study of this kind to adopt a methodology that can reveal configurally interactions existing between variabales. Thus we conclude that although the traditional linear additive techniques have revealed some interesting relationships, they are unlikely to be able to provide a comprehensive picture of the investor's decision making process. It is one thing to argue in broad terms that earnings, dividends, market interest, etc. influence share values but quite another to be more specific about how these variables interact with each other. A brief interview of any investment analyst would confirm that these broad generalisations do not provide a valid description of his evaluation process.

In order to overcome this deficiency in linear additive techniques a second type of analytical technique based on the ANOVA principle has been employed. This second set of analyses will be reported in the following chapter where the technique of Automatic Interaction Detector will be presented. By adopting this approach we not only hope to develop a more realistic model, hopefully providing superior insight into market processes, but also there is the potential added benefit of "cross-methodological validation of the research results" (Libby & Lewis, 1977). This provides a wider body of knowledge of the underlying relationships and thus should lead to more relevant findings. This line of thought is also recommended by Shanteau and Phelps(1977) who argue for greater flexibility by researchers. The authors argue for the adoption of analytical techniques which are most suitable for the investigation, rather than the investigator, and this may mean the use of several techniques depending on the problem under consideration, with each contributing something to the study. Essentially in this study we have followed this line of thought.

CHAPTER VII

A CONFIGURAL APPROACH TO UNDERSTANDING RELATIVE SHARE VALUES

1. Introduction

In this thesis it has been argued that when investigating any decision making process it is necessary to take into account the complex way in which humans process information. In the previous chapter the results obtained from using the more common linear additive analytical techniques were presented and although we were able to make several generalisations about the market's decision making process, in general the interpretations we were able to make were relatively restricted. Our results clearly emphasized the importance of using analytical techniques capable of providing a more detailed insight into the investor's decision making process.

In this chapter we try to overcome the deficiencies revealed in the previous chapter by replicating the analysis using a technique capable of uncovering the configural way in which variables are combined within the market's judgement process. This statistical technique termed Automatic Interaction Detector (AID) has not been used before in this area of research. Because it possesses certain analytical advantages for our purposes over the more traditional techniques, we hope the analyses that follow will lead to the development of a more realistic and informative model of how investors value accounting information.

This second stage of the analysis proceeds with a discussion of the AID technique which includes a brief analysis of its benefits and limitations, a description of the AID algorithm, an examination of the potential pitfalls in its use and suggestions made by the literature to overcome these, and finally the controlling criteria used in the subsequent analyses are presented. The following two sections present the results obtained with both the earnings yield and the valuation ratio as dependent variables. Within both of these sections the discussion is split into three subsections covering the statistical interpretation, a general description, and the implications for theory of the derived AID models. The chapter is concluded with a general summary of the AID results and an examination of how these results help us to meet the objectives of this thesis.

2. The AID Technique

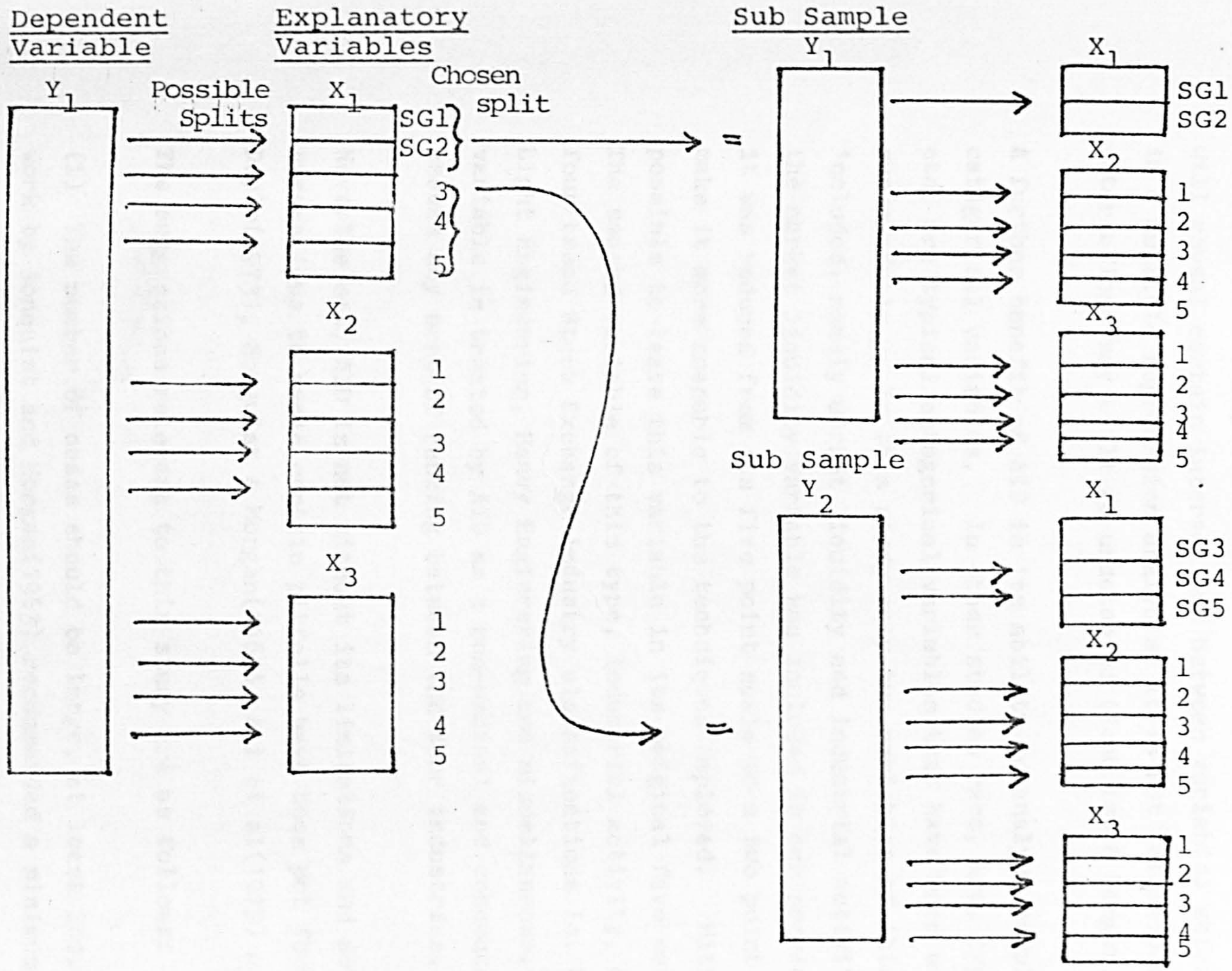
Despite the AID technique being a relatively new analytical tool, it has been employed in a wide variety of research areas such as market research (Assael,1970; Newman,1973), education (Orr,1972), population analyses (Ross and Bang,1976), and a study into the British Fishing Industry (Heald,1972). However, in the author's knowledge, this is the first study to use AID in the building of share valuation models. In fact, the only other study that has used AID in the finance area is by Lewellen, Lease and Schiarbaum(1976) which investigated the various patterns of investment strategy and behaviour among 1,000 individual investors. Although this study did reveal some interesting findings, the methodology employed and objectives were so different from the issues under examination in this thesis, that we believe further discussion of this study here is not warranted.

The main reason for the increasing popularity of the AID approach in the social sciences is its ability to explore and reveal certain relationships, intercorrelations and interactions between variables, which the more traditional analytical techniques may not be able to uncover. The AID algorithm was developed by Sonquist and Morgan(1963) and has been made widely available by the publication of a book by Sonquist and Morgan(1964) containing a description of the technique, its benefits and pitfalls, and an AID computer program. The version of AID employed by the author was produced by the London School of Economics (1972) and entitled AID 1.

AID does have some similarities to stepwise regression in that it attempts to explain the dependent variable in terms of explanatory or predictor variables. However, it differs from regression in that it makes no assumptions concerning linearity or additivity of the contributions made by the explanatory variables (Sonquist and Morgan, 1963). Essentially, AID operates by successively searching among the independent variables for the best binary split which maximises the variance explained in the dependent variable. At each stage in the analysis the independent variable selected will split the data set being analysed into two parts, one part being defined by a subset of the independent variable's categories and the remaining categories defining the other part. This process is continued until no more splits are possible without violating the various control criteria. The end result is a tree structure as presented in figures 7.4 and 7.5 where it can be seen that each new branch is formed a result of a binary split. The AID technique is based upon "one way analysis of variance" (ANOVA) with splits being determined by the variable that minimises the "residual sum of squares" of the dependent variable in the resultant two groups. This is equivalent to maximising the "between subgroup sum of squares" in ANOVA terminology. A more extensive description of the algorithm is given in Appendix I.

A clearer picture of the AID analytical process can be obtained if Stage 1 in figure 7.1 is referred to. Essentially, there is one dependent variable represented by vector Y and several independent variables represented by vector's X1 to Xn. Each independent variable's observations are ranked and then split into subgroups (or categories), SG1 to SGn, (in figure 7.1 we have used five). The AID technique proceeds by trying to find the best dic otomonous split on any dependent variable that is able to explain the most variance in the independent variable. If we consider figure 7.1 the technique would commence on variable X1, and proceed by examining the splits determined by subgroup 1 and subgroups 2 to 5, then it would examine the splits determined by subgroups 1 and 2, and subgroups 3 to 5 and so on. This process continues until all possible splits on all variables have been examined and the one split that explains the most variance is selected as the basis for splitting the sample into two subsamples. The process is then repeated on the two subsamples formed (shown on figure 7.1 as stage 2). Again new subsamples will be formed and the process is continued until certain statistical criteria are not met.

STAGE I STAGE 2 FIGURE 7.1



A DIAGRAMMATIC VIEW OF AID

The main benefit from using AID, as stated above, is that it makes no assumptions concerning linearity or additivity in the independent or explanatory variables. The reason for this is that each stage of the analysis is evaluated independently from the previous stages, with each new parent group being analysed as a distinct set of data. From this process a series of decision rules based upon the order of the splits is produced and this provides a basis for understanding the variance in the dependent variable. Although this type of analysis will reveal certain interactions between variables which may be hidden in a multiple regresssion analysis, it is not infallible as certain interactions may still go undetected (Sonquist & Morgan, 1963).

A further benefit of AID is its ability to analyse complicated categorical variables. In other studies race, age, type of education etc. are typical categorical variables that have been used successfully. In this study only two variables of this kind were included, namely market liquidity and industrial activity. Although the market liquidity variable was included in our previous analyses, it was reduced from its five point scale to a two point (0,1) scale to make it more amenable to the techniques employed. With AID it was possible to leave this variable in its original five category state. The second variable of this type, industrial activity, comprised the four broad Stock Exchange industry classifications ie. Capital Goods, Light Engineering, Heavy Engineering and miscellaneous. This variable is treated by AID as a non-ordinal and consequently does not assume any sort of ranking between the four industries.

Nevertheless, AID is not without its limitations and several suggestions to avoid certain pitfalls have been put forward by Doyle(1973), Songuist & Morgan(1963), Ali et al(1975) and Ecob(1978).

The suggestions relevant to this study are as follows:

(i) The number of cases should be large, at least 200. The earlier work by Sonquist and Morgan(1963) recommended a minimum of 1,000 cases but a recent study by Ecob(1978) states that smaller samples can be used effectively providing the controlling cut-off criteria are adjusted accordingly. For small samples, below 200, Doyle(1973) suggests that multiple regression is far more powerful as an analytical tool than AID. In this study the sample size of 547 companies is perfectly acceptable.

(ii) Intercorrelation between predictor variables must be carefully monitored to avoid spurious results. For example, if variable A were selected to split a parent group, then, if any other predictor variables are correlated with variable A, they become less likely to be selected to split any of the subsequent groups. It is feasible that had a second variable B, which has almost as much discriminatory power as variable A, been selected for the first split instead of A, then the resultant AID model derived may have been appreciably different. In order to avoid this problem the data must be examined for high intercorrelations and competition between variables for splits and numerous analyses must be undertaken excluding certain variables. (It was at this point that the factor analysis referred to in chapter V was employed to select uncorrelated variables.)

(iii) The continuous predictor/independent variables have to be ranked and recoded into subgroups (see figure 7.1). Each subgroup should contain approximately the same number of observations and different analyses have to be conducted to determine the optimum number of subgroups. In this study numerous analyses of this nature were undertaken and it was found that the most useful models were obtained from using 12 subgroups, that is approximately 45 observations per subgroup per variable.

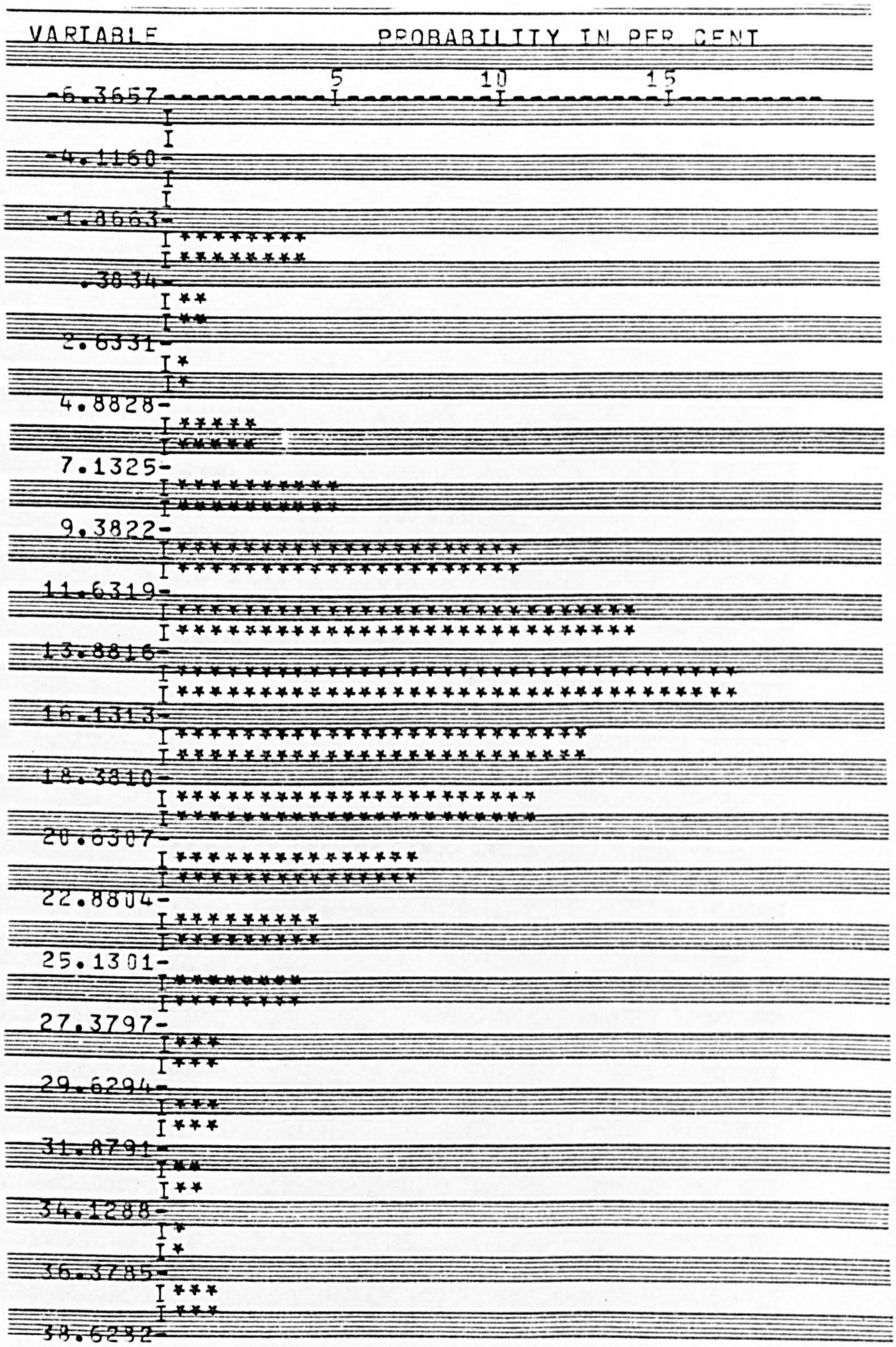
(iv) The dependent variable should not be heavily skewed as this may cause spurious results. In chapter 5 it was reported how each ratio distribution was examined for skewness and, where necessary, transformed to improve normality and symmetry. The distributions of the dependent variables, the earnings yield and the log of the valuation ratio, are shown in figures 7.2 and 7.3 respectively.

In addition to these suggestions Doyle(1973) recommends that the resultant AID tree pattern should be tested for stability as follows:

(a) the original data set should be split into two subsamples, one subsample to be used for the development of the model and the second

Figure 7.2

THE EARNINGS YIELD DISTRIBUTION



MEAN = 16.09 %

STANDARD DEVIATION = 7.25

Figure 7.3

THE LOG OF THE VALUATION RATIO DISTRIBUTION

```
   VARIABLE                    PROBABILITY IN PER CENT
                            5         10
   -1.2586----------I---------I---------
           I*
           I*
   -1.1100-
           I*
           I*
    -.9615-
           I**
           I**
    -.8129-
           I**
           I**
    -.6643-
           I******
           I******
    -.5157-
           I*********
           I*********
    -.3671-
           I**********
           I**********
    -.2186-
           I********************
           I********************
    -.0700-
           I********************
           I********************
     .0786-
           I*****************************
           I*****************************
     .2272-
           I*************************
           I*************************
     .3758-
           I*********************
           I*********************
     .5243-
           I*********************
           I*********************
     .6729-
           I**************
           I**************
     .8215-
           I********
           I********
     .9701-
           I*****
           I*****
    1.1187-
           I***
           I***
    1.2673-
           I*
           I*
    1.4158-
           I*
           I*
    1.5644-
           I*
           I*
    1.7130-
```

MEAN = 0.22

STANDARD DEVIATION = 0.48

for validating and testing the model's stability. Whilst this approach is feasible with very large samples, in this study the sample size was not large enough to permit this type of testing. Instead the stability of the resultant models derived from the whole sample were tested by splitting the sample into two subsamples and then analysing these subsamples. The analyses were then compared with each other and with the analyses on the total sample leading to a useful insight into the underlying stability of the relationships in the model. Obviously this approach is not as efficient as using two separate large samples but it does provide a useful and meaningful substitute stability test.

(b) several analyses using differing partitioning contraints have to be performed to establish stable final groups.

(c) the key factor causing the first split in the tree should be removed and the analysis repeated to see how the tree is affected.

In his paper Doyle(1973) adds that AID should be used as part of a comprehensive analysis and if used should be preceded by a factor analysis to isolate the important characteristics in the data. Furthermore, it is suggested that the relationships revealed should be used to provide a basis for deriving a more definitive model using multiple regression. In this study all of Doyles suggestion have been followed where possible except the last. The reasons for this is that 1) this study is concerned with understanding the user's decision making process and not predicting share prices and 2) it was not possible to manipulate the relationships revealed by the analyses in the way Doyle suggests to form new variables for regression analysis.

3. The Controlling Criteria

The tree structure obtained from an AID analysis depends heavily upon the termination rules used to stop further splitting of the parent groups. It is necessary to ensure that each split is statistically important to the analysis and not just caused by chance or sampling error. The rules adopted by this study are those recommended by Sonquist & Knott(1976) and Ecob(1978). They were as follows:

(a) the minimum number of observations in a final group was set to 35, below which the groups were considered too small for this type of analysis.

(b) the maximum number of final groups was 30 (in practice this was found to be redundant).

(c) the criterion for splitting a group was that the resultant child groups must reduce the total sum of squares by at least .012 (as suggested by Ecob(1978) when the predictors have 8 to 12 subgroups at 95% level of confidence). This is called the "split reducibility criterion".

(d) before a group could be split, it had to contain at least .013 of the total sum of squares.

(e) the t-value to test if the difference between the means of the two new child groups was significant was 2.0

In practice the most important rule for determining a split was the split reducibility criterion. The reason for this is that the program will continue to split large groups possibly several times, producing child groups which although intuitively appealing are not statistically significant. Sonquist & Morgan(1964) suggest a cut-off of .006 but as Ecob(1978) points out this level is only useful with either samples larger than 1,000 cases or with small samples with only two subgroups per variable. By using Ecob's higher cut-off level the probability of splits occuring which are important (in the sense they reduce the unexplained variation by a large amount), but not statistically significant, has been minimised.

4. Interpretation of the AID Tree Pattern

Prior to reporting the results of the earnings yield and valuation ratio analyses a brief summary of the characteristics and implications of certain AID tree patterns is given. The purpose of this summary is to clarify certain basic interpretations that will be made during the subsequent analyses.

When analysing an AID tree pattern there are three main features to be examined. In broad terms these are, the shape of the tree, the characteristics of the final unsplit groups and the competition between variables to split the parent groups. All of these factors influence the overall interpretation of the AID model.

The shape of the tree can either be described as a "trunk-twig" or a "trunk-branch" structure. A "trunk-twig" structure is found when small terminal groups split off from a main branch. An example of this is given in figure 7.7 where groups 4, 6, 8 are the small terminal groups (or twigs) with the main trunk connecting groups 1, 2, 5, 7 and 9. This particular trunk has one "alternative advantage" (or top terminating) group 6 and two "alternative disadvantage" (or bottom terminating) groups 4 and 8. The reason for this type of tree pattern is that each of the small terminal groups possesses a particular characteristic which distinguishes it from the main body of cases forming the trunk. Obviously these characteristics can be either advantageous or disadvantageous, depending on the direction of the split. For example in figure 7.7 where group 6 is formed, all companies in that group have the advantage of having a total asset value above £109m, which has caused a low earnings yield, ie. a higher-share price.

A "trunk-branch" structure is where the splits from the parent groups to child groups are symmetrical, at least for the first four major splits. The lower trunk in figure 7.6 shows an example of a trunk-branch tree pattern. Very often with this type of structure some of the early groups remain unsplit and, if this is so, they usually possess large amounts of unexplained variation. It is, therefore, important to try to understand why this type of terminal group cannot be explained.

A further property of a tree is its symmetry or nonsymmetry in terms of the variables used in the splits on various trunks. Morgan and Sonquist(1964:112) explain this property:

> "Nonsymmetry implies interaction, ie. effects of combinations of factors. If a variable is used on one of the trunks, and if it shows no actual or potential utility in reducing predictive error in another trunk, then there is clear evidence of an interaction effect between that variable and those used in the preceeding splits."

This aspect of interaction is most important and worthy of further explanation. Interaction between variables in its simplest form is where a variable has the effect of influencing a decision in one way given one set of circumstances, and in a completely different way, given a different set of circumstances. For instance, it is plausible that an investment analyst may prefer to see a very high turnover of fixed assets for a distribution/warehousing type of company, whereas an equally high turnover of fixed assets in a manufacturing concern may be considered unhealthy, possibly a sign of overtrading. In this hypothetical example there is what we have termed "perfect interaction" whereby the influence of one variable on the decision maker is completely reversed and is solely dependent upon the industrial classification of the company under examination. In practice, however, perfect interaction is rare and is unlikely to be found in a study of this nature. Nevertheless, there are other forms of interaction between variables which are less obvious and yet clearly demonstrate the configural nature of the human decision making process. For example, it is possible that the variable may influence the decision maker in a similar direction given two different sets of circumstances but the impact of the variable in each case is quite different. For instance, a high fixed asset turnover ratio may be found to be undesirable when analysing either a distribution or a manufacturing company but the overall impact on the assessment of the distribution company may be considerably more than on the manufacturing company. In this case there is interaction between fixed asset turnover and type of company but is in a less discrete form than above.

A second type of interaction which was referred to above in a reference to Sonquist and Morgan(1964) is nonsymmetry. This form of interaction is where a variable is found to be important given one set of circumstances but is missing from a second set. For example it may be found that fixed asset turnover is important in assessing a distribution company but insignificant in the assessment of a manufacturing company. This clearly reveals that different variables only have an influence given a specified set of circumstances and although this indicates interaction it is not perfect as per our definition above. In order to aid the clarity of the discussion that follows these less obvious forms of interaction will be referred to as "imperfect interactions".

A further important feature of an AID tree is the utility of variables in the model which is reflected by the amount of the unexplained variance they can explain. Obviously, the more a variable is able to contribute to explaining the variation in the dependent variable, the more influence it will have in the overall model. However, in addition to this, it is important to monitor the competition between each variable for splits. Often two variables will be found to explain similar large amounts of the variance, but only one can be chosen for the split. If competition is present and if the defeated variable does not enter at a subsequent split, then it is necessary to rerun the analysis excluding the victorious variable in order to establish whether a better tree structure could be found using the vanquished measure.

Finally, each of the unsplit groups should be inspected for the reason why the splitting has stopped. It is possible to distinguish three main types of final group, small groups, explained groups and unexplained groups. A small group is one containing too few cases to warrant an attempt to split. An explained group is one over the minimum size but which has too little variation to warrant an attempt to split. An unexplainable group is one which possesses enough cases and variation to warrant a split but no variable in the analysis is able to make a useful contribution to reducing that variation.

5. The Earnings Yield Analysis

The earnings yield under examination in this thesis represents the investors' valuation of a company's earnings as at the day after publication of the accounts. A high yield, that is high earnings relative to the share price, indicates that investors require more earnings per pound of investment and implies that this type of share possesses more risk than a lower yielding share. However, this rule of thumb is not always applicable and on certain occasions it would be wrong to use it, eg. when a company is generating a loss or a very low profit (see chapter 5).

In the previous chapter the results of the multiple regression and discriminant analysis revealed the following factors to be important in determining the relative earnings yield:

(1) Dividend Payout

(2) Market Interest

However, the explanatory power of the derived models was rather weak with the discriminant model classifying only 79.2% of the cases correctly and the regression model explaining only 26.3% of the variance. With the AID technique we will try to improve upon the accuracy of the traditional models and also try to reveal certain previously unidentified interactions between variables.

In this section the AID results presented are the final models considered to be the most informative, complete and stable. These final models have been decided upon after concluding numerous analyses with varying control criteria and differing combinations of variables. In addition, tests for stability were performed on the sub-samples of the total sample. The results obtained from these tests are not, however, presented here because the trees produced merely confirmed the major splits in the tree derived from the total sample.

The discussion on the earnings yield analyses that follows commences with a detailed review of the statistical aspects of the two AID models derived, namely earnings yield AID tree patterns (1) and (2). This is then followed with a general description and a discussion on the theoretical implications of the models with particular attention given to the underlying economic logic of each split. The remaining part of this chapter presents the valuation ratio analyses and is in a similar format.

5.1 THE STATISTICAL INTERPRETATION

Earnings Yield AID Tree Pattern (1)

The AID tree pattern produced from an analysis of the whole sample of 547 companies is shown in figure 7.4. This tree structure shows how the analysis progressed from group 1 on the left to each of the six final groups (2, 11, 10, 9, 8, 6) on the right. Also shown in the figure are the following statistics for each group.

(i) the ratio and the cut-off value used in the previous split to form the group

(ii) the mean of the dependent variable

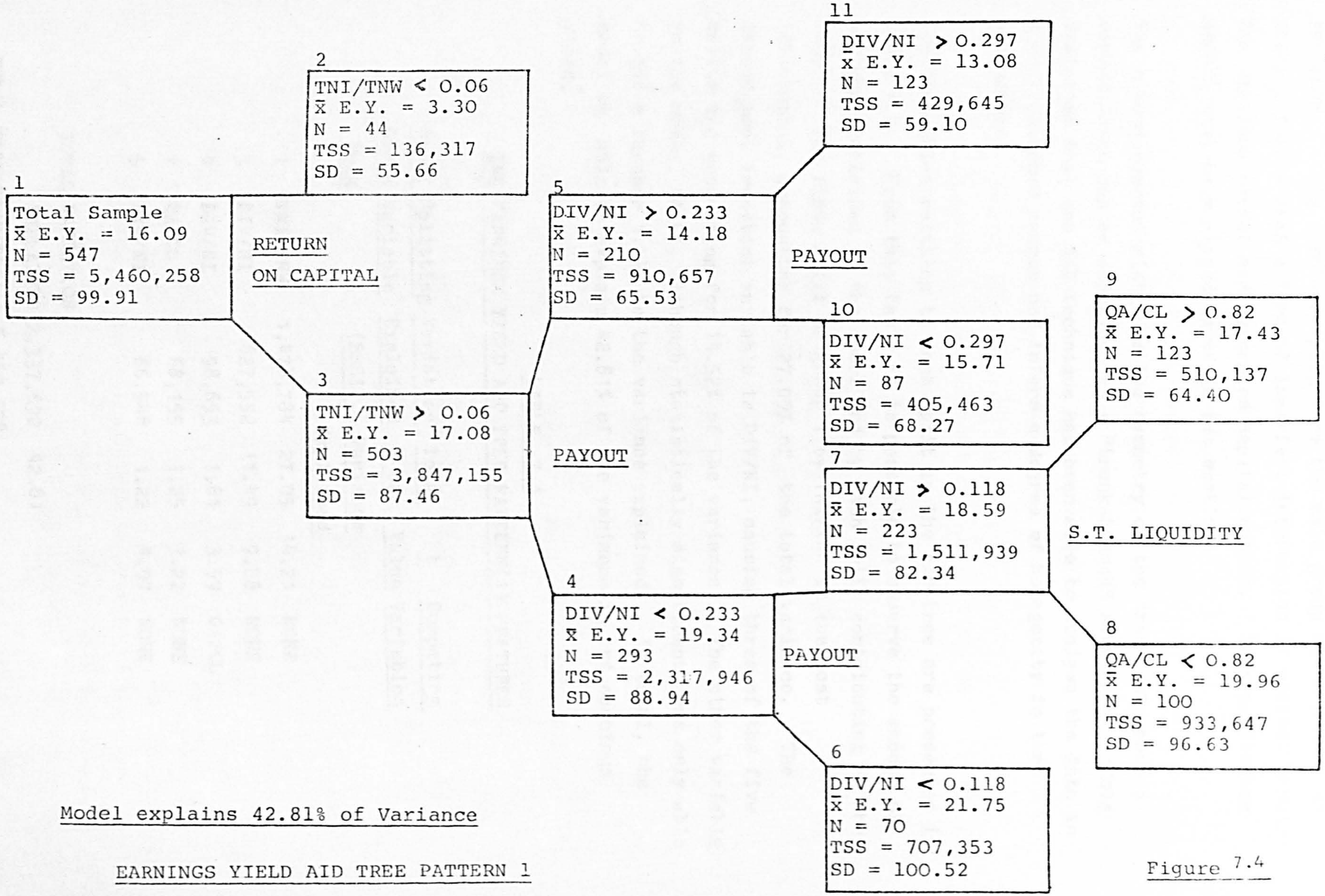
(iii) the number of cases in the group

(iv) the total sum of squares of the group, eg. the variance

(v) the standard deviation of the dependent variable for that group.

(note items (iv) and (v) are based on a normalised scale and cannot be directly compared with item (ii)).

The earnings yield pattern shown in figure 7.4 possesses two distinct characteristics. The first is the isolated "twig" structure created when group 1 is split into groups 2 and 3 by the return on capital



Model explains 42.81% of Variance

EARNINGS YIELD AID TREE PATTERN 1

Figure 7.4

variable. This distinct split from the main group of companies by group 2 infers that a form of imperfect interaction is present between the dividend payout and return on capital ratios. This particular aspect will be analysed later in this section.

The second characteristic is the symmetry of the tree from group 3 onward which can be described as a "trunk-branch" structure. This indicates that the AID technique has been able to analyse the data in a well balanced manner and infers a degree of homogenity in the sub-sample.

The statistics relating to each split in the AID tree are presented in table 7.1. From this table it is possible to observe the amount of variance explained by the model and by each split contributing to the model. The first split of group 1 by TNI/TNW is the most influential, accounting for 27.05% of the total variance. The second most important variable is DIV/NI, causing three of the five splits and accounting for 14.52% of the variance. The other variable in the model, QA/CL, although statistically significant, was only able to add a further 1.22% to the variance explained. In total, the model was able to explain 42.81% of the variance in the earnings yield.

TABLE 7.1

THE EARNINGS YIELD AID TREE PATTERN(1) FEATURES

Split Group No.k	Splitting Variable	Variation Explained (BSSi)	Total % of Variance Explained	t Value	Competing Variables
1	TNI/TNW	1,476,784	27.05	14.21	NONE
3	DIV/NI	627,552	11.49	9.88	NONE
4	DIV/NI	98,653	1.81	3.59	QA/CL
7	QA/CL	68,155	1.25	3.22	NONE
5	DIV/NI	66,548	1.22	4.07	NONE
TOTAL VARIATION EXPLAINED		2,337,692	42.81		

TOTAL VARIATION(TSS) = 5,460,258

In addition, table 7.1 shows the t-values for testing the difference between the child group means (all of which are statistically significant) and the competing variables for each split. In all cases, except for group 4, there were no other variables competing for the splits. However in the case of Group 4 the competition, although strong, was not important as the competing variable, QA/CL, was able to contribute to the model at the subsequent split of group 7. This subsequent involvement of the competing variable signifies that the two ratios are measuring different characteristics with the dividend payout ratio being the more influential.

TABLE 7.2

EARNINGS YIELD AID TREE PATTERN (1)

FINAL GROUP CHARACTERISTICS

Final Group No.	Earnings Yield Mean	No. of Companies	Unexplained Variation (TSS_i)	Standard Deviation	Reason for Split Stopping
2	3.30	44	136,317	55.66	too few cases
11	13.08	123	429,645	59.10	no significant explanatory variable
10	15.71	87	405,463	68.27	" " "
9	17.43	123	510,137	64.40	" " "
8	19.96	100	933,647	96.67	" " "
6	21.75	70	707,353	100.53	" " "

The next stage in the statistical analysis is to examine the characteristics of the final unsplit groups and in table 7.2 a summary of these characteristics is given. The table reveals that all of the final groups contained enough unexplained variation to warrant further statistically valid splits, but in each case other factors prevented these splits from taking place. In the case of group 2, there were not enough companies in the parent group to form two new child groups. As for all of the other groups no further splits took place because there were no statistically significant variables available in the data set. This implies one of two things. The first is that the database is not comprehensive and that other variables, if included, could have explained more of the variation. The second, and in the author's opinion more likely, is that the model has been formulated incorrectly in that the earnings yield is not the most appropriate measure of relative share value because of the assumptions made about the relationship between earnings and share prices. Consequently the unexplained variation is unexplainable using this dependent variable. One further observation to be made from table 7.2 is the large difference between the mean of group 2 and the means of all the other groups. In order to appreciate the extent of this difference the AID tree presented in figure 7.4 has been redrawn to scale using the mean values of each group as the location for each split, and this is shown in figure 7.6. This diagramatic AID Tree reveals the extent of the isolation of group 2 caused by the split using the return on capital ratio. The reason for this well-defined split is due to the AID technique identifying a group of companies which possess very low earnings yields caused by very low returns on capital, that is below 6%.

This anomaly in the earnings yield distribution was expected and was discussed at length in chapters 5 and 6. It is interesting that the AID technique was able to isolate this group of companies which possess low return on capital and a low earnings yield. Although it is not possible to derive an exact rule for determining the point below which the return on capital becomes influential (due to the arbitary way in which the subgroups are formed), this split clearly reveals a case of "imperfect interaction" between the earnings yield and the return on capital ratio.

Despite the overall statistical significance and the extreme nature of this interesing split, it does, unfortunately have a restricting effect on the whole model. The reason for this is due to the nature of the companies in group 2 (that is, low returns on capital). The earnings yields of these companies are not intuitively meaningful and therefore not amenable to this type of exploratory analysis. The net effect of including this group of 41 companies in the analysis is to increase the total variance to be explained by 46%, which leads to a reduction in the statistical significance of late splits in the tree thus shortening the length of the major trunks. As this group of companies can be said to be inhibiting the resultant model, the analyses were rerun using the reduced sample used in the multiple regression and discriminant analyses. This second set of analyses is called the earnings yield AID pattern (2).

Earnings AID Tree Pattern (2)

Reducing the sample size from 547 to 505 companies by excluding those companies with meaningless earnings yields produced the AID pattern tree shown in figure 7.5.

This new tree has been lengthened by two additional splits, with one occurring on the upper trunk and the other occurring on the lower trunk. A further change to the tree has occurred in the lower branch of the lower trunk, where the short-term liquidity split that occurred in AID tree pattern (1) has been preceded by a size factor split. This indicates that with a smaller total variance the size factor was able to explain marginally more variation than the short-term liquidity factor.

The statistics relating to this tree are presented in tables 7.3 and 7.4. Table 7.3 reveals that this new model only explains 26.36% of the total variance, which is substantially less than the previous model (42.81%). However, when the effect of the additional variance caused by the low return on capital companies is taken into account then the new model can be seen to leave less variance unexplained than the first model (2,754,877 v's 3,122,566).

EARNINGS YIELD A.I.D. TREE PATTERN 2

Figure 7.5

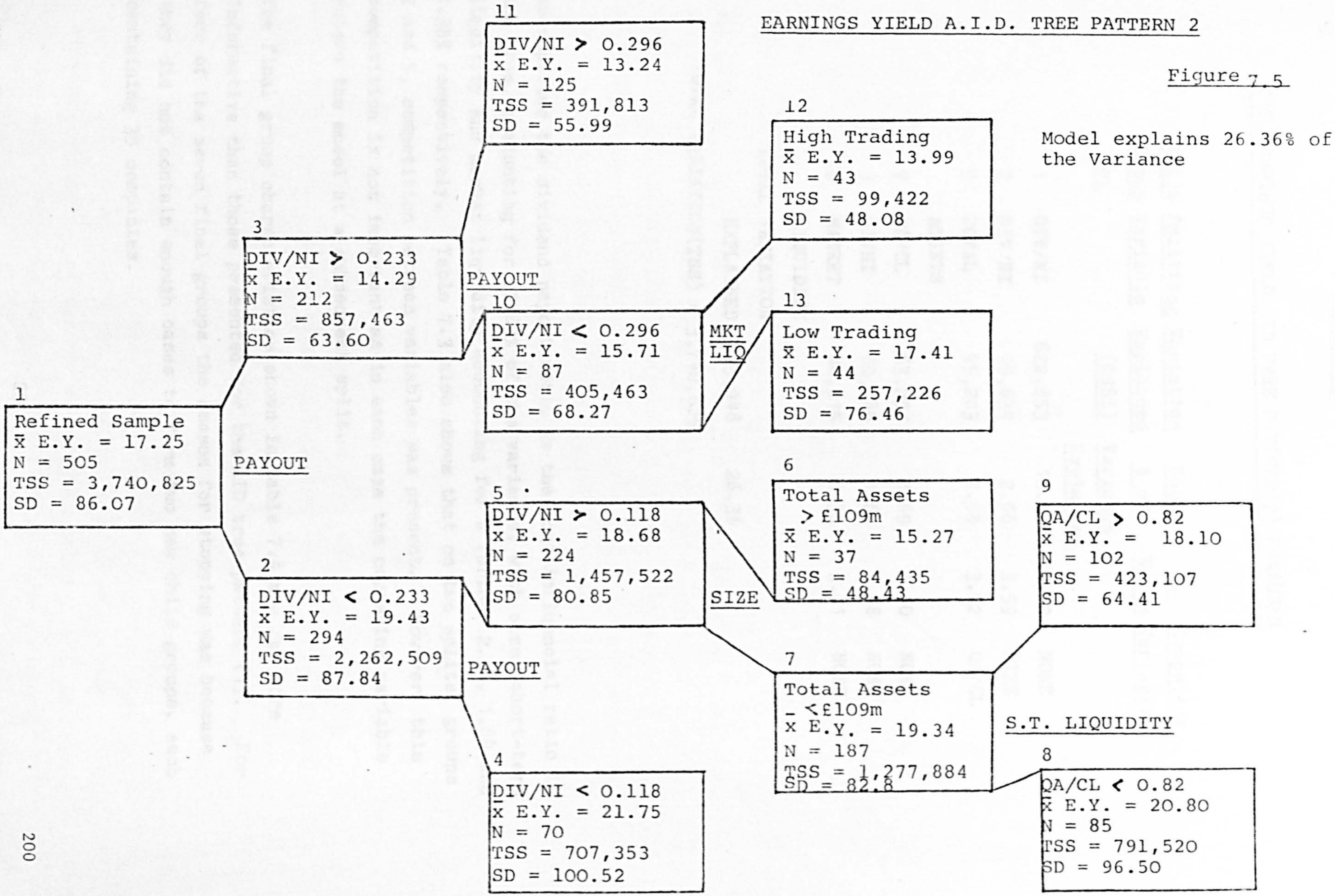


TABLE 7.3

THE EARNINGS YIELD AID TREE PATTERN(2) FEATURES

Split Group No.	Splitting Variable	Variation Explained (BSSi)	Total % of Variance Explained	t Value	Competing Variables
1	DIV/NI	622,853	16.65	10.02	NONE
2	DIV/NI	95,634	2.56	3.59	SIZE
5	TOTAL ASSETS	95,203	2.54	3.92	QA/CL
7	QA/CL	63,257	1.69	3.10	NONE
3	DIVNI	60,186	1.62	3.98	NONE
10	MARKET LIQUIDITY	48,815	1.30	3.41	NONE
TOTAL	VARIATION EXPLAINED	985,948	26.36		

TOTAL VARIATION(TSS) = 3,740,825

As expected the dividend payout ratio is the most influencial ratio in the tree, accounting for 20.83% of the variance, with size, short-term liquidity and market liquidity accounting for a further 2.54, 1.69 and 1.30% respectively. Table 7.3 also shows that on two splits, groups 2 and 5, competition between variables was present. However, this competition is not important as in each case the competing variable enters the model at a subsequent split.

The final group characteristics shown in table 7.4 are far more informative than those presented for the AID tree pattern (1). For four of the seven final groups the reason for stopping was because they did not contain enough cases to form two new child groups, each containing 35 companies.

TABLE 7.4

EARNINGS YIELD AID TREE PATTERN(2)

FINAL GROUP CHARACTERISTICS

Final Group No.	Earnings Yield Mean	No. of Companies	Unexplained Variation (TSS_i)	Standard Deviation	Reason for Split Stopping
11	13.24	125	391,813	55.99	no significant explanatory variable
12	13.99	43	99,422	48.08	too few cases
6	15.27	36	84,434	48.43	" " "
13	17.41	44	257,226	76.46	" " "
9	18.10	102	423,107	64.41	no significant explanatory variables
8	20.80	85	791,520	96.50	" " "
4	21.75	70	707,353	100.52	too few cases

This indicates that the possibilities for further variation explanation along these branches had been fully exhausted. However, the remaining three terminal groups all possessed enough variation and cases to warrant further splitting but no significant variable could be found in the data base. Again, based on the arguments presented above, in the author's opinion this remaining variance is unexplainable by this type of analysis. The table also shows that the means of the groups have become more evenly split and the standard deviations have been slightly reduced. The overall impression being a reduction in the unexplained variance and an improved AID model.

Finally, before we consider the theoretical implications of this model, these results need to be compared with those found in the previous chapter. The variance explained by the AID of 26.4% is very close to the variance explained in the multiple regression analysis of 26.3%. Thus we can conclude that although the algorithms of these two techniques are different, the underlying analytical power is very similar indicating that interactive analytical techniques may have little to offer in terms of explaining the underlying variance. However, with AID some information is lost through the use of categorical variables, as opposed to multiple regression's continuous variables and therefore suggests that AID has performed slightly better than the linear additive analysis. it remains to be seen whether this interactive model can provide a better insight into the factors at work within the market's judgement process.

6. A Descriptive and Theoretical Overview of the AID Model

From the above statistical review of the AID tree patterns it is reasonable to conclude that the AID technique has produced a statistically sound model of certain of the factors that influence earnings yields, although it should be remembered that the overall explanatory power is rather weak. Nevertheless, despite the statistical significance of the splits, it is necessary to establish that the relationships proposed are intuitively acceptable. In this section, therefore each split in the model is described in detail with particular emphasis on any interactive relationships present and this is followed by a discussion of the broad theoretical implications suggested by the model.

6.1 A General Description

. Conceptually, the AID tree pattern represents a series of alternative routes that eventually lead to a theoretical earnings yield, the route followed being dependent upon certain financial ratio values. Each of these routes in the model will now be examined in turn commencing with group 1 and working along each of the three major trunks to the terminal groups.

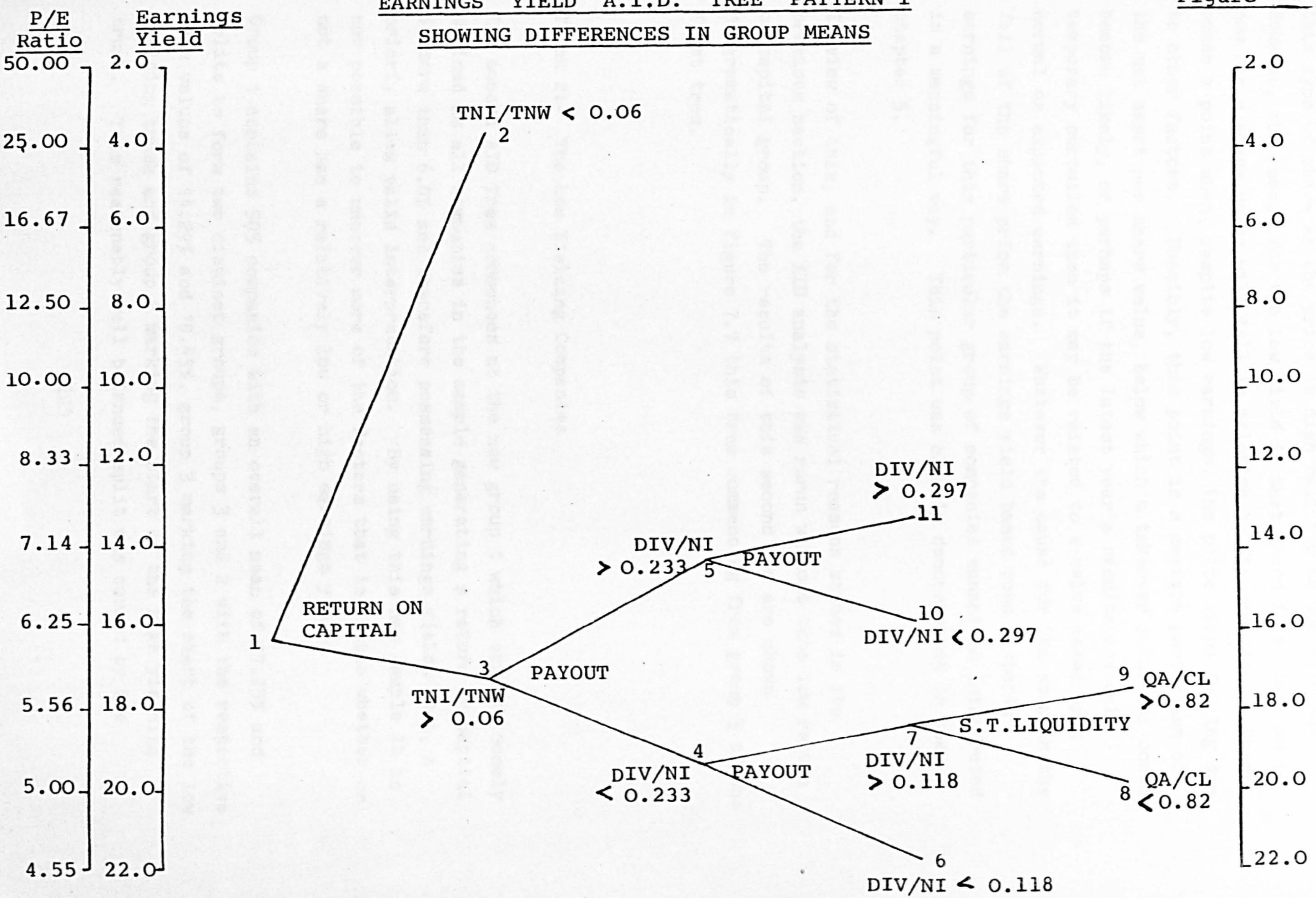
Trunk 1:- The Low Return on Capital Companies

The first split in the model, as discussed earlier, is the most distinctive of the whole tree with group 2 forming an isolated group of 44 companies all of which possess a return on capital of less than 6.0%. The extent of the isolation of this trunk is shown diagramatically in figure 7.6. The model implies that companies with a return on capital of less than 6.0% (ie. TNI/TNW) are likely to

Figure 7.6

EARNINGS YIELD A.I.D. TREE PATTERN 1

SHOWING DIFFERENCES IN GROUP MEANS



possess very low earnings yields. Under normal circumstances this would be interpreted as meaning that investors have a preference for this type of share as the price is high relative to the earnings. However, the reason for the low yield is that there is a limit as to how far a share price will fall in relation to its earnings. There comes a point when, despite low earnings, the price stops falling due to other factors. Possibly, this point is a certain percentage of the net asset per share value, below which a takeover situation could become likely, or perhaps if the latest year's results are only temporary curtailed then it may be related to a value based upon normal or expected earnings. Whatever the cause for the stop in the fall of the share price the earnings yield based upon historic earnings for this particular group of companies cannot be interpreted in a meaningful way. This point was clearly demonstrated in the chapter 5.

In view of this, and for the statistical reasons stated in the previous section, the AID analysis was rerun without this low return on capital group. The results of this second run are shown diagramatically in figure 7.7 this tree commencing from group 3 of the first tree.

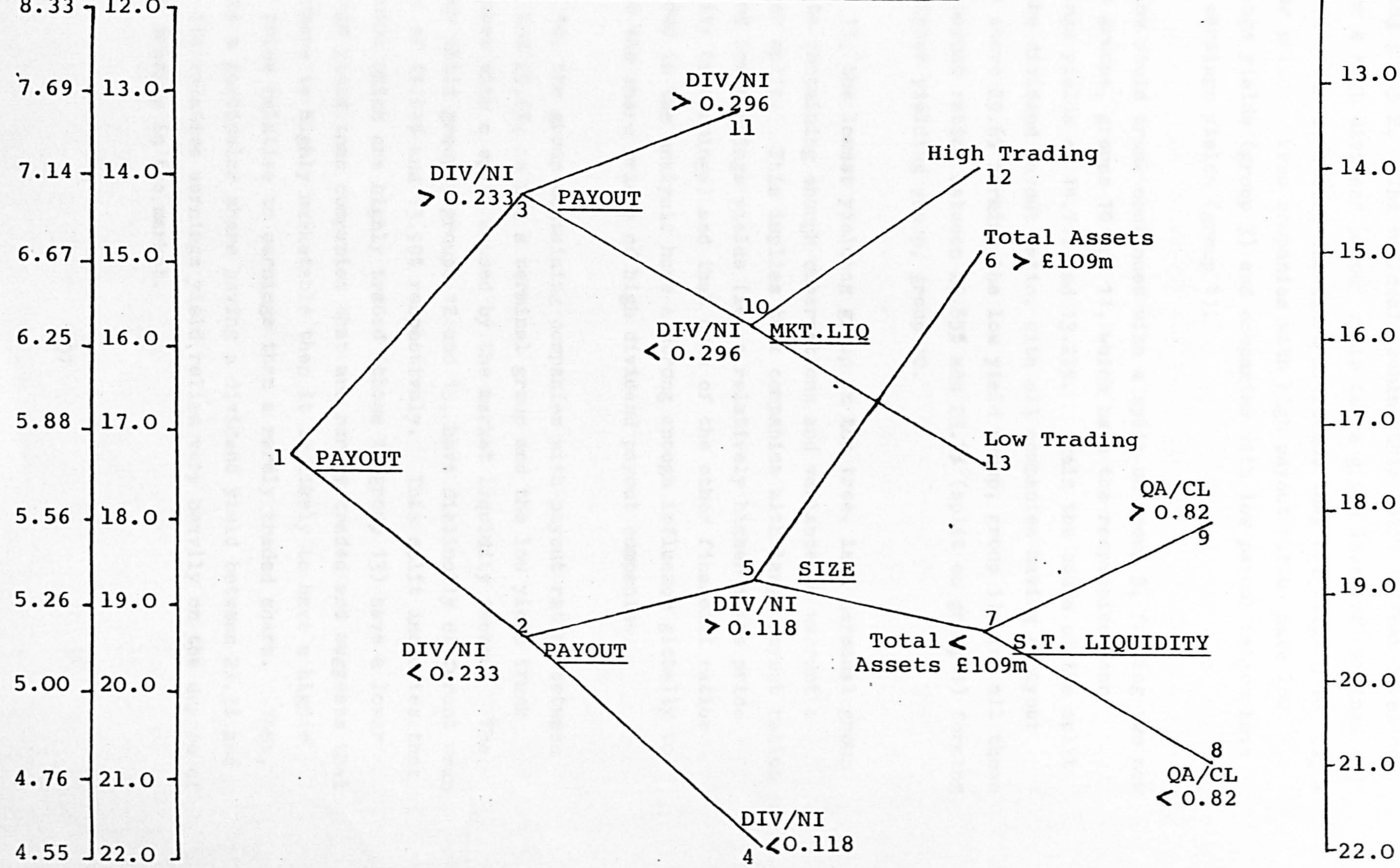
Trunk 2:- The Low Yielding Companies

The second AID Tree commences at the new group 1 which can be loosely defined as all companies in the sample generating a return on capital of more than 6.0% and therefore possessing earnings yields that, a priori, allow valid interpretation. By using this new sample it is now possible to uncover more of the factors that influence whether or not a share has a relatively low or high earnings yield.

Group 1 contains 505 companies with an overall mean of 17.25% and splits to form two distinct groups, groups 3 and 2 with the respective mean values of 14.29% and 19.43%, group 3 marking the start of the low yielding trunk and group 2 marking the start of the high yielding trunk. This reasonably well balanced split was caused by the

Figure 7.7

EARNINGS YIELD A.I.D. TREE PATTERN 2
SHOWING DIFFERENCES IN GROUP MEANS



dividend payout ratio, DIV/NI, with companies paying more than 23.3% of their earnings in dividends forming group 3 and those paying less forming group 2. The rationale behind this split is that investors prefer a high dividend payout ratio for a given level of earnings and that in order to secure the extra dividends they are willing to pay a higher price. Thus companies with high payout ratios have low earnings yields (group 3) and companies with low payout ratios have high earnings yields (group 4).

The low yield trunk continues with a split on group 3, forming two new child groups, groups 10 and 11, which have the respective mean earnings yields of 15.71% and 13.24%. Again the cause of the split was the dividend payout ratio, with all companies having a payout ratio above 29.6% forming the low yield group, group 11, and all those with payout ratios between 29.65% and 23.3% (split on group 1) forming the higher yielding group, group 10.

Group 11, the lowest yielding group in the tree, is a terminal group despite containing enough observations and variance to warrant a further split. This implies that companies with large payout ratios command low earnings yields (ie. a relatively higher share price relative to earnings) and that none of the other financial ratios included in the analysis have a strong enough influence globally to affect the share prices of high dividend payout companies.

Group 10, the group containing companies with payout ratios between 23.3% and 29.6%, is not a terminal group and the low yield trunk continues with a split caused by the market liquidity factor. The two new child groups, groups 12 and 13, have distinctly different mean values of 17.41% and 13.99% respectively. This split indicates that companies which are highly traded (those in group 13) have a lower earnings yield than companies that are rarely traded and suggests that if a share is highly marketable then it is likely to have a higher share price relative to earnings than a rarely traded share. Thus, despite a particular share having a dividend yield between 23.3% and 29.6% its relative earnings yield relies very heavily on the degree of active trading in the market.

Both groups 12 and 13 are terminal as they do not possess the minimum number of companies required to make further splits, and it is therefore reasonable to conclude the this particular branch is "fully explained".

Trunk 3:- The High Yielding Companies

The lower trunk in figure 7.6 can be broadly described as containing all companies with a high earnings yield. This trunk commences from group 1, the total sample, and after the initial dividend payout split discussed above continues to group 2. Group 2 contains 294 companies with a dividend payout ratio of less than 23.3% and marks the beginning of several trunk-twig splits. The first of these is on group 2 and forms two child groups, groups 4 and 5, with the respective mean earnings yields of 21.75% and 18.68%. Once again the factor causing the split was the dividend payout ratio with group 4 containing 70 companies all having a payout ratio below 11.8% and group 5 containg 224 companies all having payout ratios between 11.8% and 23.3% (ie. split on group 1). The rationale for this split is similar to that for all the other splits using the dividend payout ratio.

Group 4 is the first of the twigs in this trunk-twig structure and is of the disadvantageous type. The disadvantage being a payout ratio of less than 11.8%. It is also the highest yielding group in the tree which is obviously a result of having a very low dividend payout ratio. However, the standard deviation of the dependent variable in this group is considerably higher than for any of the other terminal groups, and therefore it is difficult to draw any firm conclusions. The implication is that there may be other factors which influence the share prices of low dividend payout companies but that these factors are diverse and consequently not strong enough in their own right to be detected by AID.

The high earnings yield trunk continues with a split on group 5, the group containing 224 companies all with payout ratios between 23.3% and 11.8%. The cause of the split forming the two new child groups,

groups 6 and 7, is the size measure total assets: group 6 containing 37 large companies (ie. total assets above £109m) and group 7 containing 187 small companies (ie. total assets less than £ 109m). From the diagramatic AID tree shown in figure 7.6 it can be seen that there is a marked difference between the group means. The respective mean values of groups 6 and 7 were 15.27% and 19.34%.

Companies in group 6, the twig group, possess the advantageous characteristic of being large. This suggests that the size of company has a considerable impact on relative earnings yields with large companies commanding higher share prices relative to earnings than small companies. However, it is important not to forget that this group has a relatively low payout ratio of between 11.8% and 23.3%, and therefore it is reasonable to summise that despite a low dividend yield a company's share price may still be relatively high if it is a large company.

The next and final split on this high yielding trunk is on group 7 which contains 187 small companies, all with a dividend payout ratio between 11.8% and 23.3%. The cause of the split is the acid test ratio, QA/CL. All companies possessing a ratio above .82 form group 9, the larger of the two child groups. This group represents the more liquid companies and thus has a lower mean earnings yield of 18.1% than group 8 with 20.8%. Group 8 is the twig of this particular split and all 85 companies in this group possess the disadvantage of having a low short term liquidity cover. This split indicates that investors who invest in companies with a payout ratio between 11.8 and 23.3% and with a total asset value of less than £109m prefer to invest in companies which have a good short term liquidty cover.

6.2 The Theoretical Implications

The above discussion has indicated that there are five different variables present in the Earnings Yield AID Tree, namely return on capital, dividend payout, market liquidity, size and the acid test. In the discussion that follows we shall review each of these variables in turn with the view to forming an overall picture of how these factors are combined in the investors decision making process. However, it is stressed that this model was only able to explain 26.4% of the total variance and consequently the following discussion should not be interpreted as definitive.

1) Return on Capital and the Value of the Firm

The split controlled by this variable clearly demonstrated the anomaly in the earnings yield distribution caused by a very low return on capital. The obvious conclusion to be drawn is that investors do not simply view earnings as the sole determinant for assessing share values without due regard for the underlying quality of the earnings. The AID model proposes that the point at which the underlying value of the assets becomes more dominant than the earnings themselves is when the return on capital is less than 6%. However, a rigid cutoff point is totally unrealistic and it is probabaly true to say that investors have a tendency to rely more on the asset values as earnings decline. Nevertheless, we cannot determine a more sophisticated rule from the AID analysis presented so far.

2) Dividend Payout and the Value of the Firm

If AID tree pattern (2) is examined it will be seen that dividend payout controls the first three splits and as such is the most dominant ratio in the model. This symmetry in the structure of the tree suggests that the impact of dividends is consistent throughout the data, in that the higher the dividend payout ratio the higher the relative earnings yield. In other words, if earnings are held constant, the higher the dividend paid the higher the relative share price.

This systematic preference for dividends is the same as that found in the linear additive analyses presented in the previous chapter. Our inferences as to the cause of this preference remain the same, that is it is believed that dividends may be preferred by investors because 1) they reduce uncertainty and 2) there could be some clientele effect possibly accentuated in our data by the dividend restraint policies in force at the time.

3) Market Liquidity, Size and the Value of the Firm

Market liquidity and size may be conveniently grouped together as they represent the same underlying factor namely market interest. In the previous chapter it was seen that both of these variables seemed to play an influential role in affecting share prices in much the same way as that proposed by the AID model. In general terms this indicates that the higher the relative market interest the higher the relative share price. Again, our explanation for this type of result is the same as proposed in the previous chapter, that is, not surprisingly, there would appear to be a systematic preference for stocks which are more marketable.

Perhaps one of the more interesting aspects of the relationship proposed by the AID tree is the marked impact that market interest has on share prices. If figure 7.7 is examined it will be seen that the split using the size measure of total assets forms two groups with very different relative share values. The effect of this phenomenon in share price terms is that a large company with a low payout may be valued more than 28% higher than a similar small company (see table 7.5 for calculation). Furthermore, if the split controlled by the market liquidity factor is considered there is again a 25% difference between the share price of a low and high traded company.

TABLE 7.5

The Impact of Size and Market Interest on Share Prices

Group	Controlling Variable	Earnings Yield %	Share Price in p*	% Change in Share Price
6	Size 109m	15.27	65.5	27.9
7	Size 109m	19.34	51.2	
12	High Market Liquidity	13.99	71.5	24.6
13	Low Market Liquidity	17.41	57.4	

* based on earnings of 10p per share eg. for group 6 the mean earnings yield is 15.27% (see figure 7.5), and therefore the expected share price is 65.5p (10p/.1527).

The AID tree pattern shown in figure 7.7 clearly demonstrates how important this factor of market interest is in determining share values in the U.K. Stock Market, at least for the period covered by this study. The impact is so great that high dividend payout companies with low market interest (group 13) are valued less than the low payout companies with high market interest (group 6). (Note the cross-over of the connecting lines between the groups). Again, unlike Williams(1938), we would argue that market interest is an important aspect of share valuation.

A final point of interest is that marketability only appears to be significant in the middle range of dividend payout ratios (ie. greater than .118 but less than 0.296). Despite both the extreme groups in the tree possessing enough companies to warrant further splits, no other variable proved to be statistically significant. This therefore provides us with a slight refinement to our original model in that it would appear that companies with either very high or low dividend payout ratios are either set at a very high premium or at a large discount and that marketability is not so important. A possible reason for this may be that at the extremes the dividend policy adopted determines the market interest factor, ie the clientele effect, although a thorough examination of these two groups of companies revealed no tendency toward high or low market trading. Thus our refined conclusion is limited to suggesting that market interest is of prime importance for an average payout type of company but that at the extremes it would appear to be far less significant. This behaviour is consistent with the hypothesis thatthe investor's decision making process could suffer from an anchoring and adjustment bias (see Wright, 1980) when it comes to assessing outliers. It is stressed however that this suggestion is only tentative as this type of behaviour needs to be tested further before any stronger conclusions can be made.

3) Short-Term Liquidity

This final variable, often referred to as the 'acid test' is the least significant in the whole tree and therefore any conclusions drawn must be considered tentative. As pointed out above the relationship proposed is that if a company has a good short term liquidity position then it is valued more than a company with a bad short term position. Unfortunately, the model only permits us to argue this point when we are considering companies with dividend payout ratios between .118 and .233 and with total assets of less than £109m. It is plausible that if the sample size had been larger, then this type of relationship may have been found elsewhere in the tree.

This preference for greater short-term liquidity is understandable and supports traditional ratio analysis theories which advocate that a company is healthier the greater its ability to cover its short-term liabilities with short-term assets. What is perhaps more surprising is that this variable entered the model prior to the more traditional risk measures such as financial gearing and beta. The inference is that investors see more use in short-term liquidity ratios than in other risk ratios. Obviously this argument is counter-intuitive for it is perhaps unrealistic to expect investors to react in such a way as to contradict traditional theories on and the practice of fundamental analysis. Possibly one explanation for the impact of this short-term liquidity ratio is that it may be a surrogate measure for "over-trading" which often is used to describe a company that is trying to expand sales rapidly without the necessary finance and consequently causes short-term liquidity problems. It may be reasonable to suggest that investors place a great amount of emphasis on over-trading, which is difficult to define in terms of one ratio, and therefore this measure of short-term liquidity could possibly be the best substitute in the data base. However, as we have no evidence to support this line of argument it is difficult to be more definite about the reason for the influence of this variable, in preference to other risk variables, in the tree and therefore this conclusion is very tentative.

Finally, in this section on the theoretical implications of earnings yield AID models it is important to relate these results to the five hypotheses proposed in chapter IV. The first hypothesis which postulates that earnings are the primarily determinant of share prices has been sub-sumed by analysing the earnings yield as the dependent variable. However, the AID model has added a further dimension to this hypothesis in that although earnings are important they should not be viewed in isolation of the size of the asset backing per share. When a company generates a low return on capital, earnings no longer remain the prime determinant of the share price. The second hypothesis relating to dividends has been ratified in that the AID model clearly provides some empirical evidence to support the theory that dividends have a positive influence on relative share values although we stress that these results are restricted to one time period when dividend restraint policies were in force.

The third hypothesis concerning the impact of financial risk as measured by the debt/equity ratio on share prices has not been rejected in that no measure of gearing entered into the model. However, the absence of a relationship from a model cannot be taken as evidence to substantiate a hypothesis and therefore we are unable to be conclusive about the validity of the hypothesis.

The remaining two hypotheses concerning default risk and systematic risk have not been ratified by our model as neither z-score nor beta was seen to be influential in determining share values. Again we stress our results do not in anyway provide evidence to reject these hypotheses.

7. THE VALUATION RATIO ANALYSIS

The valuation ratio measures the relationship between the book value of equity assets and the stock market valuation of those assets. The higher the ratio value the less the markets' regard for the assets and vice versa. In the previous chapter the results of the multiple regression and disciminant analyses showed that the following factors had an influence in determining relative valuation ratios:

(1) Return on Equity

(2) Dividend Payout

(3) Profit Growth

(4) Market Liquidity

(5) Gearing

In this section the results using the AID technique will be presented. Firstly the statistical aspects of the model will be discussed and this will be followed by an examination of the theoretical implications of each split.

7.1 The Statistical Interpretation

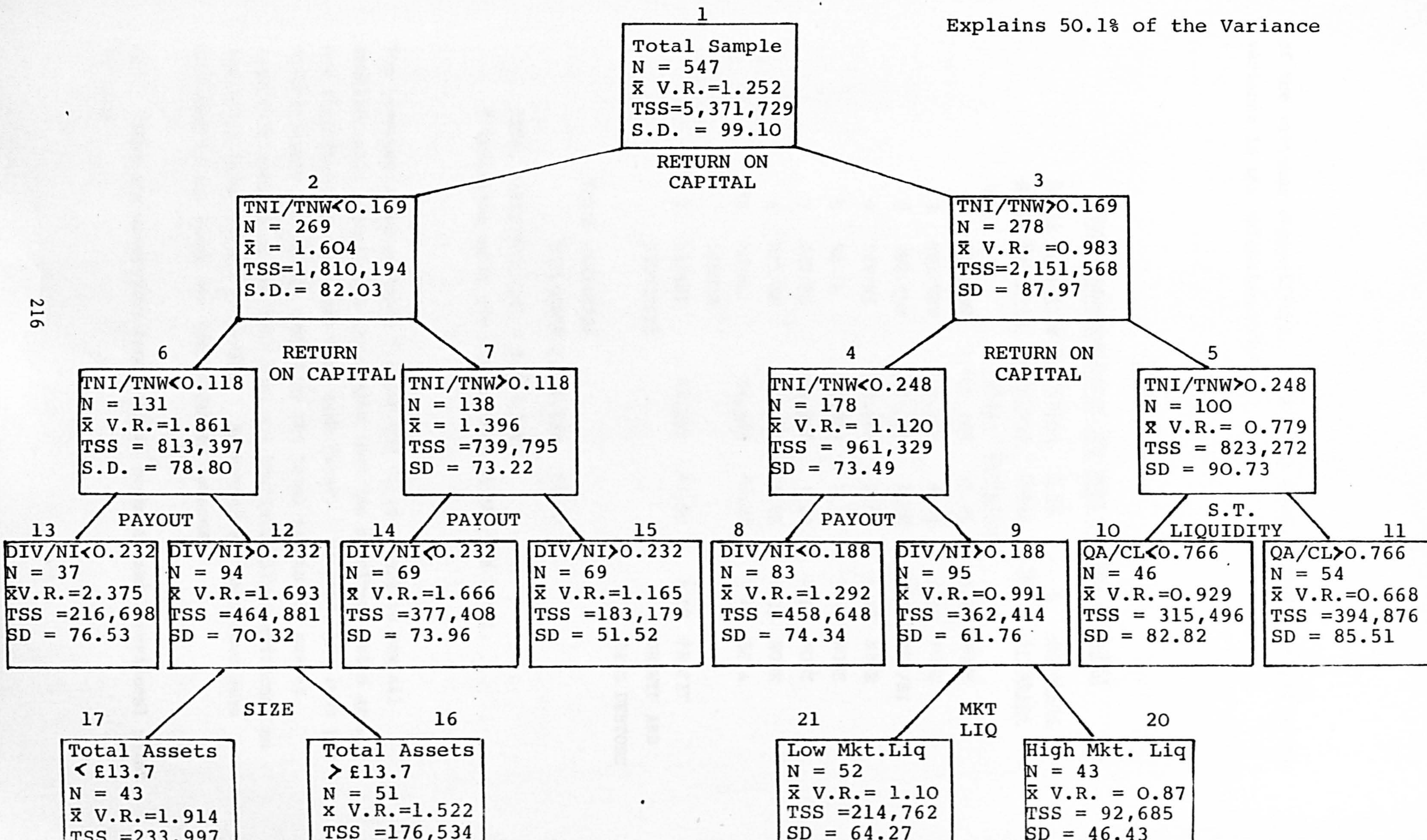
The Valuation Ratio AID Tree Pattern is presented in figure 7.8. It shows how the analysis progressed from Group 1, the total sample, to each of the ten terminal groups, together with all the relevant statistics for each group. This tree has a distinct trunk-branch structure depicted by the symmetry of the splits and signifies that the model is able to consistently analyse the data into well-balanced child groups indicating a reasonably homogeneous sample.

The statistics relating to each of the splits are shown in table 7.6. It can be seen that the variable explaining a majority of the variance (39.74%) and responsible for three of the nine splits is TNI/TNW, a return on capital measure. The next most important variable is the dividend payout ratio, DIV/NI, which again accounts for three of the nine splits but only 10.57% of the variance. The other variables in the model viz QA/CL, a short term liquidity measure, total assets, a measure of size, and market liquidity, explain 2.10%, 1.02% and 1.02%

THE VALUATION RATIO

A.I.D. TREE

Figure 7.8



of the variance respectively. The total model explained 50.4% of the variance in the valuation ratio.

TABLE 7.6

THE VALUATION RATIO AID TREE PATTERN FEATURES

Split group No.	Splitting Variable	Variation Explained (BSSi)	% of Total Variation	t Value	Competing Variables
1	TNI/TNW	1,409,968	26.25	13.93	NONE
3	TNI/TNW	366,966	6.83	7.53	NONE
2	TNI/TNW	257,000	4.78	6.65	DIV/NI
4	DIV/NI	140,266	2.61	5.48	NONE
5	QA/CL	112,899	2.10	3.95	NONE
7	DIV/NI	179,208	3.34	6.59	NONE
6	DIV/NI	131,817	2.45	4.99	NONE
15	TOTAL ASSETS	54,349	*1.02	3.49	BETA
9	MARKET LIQUIDITY	54,967	*1.02	4.08	PROFIT GROWTH AND DAYS DEBTORS
TOTAL VARIATION	EXPLAINED	2,707,440	50.40		

TOTAL VARIATION(TSS) = 5,371,729

* indicates split not significant at the 95% level.

The t-values shown on table 7.6 for the first 7 splits are all statistically significant indicating that the resultant child groups are significantly different from each other. However, the last two splits namely the splits caused by the total assets and market liquidity variables, are only just not statistically significant on the split reducibility criterion. Nevertheless, they have been included in the model for the following reasons:

(i) they are acceptable from both an economic and behavioural point of view

(ii) they split two potentially terminal groups which both contain high amounts of unexplained variance

(iii) the four child groups formed are all terminal due to possessing too few cases to allow further splitting and therefore these branches can be said to be fully explained given the sample size

Table 7.6 also shows that there were other variables competing for control for three of the nine splits. The first sign of competition was found in the split of group 2 where the dividend payout ratio was competing with the return on capital ratio for control of the split. However, this competition was not considered to be important as the losing variable, the dividend payout ratio, was able to contribute to the model by controlling both of the splits on group 2's child groups. The other competing variables, namely beta on group 15 and profit growth and days debtors on group 9, were all competing on the insignificant splits referred to above and therefore were not considered further.

In Table 7.7 the final group characteristics for each of the ten terminal groups are presented. It can be seen that for all the groups except for group 8, the reason for the splits stopping was that they did not contain sufficient cases to form two new child groups. As a result the AID technique has been able to classify all the observations in these branches into the smallest possible terminal groups and thus has "fully analysed" the sample. However, it must be stressed that each of these groups contains enough variance to warrant further splitting and it was only the sample size that restricted the tree length.

The remaining group, group 8, contains 83 companies and possesses enough variation to warrant a split but could not be split further as there were no statistically significant variables in the data base.

TABLE 7.7

VALUATION RATIO AID TREE PATTERN

FINAL GROUP CHARACTERISTICS

Final Group No.	Valuation Ratio Mean	No. of Companies	Unexplained Variation (TSS_i)	Standard Deviation	Reason for Split Stopping
10	0.668	54	315,496	82.82	too few cases
20	0.870	43	92,685	46.43	too few cases
11	0.766	46	394,876	85.51	too few cases
21	1.100	52	214,762	64.27	too few cases
15	1.165	69	183,179	51.52	too few cases
8	1.292	83	458,648	74.34	no significant explanatory variable
14	1.666	69	377,408	73.96	too few cases
16	1.522	51	176,534	58.83	too few cases
17	1.914	43	233,997	73.77	too few cases
12	2.375	37	216,698	76.53	too few cases

One further observation from table 7.7 is that unlike the earnings yield AID tree the differences between the group means and standard deviations are not large. The means of each of the groups have been drawn diagramatically in figure 7.9 where it can be seen that the terminal groups are evenly spread along the valuation ratio scale.

From the above it is reasonable to conclude that the AID tree represents a statistically valid set of relationships between accounting information and relative share values as measured by the valuation ratio. Despite possessing the two slightly insignificant splits the overall model explains 50.4% of the variance. Nevertheless, it is not enough for the model to be statistically significant, it must also be intuitively meaningful and acceptable from a theoretical point of view.

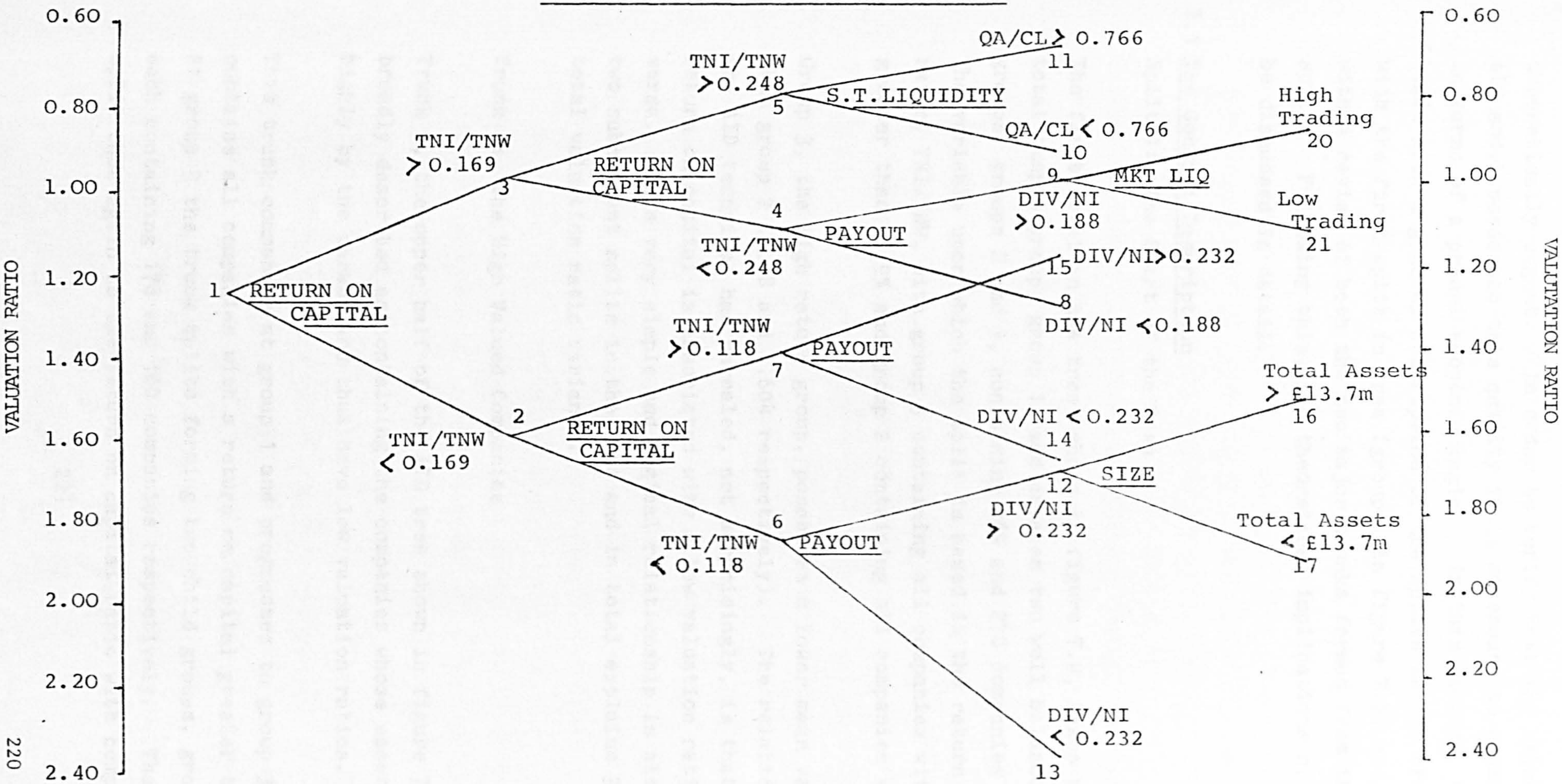
8. A Descriptive and Theoretical Overview of the Valuation Ratio Model

A prerequisite of any model derived from statistical analysis is that all of the cause and effect relationships uncovered must be

Figure 7.9

VALUATION RATIO A.I.D. TREE PATTERN

SHOWING DIFFERENCES IN GROUP MEANS



theoretically cogent. In order to verify that the valuation ratio AID model possesses this quality it is necessary to examine each split in terms of a priori economic logic. In this section, therefore, we begin with a general description of the splits in the tree commencing with the first split in tree (group 1 in figure 7.9) and then continue with a review of both the two major trunks formed from this first split. Following this, the theoretical implications of the tree will be discussed in detail.

8.1 The General Description

Split 1: The Start of the Tree

The first split in the tree, shown in figure 7.9, takes place on the total sample group, group 1, and creates two well balanced child groups, groups 2 and 3, containing 269 and 278 companies respectively. The variable upon which the split is based is the return on capital ratio, TNI/TNW, with group 3 containing all companies with a return greater than 16.9% and group 2 containing all companies with less.

Group 3, the high return group, possesses a lower mean valuation ratio than group 2 (0.98 and 1.604 respectively). The relationship that the AID technique has revealed, not surprisingly, is that a higher return on capital is associated with a low valuation ratio and vice versa. This very simple and logical relationship is also found at two subsequent splits in the tree and in total explains 38% of the total valuation ratio variance.

Trunk 1: The High Valued Companies

Trunk 1, the upper half of the AID tree shown in figure 7.9 can be broadly described as containing the companies whose assets are valued highly by the market and thus have low valuation ratios.

This trunk commences at group 1 and progresses to group 3 which contains all companies with a return on capital greater than 16.9%. At group 3 the trunk splits forming two child groups, groups 4 and 5, each containing 178 and 100 companies respectively. The cause of the split once again is the return on capital ratio with companies generating returns greater than 24.8% forming group 5 and those generating less forming group 4. As expected group 5, the high return group, possesses the lower mean valuation ratio.

The upper branch of this trunk continues with group 5, the high return group being split by the short-term liquidity measure, QA/CL, creating two terminal child groups namely groups 10 and 11. Group 11, the group with greater short-term liquidity cover (above 0.766) has the lowest mean valuation ratio (0.67) in the whole tree and can be described as containing the highest valued companies. The conclusion to be drawn from this set of relationships is that given a choice between two companies, both producing high returns (greater than 24.8%) investors prefer companies with greater short-term liquidity cover than companies with less.

This result, although theoretically acceptable, is unexpected as it does not follow the pattern found in the other branches of the tree where the dividend payout ratio is the controlling variable. However, it can be seen from table 7.6 that there were no other competing variables for this split and therefore this appears to suggest that short term liquidity cover was exerting a stronger influence in the share price fixing mechanism in the sample of companies and for the time-frame considered than the dividend payout ratio when the companies under consideration were generating very high returns. This interaction between return on capital, liquidity, dividend payout and share values is discussed at length later.

Having considered the upper branch of trunk 1 it is necessary to analyse the lower branch which starts at group 4, a group containing 178 companies all generating a return on capital between 16.9% and 24.8%. This group is split into two well balanced child groups, groups 8 and 9, based upon the dividend payout ratio. Group 8 containing 83 companies, all with a dividend payout ratio of less than 18.8% and group 9 containing 95 companies all with payout ratios above 18.8%. This split is very similar to those found in the earnings yield AID tree where companies possessing high payout ratios command higher relative share prices. Group 9, the high payout group, possessed a lower mean valuation ratio than group 8. The underlying logic of the tree so far would appear to be that investors use earnings to determine a relative share price range and then adjust accordingly depending on the level of dividend payout.

The tree continues with group 9, the high payout group, being split by the market liquidity measure. The two new groups formed are groups 20 and 21, with group 20, the highly traded group possessing a mean valuation ratio of .87 and group 21, the rarely traded group, a mean of 1.10. Again a similar relationship was seen in the earnings yield AID tree where the more a share was traded the higher its relative share value. It is stressed, however, that this split is not statistically significant and therefore cannot be interpreted in quite the same light as the previous splits. Nevertheless, it is interesting to note that group 20 has a lower mean value than group 10, the group with a return on capital greater than 24.8% and short term liquidity cover of less than 0.766. Again this suggests that the underlying relationships which determine relative share prices are dependent upon a combination of many different factors which simplistic share price models are unlikely to be able to account for.

Trunk 2: The Low Valued Companies

Trunk 2, the lower of the two main trunks shown in the tree in figure 7.9 contains the companies with relatively lowly valued assets. As discussed earlier this trunk commences from group 1 and progresses to group 2, a group that contains 269 companies all with a return on capital of less than 16.9%.

The trunk continues with group 2 being split into two well balanced child groups, groups 6 and 7, each containing 131 and 138 companies respectively. The variable controlling the split is again the ratio TNI/TNW, with group 6 forming the higher return on capital group (ie. between 11.8% and 16.9%) and group 7 forming the lower return group (ie. $<$11.8%). The underlying logic of this split is the same as that for groups 1 and 3.

The next split to be considered is on group 7, the group generating a return between 11.8% and 16.9%. At this split two new terminal child groups are formed based upon the dividend payout ratio. These new groups are group 15, a group containing all companies with a payout ratio above 23.2%, and group 14, a group containing all those with less. Again the underlying logic of this split is the same as the previous split on group 4, the higher the dividend payout the higher the relative share price. It is interesting to note that the valuation ratio mean of group 15 (1.165) is less than the mean of group 8 (1.292) causing the two branches to cross (see figure 7.9). This suggests that although the earning power of the assets is the primary factor that determines share prices, a high payout ratio, and thus a high dividend, can sway the balance to such an extent that a company generating a low return on average could have a relatively higher share price than a high return company with a low dividend payout.

The final branch on trunk 2 to be reviewed is the one commencing from group 6. Group 6, the group containing companies with a very low return on capital, is split into two child groups, groups 12 and 13, based again upon the dividend payout ratio. Of those companies in group 6, group 12 contains those companies with a payout ratio greater than 23.2% and group 13 contains those below 23.2%. The rationale behind this split is the same as for all the other splits using the dividend payout ratio ie. the higher the payout ratio the lower the valuation ratio and thus the higher the relative share price.

This trunk is concluded with a split on group 12 caused by a size measure, total assets. Companies with total assets worth more than £13.7m form group 16 and those worth less make up group 17. This split would suggest that large companies are relatively more highly valued than small companies which again is a relationship seen in the earnings yield AID analysis.

8.2 The Theoretical Implications of the Valuation Model

The above description of the valuation ratio AID model reveals an AID tree pattern somewhat more complex than that of the earnings yield model, possessing nine as opposed to six major splits. Furthermore, despite both models containing the same number of variables, namely return on capital, dividend payout, short-term liquidity, market liquidity and size, the valuation ratio model was able to explain nearly twice as much variance as the earnings yield model. Although this additional explanatory power was to be expected given the results of the previous chapter, it would appear at first sight that this model does potentially provide a more complete picture of the investor's decision making process. In the discussion that follows each of the main characteristics in the tree will be examined in turn, the most significant first.

Return on Capital and the Value of the Firm

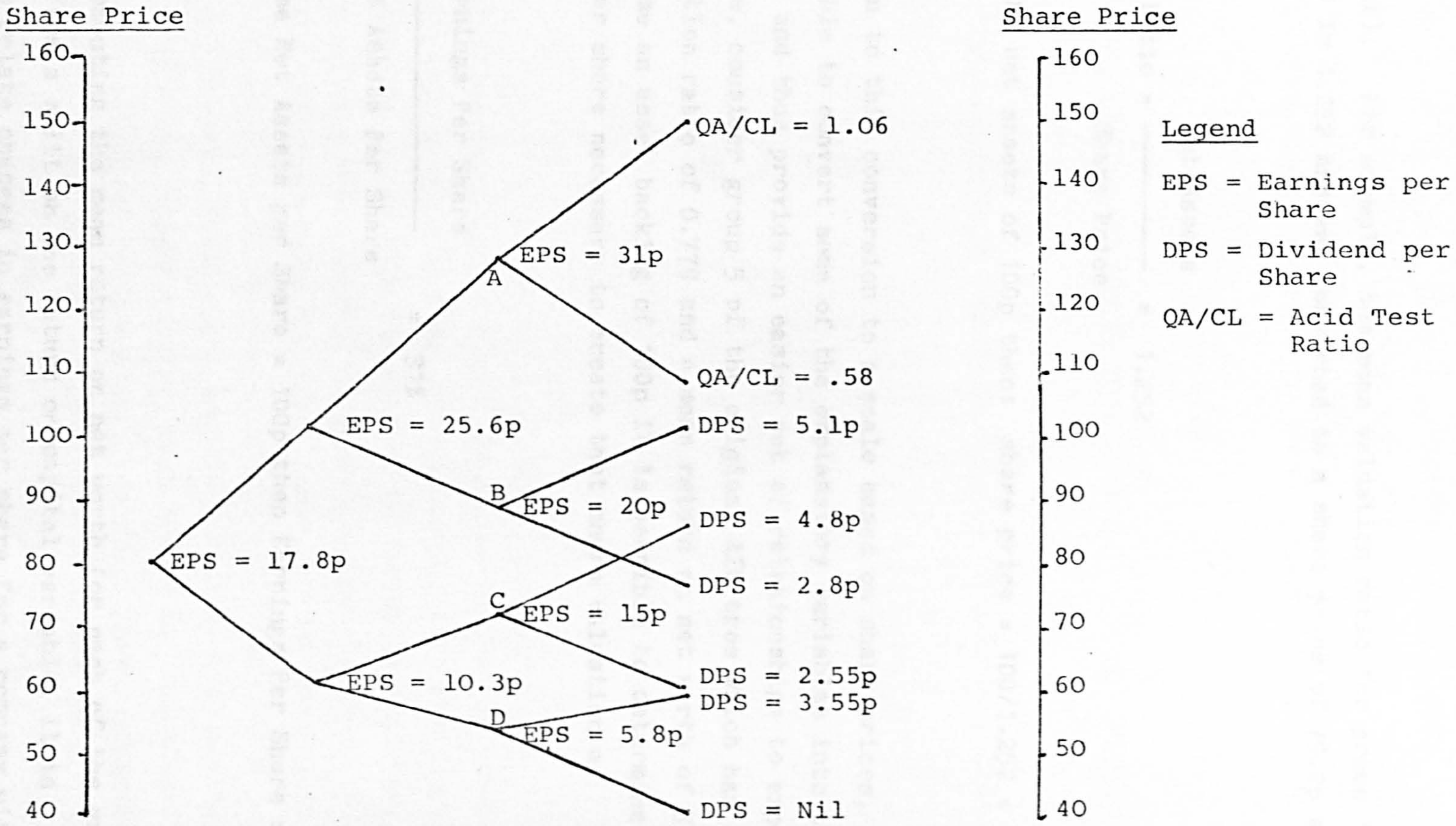
The general conclusion to be drawn from the valuation ratio AID model is that the value placed on a company's assets by the market is primarily determined by the earning power of those assets. This result is exactly the same as that found in the multiple regression analysis with the underlying rationale being that investors are primarily interested in earnings per se. However, the multiple regression model revealed a slightly more complex relationship between return on capital and the valuation ratio. It was shown in figure 6.2 that the relationship was nonlinear and that when the return on capital was low, the rate at which the earnings were discounted into the share price started to decrease. It remains to be seen whether this relationship is present within the valuation ratio AID model and whether we can be more precise as to the exact form the relationship takes.

In order to examine this issue more closely the Valuation Ratio AID tree as presented in figure 7.9 has been redrawn in terms of share prices based on a net asset backing of 100p per share (see figure 7.10). This has been achieved by converting each of the mean valuation ratios for each group into an equivalent share price. (One of the benefits of using AID is that the algorithm is based on finding groups that have statistically different means and consequently this allows us to examine the relative positions of each group using the

Figure 7.10

AID VALUATION RATIO TREE EXPRESSED IN PENCE PER SHARE

Net Assets per Share of 100p



Note: Values stated are the average for each of the A.I.D. groupings group means). For example, the mean valuation ratio for group 1 in figure 7.9 is 1.252 and was converted to a share price of 79.9p as folows:-

$$\text{Valuation Ratio} = \frac{\text{Net Assets}}{\text{Share Price}} = 1.252$$

assuming the net assets of 100p then: share price = 100/1.252 = 79.9p

In addition to this conversion to a scale based on share prices, it is also possible to convert some of the explanatory variables into the same scale and thus provide an easier set of relationships to explain. For example, consider group 5 of the original AID tree which has a mean valuation ratio of 0.779 and a mean return on net worth of 31.0%. If we assume an asset backing of 100p it is possible to determine the earnings per share necessary to create that share valuation as follows:-

$$\frac{\text{TNI}}{\text{TNW}} = \frac{\text{Earnings Per Share}}{\text{Net Assets Per Share}} = 31\%$$

if we assume Net Assets per Share = 100p then Earnings Per Share = 31.0p

Thus, by computing the mean return on net worth for each of the groups resulting from a split on the return on capital variable, it is possible to relate changes in earnings per share for a company with a net asset backing of 100p per share to changes in share prices. By examining figure 7.10 it can be seen that if the company had earnings per share of only 5.8p then its share price is likely to be 54p, whereas if the earnings per share are 31p then the equivalent share price is 128p.

In order to examine the relationship between earnings and share prices in more detail we shall concentrate on the four focal points in the revised tree marked A to D. These four points mark the end of the influence of the return on capital variable and therefore indicate a major shift in emphasis by investors from earnings to other variables.

TABLE 7.8

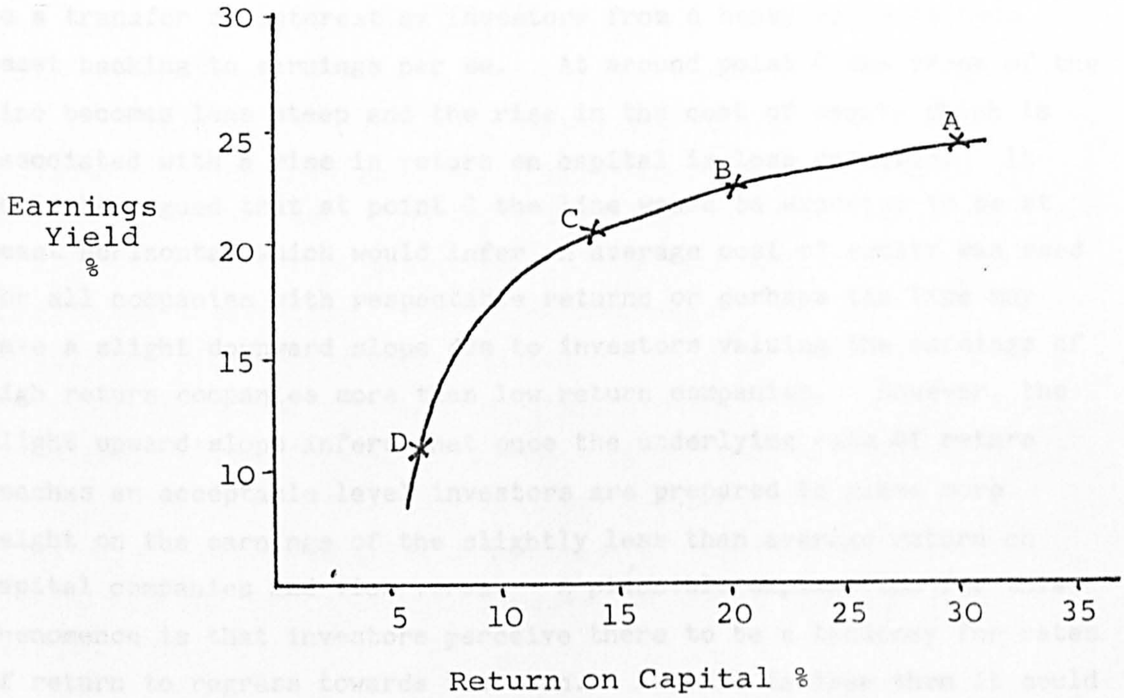
The Relationship between the Earnings Yield and Return on Capital

Point	EPS	Share Price	Earnings Yield %	Return on Capital %
A	31	128	24.2	31
B	20	89	22.5	20
C	15	72	20.8	15
D	5.8	54	10.7	5.8

By using the figures at points A to D in figure 7.10 it is possible to compare the rate at which earnings are discounted into share prices (ie. the earnings yield) with the rate of return on capital (see table 7.8). Figure 7.11 shows a graph of these four points where it can be seen that the relationship is far from linear. Between points A, B and C the discount rate is reasonably constant although there is a slight upward slope. This slight incline indicates that although the share price of a company generating a high return on capital will be greater than a less profitable company, the relationship between earnings per share and share price does not remain constant. In other words the marginal benefit of additional earnings per share reduces as the return on capital generating those returns increases. A plausible explanation of this phenomenon is that investors may perceive there to be greater downside risk attached to earnings that are generated via a relatively high return on capital and vice versa.

FIGURE 7.11

THE RELATIONSHIP BETWEEN THE COST OF EQUITY AND RETURN ON CAPITAL



At the other end of the graph, at point D, the rate at which earnings are discounted is very low in comparison. It would appear at first that companies generating a low return on capital are highly valued. However, it will be recalled from our discussions on the earnings yield model that low return on capital companies have meaningless earnings yields and therefore it is reasonable to suggest that at this point the low discount rate is a function of the high asset backing preventing the share price from collapsing completely. In the example given in figure 7.10 the share price of a company with earnings of 5.8p on 100p worth of assets is 54p. That is the assets stand at the large discount of 46%. It is worth noting that very often press comment refers to asset backing when discussing low return on capital/failing companies.

In summary the above analysis has revealed that there appears to be a distinct relationship between that rate at which investor's discount earnings and the underlying rate of return on capital that generated those earnings. This relationship takes the form whereby the cost of equity (eg. the discount rate on earnings) increases dramatically as the rate of return on capital increases from a very low level up until approximately 10 to 12%. The cause of this dramatic rise may be due to a transfer of interest by investors from a heavy reliance upon asset backing to earnings per se. At around point C the slope of the line becomes less steep and the rise in the cost of equity which is associated with a rise in return on capital is less dramatic. It could be argued that at point C the line would be expected to be at least horizontal which would infer an average cost of equity was used for all companies with respectable returns or perhaps the line may have a slight downward slope due to investors valuing the earnings of high return companies more than low return companies. However, the slight upward slope infers that once the underlying rate of return reaches an acceptable level investors are prepared to place more weight on the earnings of the slightly less than average return on capital companies and vice versa. A plausible explanation for this phenomenon is that investors perceive there to be a tendency for rates of return to regress towards the mean. If this is true then it could be argued that the high return on capital companies are considered more of a risk due to higher downside risk and that the low return on capital companies are considered to be less of a risk due to the possibilities of improving the rate of return on capital.

To some extent this theory is supported by Whittington(1971) who investigated the behaviour of profitability of U.K. companies from 1948 to 1960. Although Whittington does argue that past performance is the best preditor of future performance, his results revealed that when profitability was different from the average, it tended to return to the average over time ie. "below-average profitability tends to be cured, and above-average profitability tends to disappear." The author makes the following conclusion:

> "The tendency is always for above-average past performance to be associated with future profitability which is above average, but not so far above average as was past profitability."

Thus, although Whittington's conclusions are based on a time period up to seventeen years prior to this study, it would appear that there may be some empirical evidence to support this attitude of investors towards differing rates of return on capital. However, it is stressed that this explanation is only tentative and requires further empirical work.

If the established theories are considered (see Van Horne, 1977 or Weston and Brigham, 1979 for a discussion of these) then it will be found that changes in the cost of equity are theorised to be associated with changes in risk, normally measured by financial gearing. However, to the author's knowledge, there is no extant work which actually refers to the level of return on capital influencing relative share valuations. It is of course possible that the analysis has picked up a surrogate measure of risk which is hidden in the return on capital variable and therefore our interpretation is misleading. Nevertheless, this does seem unlikely and therefore our overriding conclusion from this section is that more empirical analysis is required into the inter-temporal stability of this relationship and the underlying factors that cause changes in profitability.

The Dividend Payout Ratio

The dividend payout ratio is the second most important variable in the Valuation Ratio AID Tree and proposes the relationship certeris paribus that the higher the dividend payout, the higher the relative share price. This relationship between dividends and share prices has been found in our previous analyses and is explained in terms of the reduction in uncertainty and the clientele effect. Once again the empirical evidence would not lend any support for the traditional Modigliani and Miller(1961) theory on the irrelevance of dividends.

As this type of influence by dividends on share prices was found in the linear additive analyses, we have to ask whether the AID analysis has been able to contribute anything new to our understanding of the value of dividends to the investor. The answer to this question lies in a more detailed analysis of the valuation ratio AID tree pattern, but even at first sight it would appear that the dividend payout ratio is secondary to earnings in determining share prices and also that it may not have a consistent influence throughout the AID tree (note the split on group 5).

If figure 7.9 is again referred to, it will be seen that the dividend payout ratio controls three of the four secondary splits. It is interesting to observe that when the return on capital is greater than 24.8% the dividend payout ratio becomes unimportant which at first glance seems illogical. Nevertheless this "imperfect interaction" between return on capital, dividend payout, short-term liquidity and share values can easily be explained.

Dividends have so far been viewed as a means of reducing uncertainty and for providing the investor with the opportunity for controlling the reinvestment of his income. However, it is reasonable to expect that under certain circumstances this normative theory does not hold true and that other factors come into play. In this model it would appear that when a company's return on capital is very high, then and only then, do investors no longer have a strong desire for dividends. The most obvious reason for this is that if a high return can be maintained on all funds invested then it is in the investor's interest to allow the firm to reinvest his dividends and to achieve a high return in the future. A counter argument to this theory is that this action by investors may not reduce the uncertainty involved in equity investment as there is always a chance of the high return not being maintained. However, it should be remembered that the cost of equity of this high return on capital group of companies is more than for the other groups (see our discussion above) and therefore as the earnings of these companies are valued at a lower rate than companies with lower rates of return on capital, there is to some extent already a built in hedge against uncertainty in the form of the possibility of a drop in earnings. Furthermore, we are not arguing that these companies do not pay dividends, we are simply suggesting that there is not a strong systematic preference by investors for dividends when the return on capital is exceptionally high. (It is interesting to note that in the valuation ratio discriminant analysis model the dividend payout ratio was not found to be significant in discriminating between high and low value companies. The reason for this is made very clear by the AID tree.)

If we now look elsewhere for some corroboration of these results it will be found that there are very few studies that address this issue specifically. Renwick(1969) proposes a normative theory that dividends are related to investment opportunities. He argues that there are two extreme stable states, one where the future growth in earnings is low and the dividend payout is high and the second where the future growth rate in earnings is high and the dividend payout is low. The theory underlying each of these states is that the dividend policy adopted reflects the opportunity cost of the retained income. If we asssume that high rates of return are good predictors of future rates of return, and there is some evidence by Whittington(1971) to partly support this view, then we can easily adopt Renwick's model expressed in terms of expected utility of retained funds and dividend policy. With this slight change to Renwick's model our results can be seen to fit within an existing normative theoretical framework of investor preferences. A more detailed discussion on the relevance of dividends to investors is given by Walter(1967) and Lintner(1962) but they contribute little additional understaning.

In addition to the above imperfect interaction the AID tree also reveals a further interesting set of relationships between the dividend payout ratio, return on capital and the valuation ratio. A brief examination of the AID tree pattern leads one to the simple conclusion that the higher the payout ratio for a given level of return on capital, excluding the high return companies, the higher the relative share price. However, with AID we can ask whether the influence of the dividend payout ratio is constant or whether at different levels of return on capital its influence varies.

In order to make our examination of this point easier to understand we refer back to the valuation ratio AID tree which is expressed in pence per share (figure 7.10). In this tree the effect of the dividend controlled splits on groups B, C and D has been drawn, together with the mean dividend per share for each of the resultant child groups. These dividends per share have been computed as follows. When group B was split it was found that the two child groups had mean dividend payout ratios of .255 and .141. These payout ratios were then converted into dividends per share by using the mean earnings per share of the parent group thus:

Example: Dividend payout ratio = $\frac{\text{dividends}}{\text{earnings}}$ = .255

therefore if earnings = 20p then Dividend per share in pence = .255 x 20p = 5.1p.

This at first may seem a crude type of adjustment but it should be remembered that the AID technique has established that the group means are statistically different and therefore this type of analysis can be defended although working with group centroids alone ignores the distribution of observations in each group.

Having established a set of relationships between earnings, share prices and dividends per share it is possible to examine how much influence a change in dividends has upon the share price given a certain level of earnings. In table 7.9 for each of the points A to D in figure 7.10 the impact of a change in share price in pence, for the given change in dividends per share is shown.

TABLE 7.9

Computation of the Incremental Dividend Yield

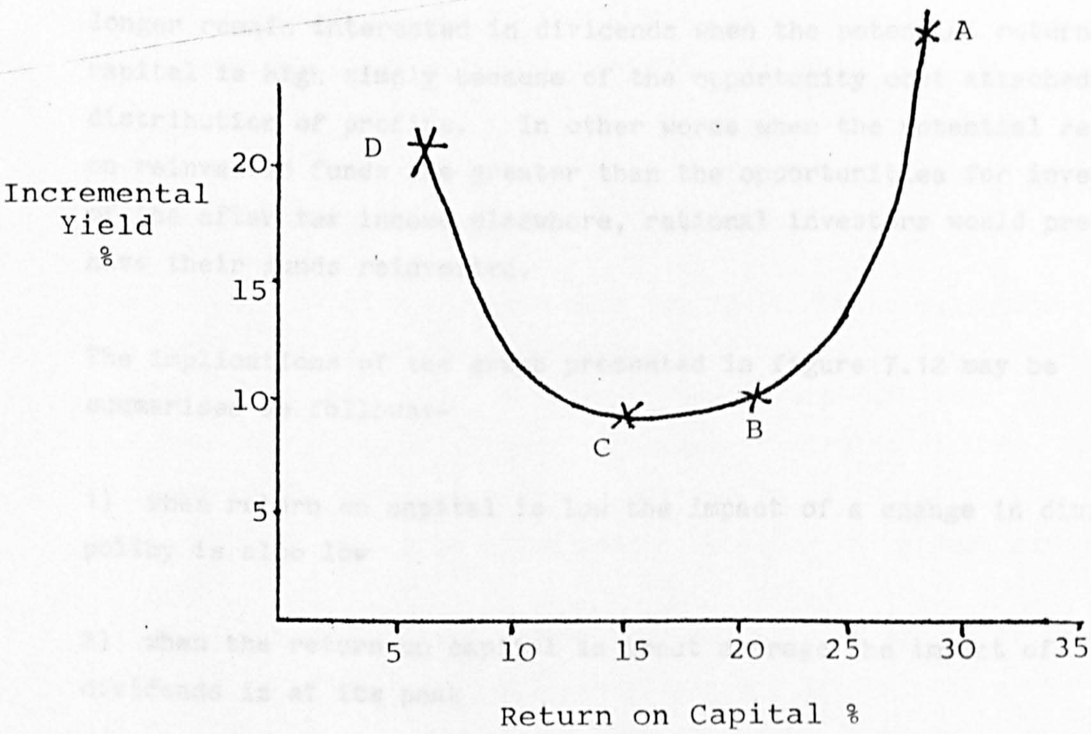
Point	Secondary Factor	Difference in Share Price	Difference in Dividends	Incremental Yield	Return on Capital %
A	Acid Test	42	-	-	31
B	Dividend per Share	24	2.30	9.58	20
C	Dividend per Share	26	2.25	8.65	15
D	Dividend per Share	17	3.55	20.88	5.8

For example if we consider the two terminal groups stemming from point c, it can be seen that the share price of the lower group is 60p and the dividend is 2.55p, whereas the upper group has a share price of 86p and a dividend of 4.8p. Thus it may be argued that given two companies with the same earnings per share (15p) then a difference of 2.25p in dividend is associated with a 26p difference in share price. In other words a 1p difference in dividend may cause a 11.55p difference in share price, or in percentage terms investors discount the additional dividends at a rate of 8.65% (ie. 1p/11.55p). This discount is shown in table 7.9 as the "incremental yield", and represents the value placed on dividends at each of the four focal points. The lower this yield, ceteris paribus, the more influential does a change in dividend have on share prices. Obviously the reverse in also true, the higher the incremental yield, the less influence a change in dividends appears to have on the share price. In the above table, point A is shown to have an incremental yield of infinity which is due to the dividend payout ratio not influencing share values when the return on capital is on average 31%. This value of infinity is probably unrealistic but our discussion above on this split suggests that dividends are of little importance to investors at this point and therefore we must conclude that a change in dividend policy when the return on capital is high may at best have only a marginal impact on share prices.

The four points A to D have been drawn on a graph (figure 7.12) which compares how the incremental dividend yield changes with different levels of return on capital. The "inverted U" shape reveals that the impact of dividends on share prices changes dramatically with the level of the return on capital. At point D where the return on capital is very low the incremental yield is high, which infers that a relatively large change in the dividend payout ratio has only a small impact on share prices. A plausible explanation for this is that investors perceive these companies to be unhealthy due to the very low return on capital and therefore any increase in dividends may be viewed as a drain on cash resources which could possibly have a further weakening affect. Given this type of situation, investors would probably prefer to see an increase in earnings per share rather than in dividends. It is stressed, however, that a change in dividends does have some influence and therefore investors do not disregard dividends completely.

FIGURE 7.12

THE RELATIONSHIP BETWEEN THE INFLUENCE OF DIVIDENDS ON SHARE PRICES AND RETURN ON CAPITAL



At the second two points on the graph, B and C, the incremental yield has fallen to around 9% which suggests that the influence of dividends is quite high at this cost of capital range. A 1p change in dividend is likely to produce an 11p change in share price. This possibly infers that investors place dividends at a premium when examining companies that have "normal earning " capacity.

The final point on the graph to be examined is point A. As we have already discussed above this point is not controlled by the dividend payout ratio but by the short-term liquidity measure and therefore the implication is that investors no longer have a strong preference for dividends when the return on capital is high. Our interpretation of this relationship is that the incremental dividend yield for this group is infinity. Obviously in reality this is probably not the case but given the underlying logic of the tree it would be reasonable to assume that the incremental yield on high return on capital companies is very high, although it is not quantifiable from the tree, and therefore the inverted U shape of the graph is realistic. The most logical explanation for this phenomenon is that investors no longer remain interested in dividends when the potential return on capital is high simply because of the opportunity cost attached to the distribution of profits. In other words when the potential returns on reinvested funds are greater than the opportunities for investment of the after tax income elsewhere, rational investors would prefer to have their funds reinvested.

The implications of the graph presented in figure 7.12 may be summarised as follows:-

1) when return on capital is low the impact of a change in dividend policy is also low

2) when the return on capital is about average the impact of dividends is at its peak

3) when the return on capital is high investors appear to be indifferent towards dividends

The underlying theory for this set of relationships may be explained in terms of the inherent risk involved with low return on capital companies, the desire to reduce uncertainty when investing in the average company and finally the opportunity cost of reinvestment of dividends. Unfortunately there are no empirical studies to the author's knowledge that have uncovered a similar detailed relationship and consequently, we can only appeal to the general theories of dividend utility propounded by Lintner(1962), Walter(1967) and

Renwick(1969) referred to above to explain or justify our findings.

In conclusion, then, our results would appear to suggest that dividends may be important in determining share values and that the extent of their influence is dependent upon the underlying rate of return on capital. However, it should be noted that this study covers a period when a government policy of dividend restraint was in force and therefore our results may reflect a temporary accentuated preference for dividends. Obviously, further work is required to establish the inter-temporal stability of the relationship and until this additional evidence is forthcoming these results must be considered tentative although very interesting.

Short-Term Liquidity

Short-term liquidity controls only one split in the valuation ratio AID tree, that is on the group containing the very high return on capital companies. It can be seen from figure 7.10 that the greater the short-term liquidity cover the higher the relative share price. In other words investors prefer companies to be liquid in the short-term ie. have more quick assets relative to current assets.

Whilst we can explain the underlying rationale of the split, it is difficult to understand why it should appear in the tree at this point. If the acid test ratio were measuring financial risk then we would expect the more traditional, and probably more commonly used, debt/equity ratio to be more influential, consequently a more suitable explanation needs to be found. Earlier in this chapter a similar type of relationship was uncovered in the earnings yield AID tree and it was argued then that this ratio is possibly a surrogate measure for overtrading. This line of reasoning would still apply here. However, as there is no other evidence to support this hypothesis we have to be very careful in drawing any strong conclusions from these results.

Market Interest

The remaining two splits to be considered in the valuation ratio AID tree are controlled by the market liquidity and size variables. The influence of these variables has already been discussed at length in the earnings yield analyses, where it was argued that they are both measuring the same underlying factor namely market interest. Quite simply the relationship proposed by the model is that the greater the market interest the higher the relative share value. Although these splits are only just statistically insignificant, they are intuitively valid and seem to provide some additional insight into the factors that influence share values.

Finally, in this section on the theoretical implications of the valuation ratio AID tree pattern it is essential to relate these results to our five hypotheses proposed in chapter IV. The first hypothesis concerning the importance of earnings is clearly in agreement with these results. The dominance of the return on capital measure in the tree and the high amount of variance explained provides empirical evidence in support of this first hypothesis. In addition, however, our results indicate that the relationship between earnings and share prices is far more complex than it would at first appear.

The second hypothesis which states that dividends are also important in determining share values but are secondary to earnings is also supported. The dividend payout ratio was found to be the next most important variable to earnings in explaining the variance of the valuation ratio. Nevertheless, the relationship is not simple with interaction between the payout ratio and return on capital influencing the way in which share prices react to changes in dividend policy.

As far as the influence of financial risk on share prices is concerned, the third hypothesis, our results have not picked up any systematic relationship between gearing and share values. Whilst this does not provide support for the hypothesis, it is not possible to be more definite as the absence of a variable from a model cannot be taken as confirmatory evidence.

Both the remaining hypotheses are again not supported, but as we have stated before the absence of z-score or beta from the models is not sufficient to reject the hypotheses.

9. Summary and Conclusions

The reason for using the AID technique for building a share valuation model was that the methodology has the ability to explore and reveal configural relationships present in a data base. Consequently, it was believed that a more comprehensive picture of how the market processes accounting information might be revealed. However, as the technique had not been used in this way before, it remained to be seen whether these potential benefits would actually materialise.

The powerful analytical ability of the AID technique was immediately apparent in the earnings yield analysis where it was able to isolate those companies that possessed meaningless earnings yields due to generating a very low return on capital. Subsequent analysis excluding this type of company revealed that the dividend payout ratio, market interest and short-term liquidity were all influential factors in determining a share's relative value. These results broadly agreed with the results from the traditional linear additive analyses presented in the previous chapter. Unfortunately the AID technique was unable to improve on the low amount of variance explained (only 26%) and therefore further detailed interpretation of the tree was severely restricted. The general conclusion reached at this stage of the analysis was that AID was unable to offer any substantial benefits over and above the linear additive techniques in terms of explanatory power, but that it was capable of providing a more informed picture of the way in which the variables interacted with one another.

The set of AID analyses performed on the valuation ratio proved to be far more informative. Whilst the variance explained was marginally less than in the linear additive analyses, the valuation ratio AID model was able to reveal a far more complex and helpful picture of the market's judgement process. The increased complexity of this model when analysed in detail revealed some very interesting interactions between variables and share values. For example it was found that both earnings and dividends had a distinct influence on share prices and that the extent of this influence could be related to the underlying rate of return on capital. Obviously more empirical work is required in this area to add substance to these findings, but at least an initial foundation has been laid for further research. The other variables found to be important in this model were short-term liquidity and market liquidity, both of which reflect acceptable rational behaviour by investors.

In conclusion we have to ask what bearing do these results have on the overall objectives of this thesis which were outlined in chapter I. Firstly, it is apparent that there appears to be a strong relationship between accounting information and share prices. Despite the rare use of the valuation ratio in practice, our results suggest that over 50% of the variation in this measure of relative share valuation can be explained in terms of accounting numbers. If one accepts that there is a large degree of "noise" in the share market which cannot be analysed by any statistical model and only financial measures were present as variables, the explanatory power of the model is perfectly acceptable.

Furthermore, if we accept that there is a strong relationship between share prices and accounting information we automatically assume that accounting information is of value to the investor. By adopting the methodology of building models that paramorphically represent the judgement decision, it is implied that any causal relationship between the input and the output of the "black box" is a direct result of human analysis. Thus it may be suggested that the important accounting numbers are those that constitute the key ratios in the share valuation models. If we accept the valuation ratio AID tree model as the most useful model developed so far, then it could be argued that all the investor requires is an abridged balance sheet, a profit and loss account and some insight into market interest.

In chapter III when the characteristics of the human information system were discussed at length, it was suggested that due to the inherent complexity of the investor's decision making process the number of variables likely to be influential would be few. Furthermore, it was also argued that policies of data expansion could be harmful without recognition of user needs. The paramorphic representation of the market presented in this chapter would support these claims.

The second objective of this thesis is to assess the configural nature of the market as a whole. It was argued that as the investor's decision making process is likely to be complex with variables interacting with each other, we could expect any model to possess similar characteristics. Lintner(1962) in concluding his paper on the theory of share valuation emphasizes this point as follows:-

> "We have found that in general theoretical models, non-linearities, complex interactions, and inequalities leading to marked preferences abound. It remains a question of fact whether models which ignore important facts . . . and which substitute linear for non-linear functions and straight-jacket variable and interacting parts into constant sums, can encompass practical reality to an acceptable approximation."

The results from the valuation ratio AID analyses do, however, clearly demonstrate the advantage from analysing the data using a technique that was capable of exploring and disclosing this complex nature of the market's judgement process. These analyses revealed that although the number of input cues that we could identify from our database may be small, there is a very complex set of interactions between them. Thus we would conclude from the results presented in this chapter and for the period covered by our analyses that the investor's decision making process is complicated and possesses the inherent configural characteristics of the way humans generally process information.

The third and last objective of this thesis is to assess the validity of traditional share valuation theories in the U.K. stock market. In broad terms the major theoretical issues under examination fall into three categories.

The first essential issue is whether equity values, ceteris paribus, are influenced by earnings or dividends. One group of authors whom we shall call the "pure earnings" theorists, assert that dividends are irrelevant to investors and that share values are dependent upon earnings alone. This group of authors includes Durand(1952), Kuh(1960) and perhaps most notably Modigliani and Miller(1961). Opposing the pure earnings theory is another group of notable authors namely, Walter(1956), Renwick(1969), Gordon(1959) and Williams(1938) whom we shall call the "pure dividend" theorists. This second group, which Durand also joined in two later papers (Durand, 1957; 1959), view dividends as being the sole determinant of share values and that earnings are irrelevant. As the detail of these opposing theories has been presented in chapter IV, it is not necessary to restate them here. It is sufficient to simply restate our general conclusion that neither theory's appears to be totally correct in its own right.

The results from the AID analyses clearly demonstrated that reality seems to encompass both theories with both earnings and dividends influencing share values. However, the way in which these variables interact with each other was found to be very complicated and therefore there would appear to be scope for restructuring these extreme theories to take into account a more realistic model of share valuation. Obviously the results of this study alone are not sufficient to establish any new theory, but at least by indicating certain possible avenues for fruitful research we have laid a foundation for future development. In conclusion we would argue that neither the pure earnings nor the pure dividend theories are correct and that a practical investment theory lies inbetween these extreme views.

The second theoretical issue of importance is that concerning the impact of fundamental risk. Once again there are two opposing theories. One theory is based on the Net Operating Income (NOI) model as advocated by Modigliani and Miller(1958) and proposes that the total value of a company is independent of the financial gearing. It is argued that as the rate of gearing increases, so does the cost of equity to compensate for the additional risk incurred. The opposing theory advocated by Durand(1959) and Solomon(1955) is that financial gearing is important and that providing the cost of equity is less than the cost of debt it is possible to increase the value of a company by replacing equity with debt. Once again we do not intend to restate the detail of these theories as they were discussed at length in Chapter IV. The results from our analyses would at first sight appear to be in favour of the net income valuation model in that the key explanatory variable in the model is based on profit after interest figure. It is conceiveable that had the NOI model been a more appropriate model of reality then the key explanatory variable would have been based on earnings before interest and tax. However, this interpretation of our results in favour of one theory or the other presupposes that certain assumptions about our analyses and the measurement of fundamental risk by the debt/equity ratio are valid. For instance it assumes that investors do not view this ratio as having a significant influence on share values and that there is a meaningful difference in the two profit measures. Because, these assumptions are difficult to accept without any supporting empirical evidence and the importance placed upon the debt/equity ratio in the finance texts we believe that this issue is worthy of further analysis and is examined in the following chapter.

Finally, the remaining two finance issues that are considered important concern the role of default risk and systematic risk in the market. Whilst we have found that neither z-score nor beta appear to be influential in the models developed above, established theory would argue that both types of risk are of prime importance in assessing relative share values. Thus there would appear to be a weakness in the link between theory and practice of investment, or at least between theory and the results of this study. With the aim of trying to reconcile theory and practice, we discuss at length the role of risk in the market in the following chapter.

In conclusion, the above AID analyses have provided an informative and interesting picture of the investor's decision making process. In general terms it has been shown that earnings, dividends, market interest and short-term liquidity have an influence on share values. Moreover, these results have provided a new insight into the interaction between accounting variables and share values and forms a foundation for further research in this area.

CHAPTER VIII

The Utility of Risk to the Investor

1. Introduction

It is argued in traditional finance theory that "rational" investors are risk adverse and consequently the assessment of risk is an essential part of the investment decision making process. As this argument is of fundamental importance to investment analysis, it would seem, a priori, that risk in one form or another should be present in any relative share valuation model. It is therefore somewhat surprising that no risk variable has entered any of the models presented so far in this thesis. An inference that may be made from this result is that risk per se is unimportant to investors. However, this suggestion is clearly premature as the issue of risk has not, as yet, been examined in sufficient detail.

In this chapter, therefore, we address the role of risk in the investor's decision making process more closely and consider the plausible reason for its absence from our share valuation models. We begin by defining what is meant by investment risk and by examining our methodology to see whether it was appropriate for capturing the impact of risk on share values. Following this we critically appraise the utility of three different types of risk measures to the investors namely beta, the debt-equity ratio and z-score.

2. Investment Risk

The risk incurred by investors in the equity market is determined by the variability of the values in their portfolios. Klemkosky and Petty(1973) argue that the determinants of this variability can be categorized into three parts namely the market factor, the industry factor and the firm specific factor. Evidence from King(1966) and Blume(1971) indicates that the market and industry factors account for about 30% and 12% respectively of the total variance in share prices in the US and that "well over 50% of the variance is attributable to factors unique to the firm". At first it would appear that analysts should concentrate their efforts on analysing this third factor rather than the first two. Portfolio theory however suggests this would be wrong as diversification can reduce the impact of firm specific risk in a portfolio to an insignificant level (Foster, 1978:242). Essentially the benefits of diversification stem from assuming the returns from each security are independent of the returns from other securities and the causes of variability are random. Thus as portfolio size increases, variability in the portfolio's return decreases. Based upon this premise portfolio theory argues that the variability caused by market factors is the only aspect of risk which needs assessment. In other words, within the framework of modern finance, investment risk is unidemensional.

In contrast, however, we have seen from our review of the literature in chapter IV that certain share valuation theories show investment risk to be depicted by several firm-determined measures such as financial leverage, size and the probability of bankruptcy as measured by a z-score. There would therefore appear to be two seperate views on risk and asset pricing. Gooding(1978), (discussed below in more detail) for example argues that although there are some "connecting links" between these two views in that firm specific factors may be directly related to the firm's beta, it would appear that investment risk is a multidimensional concept.

In the next two sections we shall consider these aspects in more detail but before hand it is necessary to establish whether our methodology was appropriate for testing the impact of risk on the investor's decision making process. Risk is defined as being a function of future share price variability, the higher the variability the higher the risk. If we assume investors behave in a rational way then, ceteris paribus, we would expect risk to be an important parameter in the investor's decision making process. Consequently high risk stocks would be expected to have lower relative share values.

A simple extension of this basic theory on investor preferences is to include the models of the investment decision making process provided by this thesis. If we accept risk as important to the investor then we must ask "how does he incorporate it within his appraisal system?" Our results suggest that earnings, dividends and market interest are the three primary factors for determining relative share values. In other words we have established a set of criteria against which relat ive share values can be derived. Having established this basic relationship, it is reasonable to expect the next stage in the analyses to be an adjustment to share values to allow for risk and therefore, a priori, a risk variable would be expected to enter the model.

Contrary to this expectation, our results revealed that risk was unable to contribute to explaining any of the variance in relative share values. This suggests that either our methodology was incorrect and that our model of the investor is incorrectly specified in some way or that risk per se is not a significant determinant of share values. Bearing in mind the theoretical importance of risk to investors and the vast amount of empirical research conducted into its utility, admittedly a majority of it stemming from the U.S.A., the first alternative seems the more probable. However, the rigour of the analyses and the ample opportunity given to the numerous risk variables to be included in any one of the six models provides a basis for strong counter arguments. In the first place although it is conceivable that risk has already been accounted for in one of three primary explanatory factors, this in itself infers an association between the variability of returns and one of these factors, and whilst this line of argument is plausible, it tends to suggest that investors use ill defined and vague measures for assessing risk.

Secondly, it may be suggested that our database did not include an appropriate surrogate measure of investment risk. In defence of this thesis this suggestion appears to be unfounded, as the database included all risk measures thought to be important after conducting a thorough review of the extant literature. Finally, it is feasible that the statistical techniques employed were unable to reveal the influence of risk due to the inability of the algorithms to analyse the data in the appropriate manner. Again this line of argument is weak as it is unlikely that the relationship between risk and share value is too complex to be revealed by one of the three analytical techniques employed.

In view of the above arguments it is suggested that the more acceptable reason for risk not entering a model is that risk per se was not a significant determinant of share values for our data sample and at the time of analyses. This suggestion however needs to be carefully examined due to the implications for both the theory and practice of finance and investor behaviour. In order to simplify this discussion the two main sources of risk, namely systematic and specific, shall be considered separately.

3. <u>Systematic Risk</u>

One of the main objectives of this thesis is to establish the utility of accounting information to the investor. In view of this it would appear that the inclusion of systematic risk as measured by beta, is unwarranted as it is unconnected with accounting information and therefore does not fit neatly within this objective. However, beta possesses two attributes that make it very important to this type of study. In the first place it is a variable that is theoretically perceived as being very important to every fund manager who wishes to optimise his risk/return profile and its ommision would therefore severely undermine any of our resultant models. Secondly, it is a risk measure that can be drived objectively from historic share price data.

The absence of systematic risk from our models needs to be reviewed from two aspects. The first concerns whether investors view beta as a useful measure in the U.K. stock market and secondly, whether the beta measure used in this thesis is specified incorrectly. It is stressed that the discussion that follows only examines the theoretical reasons for the insignificance of beta and does not provide any further empirical evidence to support these theories. Furthermore, this discussion is based on the premise that as systematic risk, as measured by beta, had no impact in our share valuation models, it is therefore unimportant to investors in the U.K.

Stockmarket. However, as stated above, this premise may be questioned.

3.1 The Perceived Utility of Beta to U.K. Investors

The perceived utility of beta to U.K. investors might appear to be called into question by our results. Do U.K. investors peceive the variability of returns as measured by beta important and if not, do they accept the theory that efficient diversification reduces specific risk to an insignificant level? A crude but interesting way of assessing the utility of betas to investors is to examine the demand for "beta services" by the investment community. Beta service organisations are not as successful in the U.K. as they are in the U.S.A. and whilst this type of organisation is relatively new in the U.K. they are in general not very successful, which may be attributed to the lack of demand (see LBS(1979)). Plausible reasons for this lack of demand may be as follows:

1) the inability of pension fund managers to see a practical use for a beta based investment strategy.

2) the average investor in the U.K. perceives specific risk as the main cause for variation in his portfolio.

3) there is a strong belief that the market is inefficient and that it is possible to beat the market with good fundamental analysis.

Acceptance of the underlying theory for using beta is essential for beta to be a significant variable in determining share values. the London Business School's Risk Management Service Handbook this aspect is covered in depth and suggests that fund managers should only be concerned with forecasting trends in sectors and in the market as a whole, and then changing their portfolio beta in line with these forecasts. Ostensibly, beta based portfolio management accepts efficient market theory in the semi-strong form and argues that fundamental analysis is to a large extent a waste of energy and time. Although the underlying theory for these arguments in favour of beta based portfolio management is sound, it does assume stock market efficiency which to some fund managers is difficult to accept. Consequently there is an apparent paradox between modern portfolio theory and believed inefficiences in the market; the latter view being the basis for the former.

The second possible reason for the lack of interest in betas is that specific risk is perceived to be more important than systematic risk. The cause of this phenomenon could be theoretically acceptable if a very large proportion of trading was conducted by investors with poorly diversified portfolios. Bierman(1974) uses the New York 1965 census of share owners which revealed the average investor owns three of four different stocks to support this line of argument. However, the use of this theory to explain the insignificance of beta in the U.K. stock market is weak because the small investor accounts for only a small percentage of the total equity investment. The majority of trading is conducted by City Institutions who in theory should manage efficient portfolios. (See Ward and Saunders(1977) for further discussion on this issue.)

Finally, the traditional training of fund managers and investment analysts has always concentrated on specific risk due to the inherent belief that it is possible to find good long term investments with thorough fundamental research. The end result of this behaviour is in theory an "efficient market" where it is argued that share prices reflect all available information and therefore attempts to improve portfolio performance by more fundamental research will not be rewarded (Treynor,1976). Despite the strong theoretical justification for an efficient market to persist, if investors do not accept the implications in practice their efforts will still be orientated towards the assessment of specific risk rather than systematic risk. Consequently the assumption that market efficiency will cause beta based investment strategies to be optimal, may not be justified as this presupposes that share prices reflect systematic risk rather than specific risk. Whilst we express caution in expressing this line of thought, it could be argued that investor behaviour may not be consistent with CAPM theory, which to a limited extent is supported by the findings of Moles and Taylor(1977) and Briece, Samuels and Smyth(1969). However, as there is a large amount of conflicting evidence in this area (see Henfrey et al, 1977 for a review), we conclude that more research is required into clarify the position.

3.2 The Measurement of Systematic Risk

If, however, we accept that the theory underlying the utility of systematic risk is applicable to the U.K. stockmarket, then in order to explain our findings we need to question whether the systematic risk variable employed was appropriate. Obviously, if there is a fundamental flaw in the computation of this variable it is unlikely that it would be found to be a significant explanatory variable.

The measure of systematic risk used in this study was beta, which was supplied by the London Business School and computed using monthly share prices taken from the three year period from 1974 to 1977. As the London Business School has been responsible for a vast majority of the research into the behaviour of betas and supplies City Institutions with a beta based Risk Management Service, it is reasonable to assume that our betas are among the best available for the U.K. stock market. Consequently, if we are to discredit our beta values it is necessary to concentrate on the conceptual issues rather than the complicated computational problems which to a large extent have been overcome by the London Business School.

The first major flaw with our betas is that they are computed from a time period prior to the time period covered by this thesis and therefore they can be described as historic betas. The problem with using historic betas is that this presupposes that betas are stable and that they have predictive ability. Furthermore we also assume that investors' future estimates of beta are based on historic betas which may not be true in practice. Rosenberg and Guy(1976) comment on this problem when discussing "fundamental betas" as follows:

"The problem of choosing among alternative estimators of the average value in the past provides a good vehicle for introducing the concepts of bias, variance and mean square error as employed in the context of estimation problems."

In other words an ex post estimation of beta based on regressing historic share returns and market returns can only be used as an ex ante estimation if certain assumptions hold true. The most important of these assumptions is that differences between the average past beta and the future beta have an expected value of zero. However, as Rosenberg and Guy argue:

"if any information currently available to implement a decision rule contains implications about the difference between the future beta and historical average, the expected value of the change in beta, conditional upon that information, will be non-zero, and the prediction will.be biased."

In order to overcome this deficiency in using historic betas to forecast future betas, Rosenberg and Guy advocate the use of "fundamental betas" which are betas computed from the latest financial characteristics of the firm. Other work in this area has been conducted by Rosenberg and McKibben(1973), Beaver, Kettler and Scholes(1970), Castagna and Matolcsy(1978), Gonedes(1973) and Eskew(1979), all of whom found that betas could be predicted more accurately using models based on accounting data. However, the significance of the difference between historic and fundamental betas is only marginal and, therefore, although we may question the accuracy of historic betas, it is unlikely that the extent of the difference would prevent beta from being a significant explanatory variable. Furthermore, one of the few U.K. studies, that by Marsh(1980) has revealed fairly strong stability in the London Business School betas which therefore throws further doubt on the argument invalidating historic betas. Other studies on U.S.A. data such as Fabozzi and Francis(1978), Roenfeldt, Griepentrog and Pflaum(1978) and Blume(1978) question further the utility of forecast betas for determining portfolio risk. Finally, Bowman(1979) in a paper that examines the theoretical relationship between systematic risk and accounting variables concludes that there is no theoretical basis for systematic risk being a function of earnings variability, growth, size or dividend policy and suggests that the results of some of the studies referred to above only indicate that the variable being tested is a surrogate for another variable eg. accounting beta. This remains to be proved.

A further factor that gives rise for concern is the element of bias introduced into the application of the CAPM in the U.K. Stock Market, by the large number of stocks which are thinly traded. The effect of this large body of thinly traded stocks must be to dilute the impact of active trading on the F.T.500 All Share Index. In other words the stocks which have no or only rare erratic share price movements due to lack of market interest are bound to restrict the overall movement of an index based on these as well as actively traded stocks. If this logic is applied to the computation of betas using this index, it would be found that thinly traded shares would have low betas, which is a result of static prices, and highly traded stocks would have high betas purely because they are the shares that move the index. Dimson(1979) in a paper that proposes a method to overcome this bias of thin trading comments

> "Consequently positive serial correlation is induced into returns which are calculated from the index and the estimated variance of returns on the index is biased downwards."

Roll(1981) in a paper that attempts to evaluate Dimson's method concludes that "Trading infrequency seems to be a powerful cause of bias in risk assessments . . . Rather herrendous bias is introduced in daily data and the bias is still large and significant with returns measured over intervals as long as a month." The net result is to cast doubt on validity of betas for thinly traded shares and consequently questions whether there is any purpose in attempting to produce a beta service to cover all quoted stocks rather than concentrating on a subset of more tradeable stocks.

If we look for corroboration of this theory in our study we find that beta is correlated with market liquidty and size (.27 and .37 respectively) and with no other variables. Thus it would seem that large companies have more market risk and vice versa. However, this does not appear to be theoretically cogent. Castagna and Matolcsy(1978) argue that there is "an expected inverse relationship between size and systematic risk as large firms are more diversified and therefore there is likely to be less variability in the factors that cause volatile share prices."

Alternatively, it could be argued that the greater the incidence and frequency of trading the greater is the stock's price volatility and, consequently the greater its relative risk. However, this argument is only valid when comparing stocks that can be traded in without erratic share price movements, that is large companies. There is little point in using a sophisticated risk measure for a stock whose share price is very erratic when trading occurs but has a low beta due simply to thin trading. In conclusion this area of conjecture would seem to be one where research is required to clarify the utility of beta in the U.K. stock market.

Finally, there is a line of thought that questions the validity of beta because it is believed that the use of one parameter in the CAPM is an over-simplification of the real world. Roll and Ross(1980) present this view in a paper that advocates the use of Arbitrage Pricing Theory (APT) which is a theory based upon similar assumptions as the CAPM for the pricing of assets. Essentially the main difference between these two lines of thought is that APT is based upon a multi-factor model, that is it tries to decompose beta into its constituent parts. Roll and Ross draw an analogy between APT and the work of Rosenburg and Guy referred to above, but point out that Rosenburg and Guy did not ascertain the separate influences of these multiple factors on individual stock expected returns. As a result, although this is not the place to examine these arguments in more depth, it would appear reasonable that the one paramter model may be suspect and requires further testing at least in the UK.

Further evidence in this area is presented in a paper by Gooding(1978) who questions the assumption that investment risk is unidimensional and synonymous with price variability as measured by the beta coefficient. Gooding used a rather unconventional methodology for the finance area by conducting a questionnaire type of study which required fund managers to assess the risk of eleven stocks. His multi-dimensional scaling analysis revealed that risk appeared to be three-dimensional: company risk as measured by the perceived debt/equity ratio and the unpredictability of earnings per share, variation in share price as measured by perceived downside risk, and market sensitivity as measured by beta. Whilst his study is restricted by the number of respondents and the inherent bias caused by the questionnaire these results suggest that the CAPM in its pure form may not be a true model of reality.

Finally, a study by Aharony, Jones and Swary(1980) investigated the systematic risk characteristics of non-bankrupt and bankrupt companies. They found that over time systematic risk was not a useful indicator of firm deterioration. Furthermore, they suggest that the important component of risk that distinguishes between the two groups is unsystematic risk. Thus this evidence does not support the traditional theory that systematic risk is the only risk that needs assessment and therefore further questions the use of the CAPM in its pure form.

To summarize, then, this discussion on the problems associated with measuring systematic risk, it does appear that there are some behavioural and theoretical arguments which cast doubt on whether beta as utilised by this study is an appropriate surrogate measure for share price variability. Firstly, we can question the use of historic betas when expected future betas are clearly in the minds of investors. Secondly, there are the inherent problems in the computation of beta in a market with a large number of infrequently traded shares and finally there is a question mark over the appropriateness of a one parameter risk model. In view of these serious misgivings we can justify our result that beta was not found to have a significant role to play in the investor's decision making process as modelled in our analyses. This area obviously requires more research.

4. Specific Risk

At the beginning of this chapter it was stated that investment risk is a function of market factors and firm specific factors, and through diversification, it is argued, this second factor can be reduced to zero. As a direct result we would assume that market risk is the only relevant risk worthy of assessment by any fund manager. However, we have seen that the problems associated with this belief are both diverse and numerous, and therefore it is necessary to examine the particular issue of the relationship between specific risk and the investor.

Specific risk is determined by those factors specific to the firm rather than by those factors influencing the economy or the particular industry in which the firm is operating. In broad terms firm specific risk encompasses two distinct types of risk. The first type concerns the variability in earnings caused by high financial gearing and the second is the risk of insolvency. Although both types of risk are important to the fund manager, their impact on portfolio returns is likely to be quite different. In view of this we shall examine them separately under the headings of financial gearing and default risk.

4.1 Financial Gearing

The impact of financial gearing has been very small on the analyses conducted in this thesis. It was seen in the valuation ratio regression model that gearing was a significant variable but on subsequent analysis it was found that it could not be interpreted in an intuitively meaningful way. The only other risk variable of significance to enter the model was short term liquidity which entered both the earnings yield and valuation ratio AID models. On both occasions the inference was that a good short term liquidity position is associated with a high relative share value. Our analysis of this phenomenon revealed that this ratio may possibly be a surrogate measure for overtrading and not financial risk per se. It is stressed, however, that due to the low amount of variance explained by this ratio, it is important not to read too much into the relationship. Perhaps what is more important is that the traditional gearing measures employed by this study were found to have no significant influence in the investors decision making process.

In chapter IV when the influence of gearing was discussed at length, we constructed a hypothesis which stated that financial gearing does not adversely affect share values unless there is a strong chance of bankruptcy, which is broadly in line with the net income model of investor behaviour and follows Renwick's(1969) normative theory of investor preferences. The absence of gearing from our models could be interpreted as lending support to this hypothesis, but such a conclusion is quite wrong and unjustified as the absence of contrary evidence neither ratifies nor allows the rejection of the original hypothesis. Consequently, so far in this thesis, we have been unable to clarify the important issue of whether gearing influences share values or not.

One reason for the results obtained is that it is conceivable that the impact of gearing on share values has been obscured in our analyses due to the dominance of a return on capital ratio with a profit before tax numerator. It could be argued that as this number is stated after the interest charge, the impact of gearing has already to some extent been taken into account. There is therefore a case for forcing a return on capital ratio based upon earnings before interest and tax into the model to see if gearing influences share values. By doing this there are three posssible types of tree that could develop after the impact of this new variable has been taken into account. These are as follows:

1) gearing would be seen to have a positive relationship with share values that is high gearing is associated with higher share values, indicating that the net income model is appropriate.

2) gearing would be seen to have a negative relationship with share values, that is high gearing would be associated with low share values, indicating that Modigliani's and Miller's Net Operating Income model is appropriate.

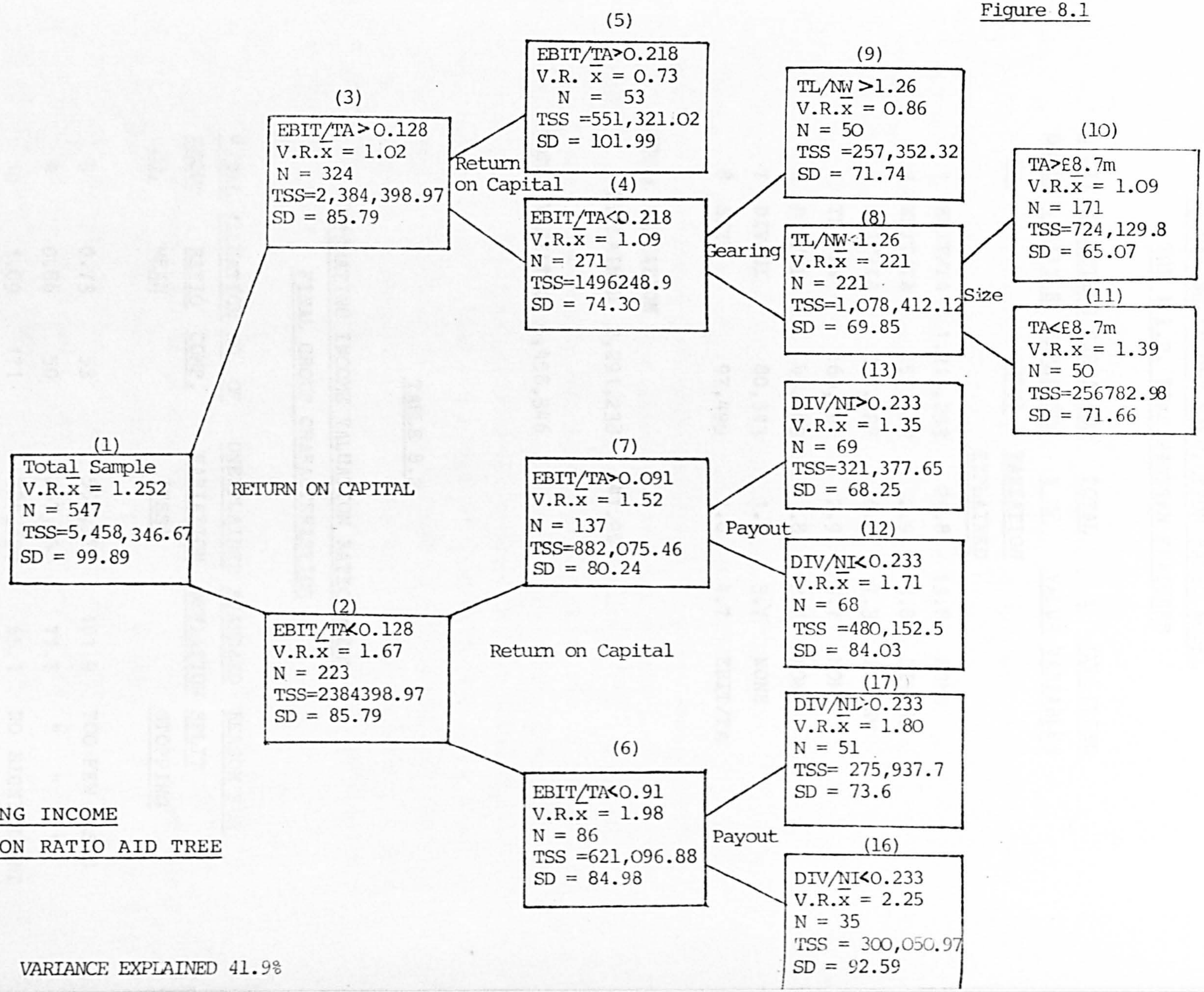
3) gearing has no effect on share values which might lead us to suggest that investors do not perceive gearing as a useful ratio in share valuation.

In order to test these possibilities the valuation ratio AID analyses were reconducted forcing a return on capital ratio based on earnings before interest and tax into the model. The AID tree obtained is presented in figure 8.1 where it can be seen that the tree is very similar to the original valuation ratio tree except that gearing has now entered the model. Before examining the implications of this new set of relationships it is important to briefly examine the statistical qualities of the tree.

The relevant statistics from this AID analysis are presented in tables 8.1 and 8.2. In table 8.1 the AID tree pattern features are presented and reveal that this model was able to explain only 41.9% of the total variance in the valuation ratio which compares unfavourably with the 50.4% obtained by the original model presented in the previous chapter. Our initial reaction is therefore one of caution in that we must realise we are examining an inferior model of the share valuation process. Also shown in the table is the variance explained by each variable. Operating return on capital is the most powerful measure explaining 34.8% of the total variance. The secondary variables are gearing, dividend payout and size which explain 2.9, 2.3 and 1.8% respectively. If these variables are compared with the original tree statistics (table 7.6) it will be seen that return on capital, dividend payout and size/market interest are all weaker in terms of explanatory power and that short-term liquidity has disappeared altogether. The gearing ratio is new and by explaining nearly 3% of the variance must be considered as a very influential variable. Finally, the table also shows that there is no significant competition between variables which is not satisfied later in the tree, except for the split on group 8 which is terminal.

Table 8.2 presents the final group characteristics and it can be seen that the reason for the tree stopping is due in all but one group, to each terminal group possessing insufficient observations to form two new child groups. This clearly indicates that the AID analysis has been able to reduce the original sample into the smallest terminal groups ie. a thorough analysis has taken place. The only group which stopped splitting prematurely was group 10 which is at the end of the longest branch in the tree.

Figure 8.1



OPERATING INCOME VALUATION RATIO AID TREE

VARIANCE EXPLAINED 41.9%

TABLE 8.1

OPERATING INCOME VALUALTION RATIO MODEL

THE A.I.D. TREE PATTERN FEATURES

SPLIT GROUP NO.	SPLITTING VARIABLE	VARIATION EXPLAINED (BSS)	TOTAL % OF VARIATION EXPLAINED	t VALUE	COMPETING VARIABLES
1	EBIT/TA	1,213,253	25.8	13.8	NONE
2	EBIT/TA	157,523	2.9	4.8	DIV/NI
3	EBIT/TA	336,828	6.2	7.3	TL/TNW
4	TL/TNW	160,484	2.9	5.7	NONE
6	DIV/NI	45,108	.8	2.7	NONE
7	DIV/NI	80,543	1.5	3.7	NONE
8	SIZE	97,499	1.8	4.7	EBIT/TA
TOTAL VARIATION EXPLAINED		2,291,238	41.9%		
TOTAL VARIATION		5,458,346			

TABLE 8.2

OPERATING INCOME VALUATION RATIO MODEL

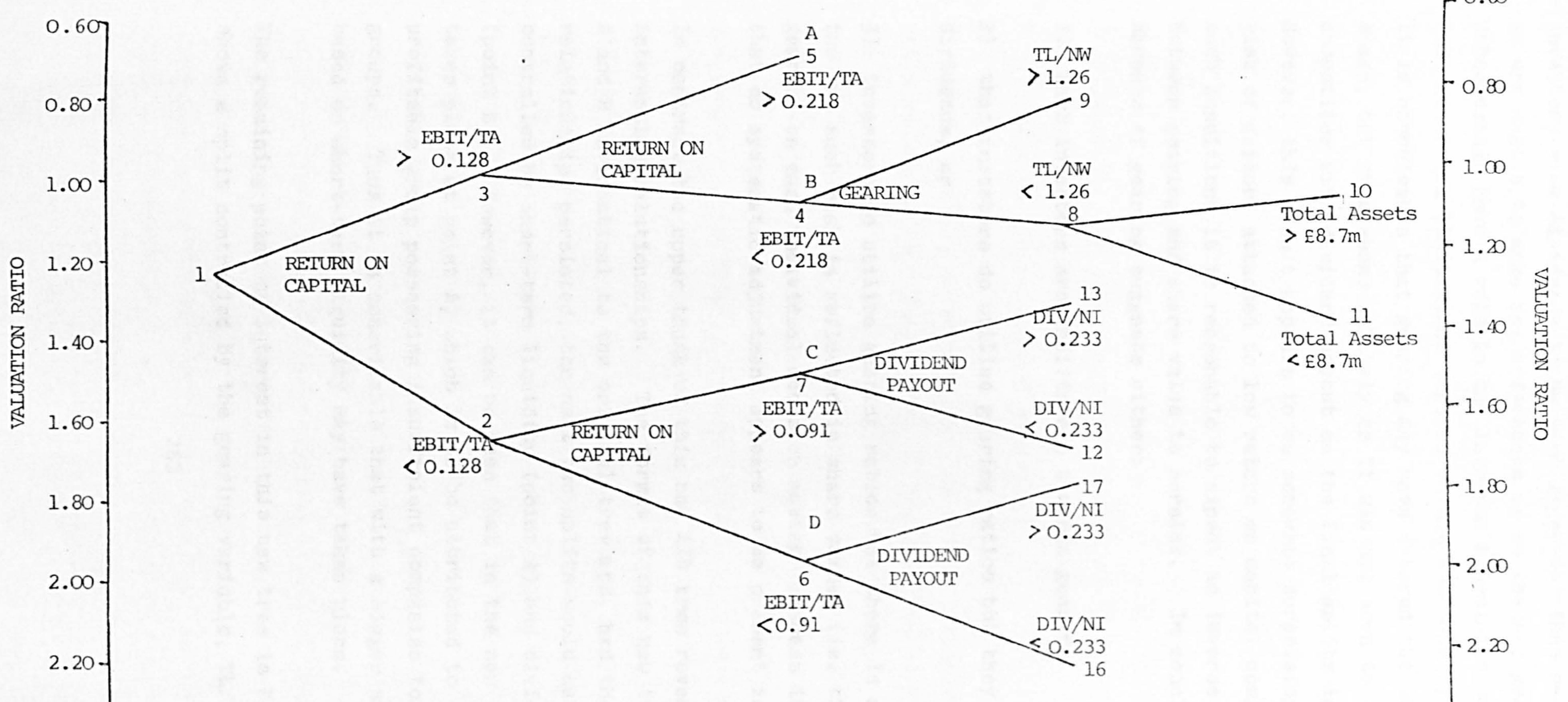
FINAL GROUP CHARACTERISTICS

FINAL GROUP NO.	VALUATION RATIO MEAN	NO. OF COMP.	UNEXPLAINED VARIATION (TSS)	STANDARD DEVIATION	REASON FOR SPLIT STOPPING
5	0.73	53	551,321	101.9	TOO FEW CASES
9	0.86	50	257,352	71.7	" " "
10	1.09	171	724,129	65.1	NO SIGNIFICANT EXPLANATORY VARIABLE
11	1.39	50	256,782	71.66	TOO FEW CASES
13	1.35	69	321,377	68.25	" " "
12	1.71	68	480,152	84.03	" " "
17	1.80	51	275,937	73.6	" " "
16	2.25	35	300,050	92.59	" " "

Having established that this new model is worthy of further analysis we turn our attention to the underlying economic logic of each split. In order to aid this task the AID tree pattern presented in figure 8.1 has been redrawn to scale in figure 8.2 using the mean valuation ratio values of each group as the location for each split. If we now compare this new AID tree with the original valuation ratio AID tree presented in figure 7.9 we will find several similarities and differences.

Firstly, the most obvious similarity is that the first three splits in both trees are controlled by a return on capital variable. (Thus up to points A, B, C and D the trees have identical formats.) This trunk-branch structure indicates that there is a remarkably strong relationship between return on capital and the valuation ratio across the whole sample. As we have already discussed in the previous chapter, this relationship indicates that the value placed on the book value of a company's assets is determined by the return generated by those assets. One subtle difference between the two trees which could go unnoticed is that the number of observations forming the upper trunk of this tree is 324 as apposed to 278 in the previous model. Whilst we cannot read into this any real significance it does indicate that we have not simply replicated the previous model using a different ratio.

The lower trunk of this new tree follows exactly the same pattern as the old tree, with dividend payout controlling the splits at points C and D. The only minor difference is that the old tree continues with an extra split controlled by a size variable. However, this difference is not important as this new trunk commenced with fewer observations and therefore prohibits the subsequent number of splits. Our interpretation of this lower trunk is that earnings and dividends are the key to share values for companies with below average profitability. The absence of gearing from this trunk suggests that



VALUATION RATIO AID TREE BASED UPON NET OPERATING INCOME

VARIANCE EXPLAINED 41.9%

Figure 8.2

investors view dividends to be more important than gearing. However, we are unable to make any inferences as to whether gearing may subsequently have a role in the investor's decision making process because of the limitations imposed on the analysis by the sample size. It is conceivable that gearing may have entered the model at the next stage, but this seems unlikely as it was not seen to be a strong competitor with dividend payout on the final splits in this trunk. However, this result appears to be somewhat surprising given the high risk of failure attached to low return on capital companies. Under such conditions it is reasonable to expect an inverse relationship between gearing and share value to persist. In conclusion the absence of gearing suggests either:

1) that investors are indifferent towards gearing

2) that investors do utilise gearing ratios but they are secondary to dividends, or

3) investors do utilise gearing ratios but there is no censensus in the way such risk is reflected in share values (ie. the impact of gearing on each individual decision making process is so different that no systematic adjustment appears to be present in the market.)

In contrast the upper trunk of this new AID tree reveals some very interesting relationships. The format of this new tree up to points A and B is identical to the original tree and, had the same relationships persisted, the next two splits would have been controlled by short-term liquidity (point A) and dividend payout (point B). However, it can be seen that in the new tree no split takes place at point A, which is to be attributed to this highly profitable group possessing insufficient companies to form two new groups. Thus it is conceivable that with a bigger sample a split based on short-term liquidity may have taken place.

The remaining point of interest in this new tree is Point B which shows a split controlled by the gearing variable, TL/TNW. This new split replaces the dividend payout ratio found in the original tree. The two new groups formed reveal that the group with the higher gearing has the higher average share value and vice versa, which infers that investors have a preference for gearing. Whilst we are cautious in generalising from our results this finding is very interesting in that it provides some evidence to support the net income theory on investor behaviour which quite simply argues that when the return on capital is between 13% and 22% gearing has the effect of inceasing relative share values through increasing the after interest return to the investor. This is in complete contrast to the Modigliani and Miller(1958) theory which argues for the reverse relationship. In other words there appears to be, on the basis of these results, no downward bias in share values due to the additional risk caused by the additional gearing.

From a theoretical point of view this relationship between gearing and share values is very interesting. The AID tree proposes that when the operating return on capital is above, say 13%, there is a beneficial impact of gearing on share values. Whilst we are unable to state whether the relationship would hold for companies with returns above 22% due to the group at point A possessing insufficient companies to form further groups, it is not unreasonable to argue that it may do so. However, the absence of gearing from the lower part of the tree indicates that this preference for gearing is not valid in all circumstances, that is there is imperfect interaction present within the tree. We can possibly explain this interaction in terms of the marginal benefit of gearing which is only obtained when the weighed average cost of debt is less than the operating return on capital. When the operating return is below a certain level, in our case 13%, then it may be argued that the shareholder no longer benefits from gearing due to the opportunity cost of additional liabilities. For instance it may be that the interest charge on additional debt is either only slightly below the current return on capital and consequently insufficient to compensate for the additional risk incurred by the taking on any additional liability, or the operating return may be equal to or less than the cost of debt in which case there would be a negative effect on shareholder returns. Although this interpretation is limited to this one period AID tree, the relationship found is broadly in agreement with normative expectations about rational market behaviour.

In conclusion this analysis has indicated that specific risk as measured by the TL/TNW does not appear to have an adverse impact on the investor's decision making process. Our results do in fact suggest that gearing is beneficial to investors when the operating return on capital is greater than 13%. Whilst these results suggest some very interesting behaviour by investors, we stress the need for caution in generalising from this single time period analysis.

4.2 Default Risk

The other type of specific risk which we consider important to investors is default risk. The variable included in the database to measure this factor was z-score which was computed using the Taffler(1977) discriminant model. Despite our a priori expectations that this variable would be of prime importance to investors, the models developed in this study revealed that z-score was unable to explain any of the variation in either of our two measures of relative share valuation. We may conclude from this that either our methodology was inappropriate for revealing its "true" impact on the investor's decision making process or that investors do not account for bankrupty risk in their evaluation process in a systematic manner. As the second of these would at first sight imply irrational behaviour by investors we shall firstly evaluate the validity of our methodology.

The basic assumption made by using z-score is that it is an accurate measure of default risk. In a paper by Taffler(1981a) the track record of his z-score model over several years is reported. It is revealed that the model "exhibits true ex ante predictive ability in a statistical sense" and this is based upon the fact that the model was able to isolate all quoted manufacturing companies which failed over the preceding five years. Futhermore, it is convincingly argued by Taffler that z-scores may not only be used for classifying companies as failing (that is at risk of failure) or not, but also as a general measure of company performance applicable throughout the full performance range. The evidence presented by Taffler on the ability of the z-score variable to measure both bankruptcy risk and aggregate performance is overwhelming and consequently we believe that the variable was measuring default risk very accurately and should not be questioned.

A more likely explanation for the absence of the z-score from our results is that the constituent elements of the z-score model are correlated with the variables in our models which would have the effect of diluting the impact of the z-score in the analyses. The z-score model comprises of four variables, namely PBT/CL (profitability), CA/TL (working capital), CL/TA (financial risk) and the No-Credit Interval (short-term liquidity), which when combined provide a holistic measure of company performance. It may be observed that the first variable is measuring profitability and is therefore measuring the same financial dimension as the PBT/TNW variable which controls the valuation ratio model. However, the correlation between these two ratios is only .57, which is not high, and furthermore .37 between PBT/TNW and z-score. These low correlations would suggest that the holistic nature of the z-score model is capturing something quite different from the return on capital ratio alone and therefore its impact on share prices is unlikely to have been significantly diluted.

Overall, therefore, we would suggest that had default risk been important to investors during the period examined it would have entered one of the models developed. Consequently, the next question we must address is what are the possible reasons why investors do not appear to assimilate default risk into relative share values? We suggest two explanations. Firstly, it may be that investors are unable to assess such risk with any degree of accuracy and secondly there are other factors at work preventing the share prices of failing companies falling to a low level that reflects their inherent risk.

There is some empirical evidence to support the first of these explanations. In our discussion on default risk in chapter IV several studies were referred to which supported the conclusion that bankruptcy took investors by surprise (Altman and Brenner,1981;

Aharony, Jones and Swary,1980). Whilst these studies did reveal that there was a distinct downward trend in the share prices over the period prior to the failure point, (see also Beaver(1968) and Westerfield(1971) for more evidence of this nature), it would appear that there was a sharp decline in the seven week period prior to bankruptcy. Aharony et al(1980) state, "This implies that even shortly before the event, the market did not fully expect that these firms would soon file bankruptcy."

From this evidence it would appear that share prices may not fully reflect the risk of bankruptcy and therefore it would seem as though investors are unable to accurately assess this type of risk. However this conclusion is premature as there are other factors at work within the share price mechanism which may counteract the potential high losses from holding high risk companies. Taffler(1981a) provides some interesting facts on the performance of quoted companies on 30.11.76 over the following four years. It is reported that only 12.2% of the companies at risk actually went bankrupt, whereas of the rest 5.2% made major divestments, 7.0% received government, bank or other support, 39.1% recovered, 10.4% were taken over and the balance remained still at risk. From the investor's point of view and bearing in mind the large potential gains obtained when either a takeover or a recovery takes place these figures suggest that investing in financially unhealthy companies over the period considered may not have been such a bad investment policy.

In a study by Shrieves and Stevens(1979) this issue of whether failing companies are likely to be taken over was examined from a different view point. Based on Altman's(1968) model, the authors compared the z-scores of two groups of companies, one containing companies that had been acquired and the other containing non-acquired companies. They found that 15.2% of the acquired firms were at risk compared with only 4.5% of the non-acquired sample. Shrieves and Stevens conclude,

> "An empirical corollary to our findings of high relative frequency of impending failure in acquired versus nonacquired firms is that many instances of severe financial crisis among large firms are resolved through the merger process."

In summary, we would suggest that the role of default risk in the investor's decision making process is not as simple as it may first appear and that share prices may not fully reflect this risk due to the probability of some event other than bankruptcy, taking place and thus yielding a capital gain. Consequently, we see this as an acceptable explanation for z-score not entering any of our resultant models.

5. SUMMARY AND CONCLUSIONS

The objective of this chapter was to examine the role of risk in the investor's decision making process and to seek possible explanations for the absence of any risk variables from the models presented in the previous chapters.

Initially, it was proposed that either the methodology of this study was inappropriate for establishing a systematic adjustment in share values for risk or that the risk measures included in the database were misspecified in one form or another. Although it is difficult to prove in any rigorous manner, the methodology would appear to be capable of revealing the impact of any statistically significant risk measure providing the underlying model is not too complex. In view of this our attention was focused on the definitiion of risk and its measurement.

Investment risk can be split into two main types, namely systematic and specific, of which in theory systematic risk is considered to be the only risk of importance to fund managers. It was revealed in closer examination of systematic risk that there are problems with its perceived utility to investors in the U.K. stock market and with its measurement. In the first place there is a reluctance by fund managers to accept the theory of the CAPM as the basis for formulating investment strategies. Secondly, there is the inherent belief by fund managers that the market is inefficient and therefore there are perceived benefits from thorough fundamental analysis.

Beta, the variable employed by this study to measure systematic risk, was also questioned. It was shown that there are empirical and theoretical reasons for suggesting that historic beta, which does not reflect future expectations, may not be the best surrogate measure of investor expectations of systematic risk, although it was pointed out that the difference was likely to be small. Furthermore, given the large number of companies in the U.K. stock market which are thinly traded there are sound reasons for questioning the validity of a beta based investment strategy. Finally, the one parameter model of the CAPM is considered too simplistic to be a useful measure of systematic risk, (Roll and Ross,1980; Gooding,1978; Aharony, Jones and Swary,1980). In summary the expected impact of the beta measure employed in this thesis on share prices is not as clear as theory would suggest with many questions unanswered and as a direct result the absence of beta from the models may not be unexpected.

The second type of risk examined was specific risk which was examined from two view points, the risk due to financial gearing and the risk of default. In the first place it was suggested that the absence of a financial gearing ratio from our models could be due to the use of a variable based on after interest profit figure which may have diluted, to some extent, the true impact of gearing on share prices. In order to explore this possible weakness the valuation ratio AID model was reworked forcing in a return on capital variable based upon earnings before interest. The resultant AID tree revealed that although gearing appeared to influence share prices, its impact was contrary to theoretical expectations as defined by Modigliani and Miller(1958). The analysis proposed that investors prefer gearing providing the return on capital was above 13% and below 22%. Below 13% no preference or dislike for gearing was revealed. This finding is in agreement with the net income model for share valuation and with Hypothesis III set out in Chapter IV.

The absence of default risk from our models was examined from several view points. In the first place it was seen that the variable z-score, used to measure this type of risk, had a proven track record. Secondly, the z-score was not found to be highly correlated with any of the other ratios in the models. Thus it was concluded that our methodology should have been capable of revealing the impact of default risk, and thus led us to question its impact on investment returns. Evidence from Altman and Brenner(1981) and Aharony, Jones and Swary(1980) suggests that default does come as a surprise to investors and the findings of Taffler(1981a) and Shrieves and Stevens(1979) indicate that the reason for this may be due to the high probability of other events such as takeover or recovery taking place. Consequently, it would seem that default risk may not take a very dominant role in the share price fixing mechanism.

The overall conclusion from these analyses is that no evidence to confirm that investors utilise risk variables in their decision making process can be found. If we accept this conclusion as valid and that our models should have been able to reveal any systematic relationship between risk and relative share values, if present, then there are a number of plausible explanations:-

1) investors may not utilise risk variables in their decision making process

2) or if they do, there is no consensus in their use and therefore there is no systematic relationship betweeen risk and share prices (Bart and Masse,1981 provide some evidence to support this explanation).

3) or, there is a systematic relationship present but its significance is so small when compared with the impact of the other share price determinants, that it becomes insignificant from a statistical point of view.

The implications of these possible explanations are very serious for both the theory and practice of investment appraisal and therefore need to be substantiated and extensively tested using different time periods, different data and different methodology.

Finally, these results suggest that if we adopt the decision usefulness criterion for improving the content of accounting statements, then it would appear that the arguments for including explicit risk measures are not substantiated. However, in view of the vast exposure given to risk it may be argued that risk per se could become important if there were some sort of consensus on its measurement, and that the standardising and reporting of specific risk measures in the annual report may help achieve this concensus.

CHAPTER IX

SUMMARY, CONCLUSIONS AND IMPLICATIONS

1. Introduction

As stated in the first chapter the main theme of this study was to examine the relationship between accounting numbers and relative share values with a view to gaining more insight into the workings of the share price fixing mechanism. In the light of this, three broad objectives were formulated:

1) to test the hypothesis that there is a relationship between accounting numbers and relative share values.

2) to test the hypothesis that the cognitive processes of the market as a whole are interactive by nature.

3) to study the applicability of the various theories related to share valuation, dividend policy, fundamental risk and systematic risk in the U.K. stock market.

It was also our purpose to further the understanding of user informational needs and thus contribute to the development of the decision-usefulness approach to accounting. In this chapter we summarise the results of our analyses relating to our objectives and to the other areas which have a bearing on financial ratio analysis such as the dimensionality of accounting data, the utility of linear additive analytical techniques etc. We shall also discuss the implications of our results for share valuation theory and practice and related areas, and recommend further areas for future research.

2. The Understanding of Relative Share Values

The analyses conducted into the association between accounting numbers and relative share values indicated that there was a statistically significant relationship present, at least for the time period covered by this study and the particular sample of companies used. It was shown that when the valuation ratio was used as the measure of relative share value, over 53% of the variance could be explained using a model consisting of only a few variables. Our hypothesis that there is a relationship between accounting numbers and relative share values is therefore clearly supported by these results. We conclude from this that accounting information is useful to investors and consequently a prime determinant directly or by surrogate, of share prices.

Demonstration of this link between the input and output of the investor's decision making process is important for two reasons. Firstly, it establishes that investors find useful information in modified historic cost financial statements. Secondly formal models representing the functional relationship between the economic judgements of investors and accounting numbers can be used to shed light on the validity of various corporate finance theories. In chapter II the decision-usefulness criterion was discussed at length and whilst it was convincingly demonstrated that accounting numbers do possess some hidden strengths (see subsection 2.4) the general belief within the accounting profession that this criterion was not being met by current financial statements was highlighted (see subsection 2.2). Furthermore, in chapter IV the survey of the extant work on the determinants of share prices revealed inconsistent, and therefore inconclusive, results with no empirically established theories (see Benston, 1981 for a recent review). Thus the need to identify the variables which genuinely and meaningfully reflect the investors decision making process is a very important aspect in advancing the body of knowledge in accounting and finance. We hope the present study goes a little way towards helping to fill this gap in knowledge.

The resultant models revealed that only a few accounting numbers were statistically significant in explaining relative share values, which is consistent with our a priori expectations given the enviromental complexity of the decision process in question (see subsection 3.2). This finding implies that the computation and interpretation of other financial ratios may not be very meaningful in the exercise of share valuation. Whilst our findings are limited to one time period and do not take into account non-financial variables, it would appear that the financial analyst might reasonably confine his financial analysis to a few carefully selected variables. Failure to do so may only serve to complicate and reduce the effectiveness of his decision making process (Taffler,1981; Snowball,1980; Schroder et al,1967; San Miguel,1976; Casey,1980).

It was found that only four dimensions were able to contribute to explaining relative share values. Profitability was seen as the most important determinant indicating that investors are primarily concerned with earnings per share. This finding is consistent both with our hypothesis that earnings are the dominant factor in determining relative share values and with the results of other studies eg. Ball and Brown(1968) Brown and Kennelly(1972). Quite clearly this result is to be expected as it implies that the value of an investment is determined by the earning power of underlying assets, the greater the earnings the higher the relative share value. Furthermore it was demonstrated that the net income model (Durand,1959) appears to be a more appropriate description of market behaviour than the net operating income theory (Modigliani and Miller,1958). The second most influential variable was the dividend payout ratio indicating that dividends are an important aspect of equity investment. This finding is consistent with our hypothesis that dividends are important to investors although secondary to earnings and with the normative theories of Renwick(1969) and Gordon(1959). However, it is contrary to the Modig liani and Miller(1961) dividend irrelevance theory. Our interpretation of this phenomenon is that there was a "clientele" effect present within the U.K. stock market causing a preference for high yielding stocks. Whilst it is recognised that the effect of dividend restraint policies in force at the time of this study may have accentuated the impact of dividends on share prices, we believe that this finding can be explained in terms of reducing the uncertainty attached to equity investment and/or the legal requirement for many investment funds to generate a minimum dividend yield (see subsection 6.4.1).

The size and market liquidity variables were seen to be measuring the same factor, namely the marketability of a stock. Although this factor was seen to contribute only a relatively small amount to the models in terms of variance explained, the AID analyses revealed that it can have a dramatic effect on relative share values. It was seen in figure 7.9 that a company with all the financial attributes of highly valued companies in terms of earnings and dividends but with poor marketability could in fact be valued less than a company with the financial attributes of low valued companies but with good marketability. The reason for this phenomenon is that the trading problems incurred with stocks with poor marketability cause such stocks to stand at a discount and vice versa (see subsection 6.7). Consequently, we conclude that at least for the period covered by this study marketability was a fundamental part of the U.K. share valuation process.

The models also indicated that short-term liquidity was influential in determining share values. Our interpretation of this variable was that it was probably a surrogate measure for over-trading (see subsection 7.6.2). However we stress that we could find no corroboratory evidence in the literature for our interpretation of this variable and therefore caution needs to be taken in making too much of this finding.

Of particular importance to the theory of share valuation was the absence of any risk measure from any of the resultant models, indicating that there may not be any consensus in the way investors evaluate investment risk, be it systematic or specific. Whilst we recognise that the absence of a variable from a model inhibits the scope of any inductive reasoning, our results were inconsistent with our three hypotheses on risk and consequently worthy of further discussion(see chapter VIII).

The concept of systematic risk can be criticised from three points of view. In the first place it is questionable how much fund managers accept the theory of the CAPM, and whether they can be convinced that good fundamental analysis does not yield results in the long term. Secondly, the ability of beta to reflect systematic risk was also questioned, especially in a market consisting of many thinly traded shares. Finally, the one parameter model of the CAPM may be considered too simplistic to be a useful measure of risk (Roll and Ross,1980; Gooding,1978; Aharony et al,1980).

Specific risk was considered under two separate headings, namely financial gearing as measured by the debt/equity ratio and default risk as measured by z-score. To examine the role of financial gearing in the share price fixing process further analysis was conducted where it was found that the debt/equity ratio did not adversely affect share values. In fact the only influence this ratio had on share values was when the return on capital was greater than 13% and below 22% and then the higher the gearing the higher the relative share value. Although this is contrary to our initial hypothesis (see subsection 4) and to the theory of finance as presented by many texts, it is consistent with the normative theory of Renwick(1969) and the net income share valuation model.

The discussion on default risk revealed that very often companies in severe financial difficulties were subject to other events such as take-overs or outside interference, and that bankruptcy was a relatively rare event (Taffler,1981a; Shrieves and Stevens,1979). Thus from the investor's point of view default risk may not be very important. Our overall conclusion was that there appears to be a distinct gap in the theory and practice of risk evaluation in the U.K. stock market.

3. The Configural Nature of the Market's Share Valuation Process

One of our initial hypotheses was that the market's share valuation process is configural in nature. The basis for this was that as the market's decision making process is simply the sum of all the individual investors' decision making processes, it is likely to reflect the characteristics of the human information processing system and consequently is likely to be configural (see Goldberg, 1968; Clarkson, 1966 and Slovic, 1969 for further discussion in this area). The results from the AID models are clearly consistent with this hypothesis and, although the models may only contain a few variables, the interaction between these variables is complex.

In subsection 7.5.1 the interaction between the earnings yield and return on capital was demonstrated, whereby a group of companies with very low returns on capital was isolated from the main body of companies. This separate group consisted of companies with "meaningless" earnings yields. Further, evidence of interaction of a less obvious nature was revealed by a close examination of the valuation ratio AID analysis (see subsection 7.8.1). It would appear from our one period analysis that the rate of return on capital employed, has a direct bearing on the market´s valuation of the firms earnings, contrary to established theory. A very low return was associated with a relatively low cost of equity indicating that factors other than earnings per se are supporting the share price, eg asset values. As the return on capital increased so did the cost of equity until a point was reached where the increase in the cost of equity was substantially less than the increase in the return on capital. This point signifies the level of the average cost of equity where earnings dominate relative share values. However, it was seen that when the return on capital increased still further this was also associated with a slight increase in the cost of equity indicating that investors value earnings of high return companies less than the average return company. Whilst we must be careful in generalising from this finding, it would appear that there may be a kind of regression towards the mean expectation by investors. (Whittington, 1976 provides some support for this argument.)

In addition it was seen in this valuation ratio analysis that dividends interacted with return on capital. When the return on capital was low, the impact of a change in dividend policy was also low. As the return on capital increased, however, so did the impact of dividends until a point was reached where dividends were seen to decline in their importance to investors. Our interpretation of this U curve(see figure 7.12) is that

1) when the return on capital is low investors seek increases in earnings and are not heavily swayed by changes in dividend policy,

2) when the return is average, dividends are viewed by investors as a means of reducing uncertainty and consequently are very influential and

3) when the return is high the opportunity value of retained earnings is higher than that of dividends and therefore investors appear to be indifferent towards dividends. This interesting set of relationships broadly agrees with Renwick's(1969) normative theory on the role of dividends. Nevertheless, we express caution in generalising from our results, particularly as there was a government policy of dividend restraint at the time of our analysis, and stress the need for further examination of this interaction in other time periods.

Another important finding from our analyses concerns the role of financial risk as measured by the debt/equity ratio. In subsection 8.4.1 it was seen from the valuation ratio AID tree based upon net operating income that this ratio was influential in determining relative share values only when the operating return on capital was above the average. This interesting result suggests that investors prefer high gearing providing the return is high. This finding is consistent with the net income model of the firm although inconsistent with the theory of Modigliani and Miller(1958) and with our hypothesis on the debt/equity ratio.

In conclusion, then, although the investor's decision making process may at first sight be considered simplistic due to the few variables utilised, the interaction between these clearly demonstrates that the judgement process is configural and very complex. Furthermore, the nature of these interactions reveals a new area for further fruitful investigation on the processes at work within the stock market.

4. Methodological Significance of the Study

The results of our study provide some useful and interesting evidence relating to a number of issues concerned with the paramorphic representation of the market's valuation process. These are:

1) the appropriate measure of relative share value
2) the relative merits of linear additive and configural analytical

techniques

3) the dimensionality and normality of the data

It was indicated in subsections 4.4, 3.4 and 5.8, respectively, that these issues had in general not been resolved by theory, and that there was little empirical evidence to aid us in the selection of an appropriate research methodology. We thus consider the results from our analyses to be particularly useful from a methodological vantage point.

4.1 Evidence on Relative Share Valuation Measures

Two measures of relative share values were employed in this study in order to provide a means of overcoming some of the perceived problems with the earning yield ratio (subsection 5.4.1) and to enable some sort of cross validation of our models. Contrary to expectations, the earnings yield ratio, despite its popularity in other studies and in the finance texts (see chapters IV and V), was found to be less informative about the factors at work within the share price fixing mechanism than the valuation ratio. The valuation ratio model was able to explain more of the variance in share values, even after allowing for differences between the constituents of each model (subsection 6.5). Closer examination of the two measures reveals that

1) the valuation ratio model was able to explore and reveal the complex relationship between return on capital and share values, and thus was able to accommodate the problems of low return on capital companies and utilise the whole sample (subsection 6.7)

2) the valuation ratio model did not assume a constant discount rate between earnings and share prices, regardless of the underlying quality of those earnings (subsection 7.8)

3) by using the valuation ratio the analysis is commenced at one stage up the hierarchy in the share valuation process and thus provides a more complex picture of the characteristics of that process.

Our conclusion is that the valuation ratio serves as a better measure of relative share valuation and is therefore more suitable for this type of research.

4.2 Evidence on the Appropriate Analytical Technique

Three analytical techniques were employed in this study, two possessing linear additive algorithms and the other a configural algorithm. Whilst the configural approach was believed likely to be the most valuable for our purposes, unlike the two linear additive techniques, it has not been used before in this research area. As a result the two linear additive techniques were used for initial analysis of the data providing several models with which the configural analyses could be compared. From our analyses the following conclusions were reached:

1) the linear additive techniques were severely limited in their ability to provide a clear understanding of the user model compared with the configural technique. This is consistent with the findings of Slovic(1969).

2) there was little difference in the variance explained indicating that the linear additive approach is probably just as powerful from a predictive point of view as the configural approach. This finding was to some extent expected, given the similarity in the analytical principles of the techniques and has been found in studies in other areas (see Dawes, 1971 and Dawes and Corrigan, 1974). Nevertheless, as the configural approach used non-continuous explanatory variables as opposed to regression's continuous explanatory variables there was inevitably a loss of information in the analyses and thus effectively suggests that the configural approach was the more powerful.

3) the main explanatory variables isolated by each approach were the same although the less significant variables proved to be unstable between techniques. Given the inherent limitations of the linear additive technique this result is not surprising and we would suggest

that the configural model to be more representative of the true nature of the decision task under examination.

4) there would appear to be little benefit in using both linear discriminant analysis and multiple regression analysis on this type of data. This conclusion is consistent with the arguments of Altman(1981) and Eisenbeis(1977).

Our conclusion is that the configural approach has convincing advantages over the linear additive approach for revealing the detailed characteristics of the decision making process. This does not mean that we dismiss the benefits of the linear additive approach for predictive model building which was not tested in this study.

4.3 Evidence on Dimensionality and Ratio Normality

In chapter V we presented the results of the principal component analysis performed on our sample of 89 independent ratios. The purpose was to determine the underlying dimensions of the data. It was found that the data set was measuring only a few independent dimensions which is consistent with the results of Taffler(1981a), Sudarsanam(1981a), Pinches et al(1975) and Johnson(1979). The implication of this analysis means that it was possible to choose only a few ratios to represent all the important dimensions of the firm. Furthermore selection of variables on this basis avoids needless redundancy in the use of financial ratios and thereby simplifies the analyses.

We also tested the assumption of normality of the ratio distributions on all the 91 ratios in the data base by using the chi-square, skew and kurtosis statistics. We also examined this assumption using four transformations on each distribution. Although no ratio in its untransformed state was found to be normal, it was possible to diminish the degree of non-normality in the distribution by transformation (subsection 5.7). Once again these findings are consistent with the results of similar studies conducted by Sudarsanam(1981) and Bougen and Drury(1980) in the U.K. and by Deakin(1976) in the U.S.A.

5. The Decision-Usefulness Criterion

In chapters I and II it was reported that there was general agreement that knowledge of the user's decision making process is important to the accountant for determining what information to provide in financial statements. It was argued that if it were possible to specify the properties of a particular judgement model, then these properties may form the basis for enhancing the format and content of financial statements. Furthermore, we initially proposed that as the investor was generally considered to be the most sophisticated user of accounting information, understanding his user model subsumes all other users needs. Since our results have provided useful insight into the market's judgement process it should be possible to make inferences on the value of accounting information to investors.

Our results revealed that the investor would appear to need only a very limited set of accounting numbers which may consequently be interpreted as suggesting that financial statements should simply concentrate on presenting relevant information about these few items of data. However, this interpretation is clearly wrong as it is not possible to deduce from our study the relevance of all the other items of information in the accounts. All we can do is to conclude that these data items are important. The problem of trying to generalise from a study of this nature clearly demonstrates the difficulties of assessing the decision-usefulness criterion empirically. We would therefore suggest that the development of this decision-usefulness criterion should be based as well on normative theories and not merely pragmatic empiricism. Finally, the complexity of the way in which accounting numbers interact with share values clearly demonstrates that it may be inappropriate to assume that the investor's model subsumes all other user models.

6. Further Research

This study was concerned mainly with establishing a relationship between accounting numbers and relative share valuations with a view to shedding light on the intricacies of the investors' use of accounting information and his decision making process and thus help to contribute in a small way towards closing the gap between the theory and practice of investment analysis. It was revealed that there are only a few significant key accounting variables used by the investor, although the way in which these variables were combined was both complex and interesting. Our conclusions have, however, been based upon a single time period analysis during which dividend restraint policies were in force, and a limited number of industries and firms. A fruitful line of research therefore is to investigate the inter-temporal stability of our models on an enlarged sample that includes a broader base of industries (that is not simply restricted to manufacturing companies). The Automatic Interaction Detector methodology used in this study appears to be a useful approach for analysing and identifying the configural nature of the market's decision making process and the results of an extended analysis may provide a basis for reappraising and reformulating current corporate finance theories.

Since an implicit assumption behind the formulation of a market model is that it is possible to capture the main characteristics of the market's decision making process, the next logical step would seem to be to test the utility of such models in investment appraisal. It has been demonstrated in other research areas that models can out-perform man due to the inherent biases present in human information processing (see Taffler, 1981b and chapter III for a review). Whether the same type of result could be expected from a market model remains to be tested. If however, as the literature suggests, models can out-perform man then it may be possible to isolate over- and under-valued shares and thus aid in the making of buy and sell decisions. Although, such a finding would have many implications for market efficiency, it could indicate that unconventional research may prove beneficial in a very conventional environment. A view supported by Treynor(1976).

At the very least the cost of identifying out of line share would be substantially reduced from such an automated process. Some of the results of this study relating to the utility of risk measures to investors were seen to be inconsistent with our a priori expectations based upon traditional finance theories. Whilst we recognise the limitations of this study and the inability to make broad generalisations, we feel that there is a need to clarify whether there is any consensus in the market's evaluation of risk. With the increasing trend towards making investment analysis more sophisticated there may, in the near future, be a greater opportunity for examining these phenomena and their implications for corporate finance.

<u>APPENDICES</u>

Appendix A

THE FINANCIAL RATIOS

	Mean Value	Standard Deviation	Constant	No of Outliers > 3.1 S.D.	Trans-formation
The Dependent Ratios					
1 valuation ratio	3.06	1.15		3	log
2 earnings yield	16.10	7.23		4	none
The Independent Ratios					
1 FF/S	-1.85	0.30	0.06	4	log
2 FF/AVTCE	0.55	0.10	0.06	6	sq.rt
3 FF/AVTA	0.46	0.07	0.05	5	sq.rt
4 VA/S	0.56	0.10		1	sq.rt
5 VA/AVTA	0.70	0.13		1	sq.rt
6 VA/AVTCE	0.86	0.19		1	sq.rt
7 VA/AVNCE	0.92	0.21		1	sq.rt
8 EBIT/S	-1.78	0.28	0.08	4	log
9 EBIT/AVTA	-1.57	0.29	0.07	4	log
10 EBIT/AVTCE	-1.19	0.32	0.10	5	log
11 VA/ER	0.65	0.16		11	recip
12 PBT/S	-1.75	0.29	0.10	5	log
13 PBT/AVTA	-1.44	0.28	0.12	4	log
14 PBT/AVTNW	-0.65	0.24	0.30	5	log
15 PBT/AVTL	-0.76	0.41	0.20	3	log
16 PBT/AVCL	-0.38	0.33	0.36	2	log
17 PBT/AVTCE	-1.06	0.31	0.17	4	log
18 PBT/AVNCE	-0.83	0.26	0.24	4	log
19 TNI/S	-1.53	0.16	0.16	4	log
20 TNI/AVTA	0.09	0.05		6	none
21 NI/AVNW	-0.67	0.18	0.34	5	log
22 TNI/AVTL	-0.67	0.26	0.31	3	log
23 TNI/AVCL	-0.17	0.19	0.60	1	log
24 TNI/AVTCE	-1.12	0.22	0.20	4	log
25 TNI/AVNCE	-0.87	0.19	0.27	3	log
26 CF/S	2.33	0.21	0.12	1	sq.recp
27 CF/AVTA	0.46	0.05	0.11	4	sq.recp.
28 CF/AQFA	1.72	1.85		3	none
29 CF/AVTL	-0.78	0.30	0.23	2	log
30 CF/AVCL	-0.33	0.22	0.45	1	log

		Mean Value	Standard Deviation	Constant	No of Outliers > 3.1 S.D.	Trans-formation
31	CF/AVTCE	-1.30	0.28	0.13	3	log
32	CF/AVNCE	-1.19	0.27	0.14	3	log
33	OSCF/AVOSE	-0.93	0.25	0.20	3	log
34	DR/CA	0.42	0.13		1	none
35	DR/INV	0.92	0.25		6	sq.rt
36	CA/CL	0.53	0.28		5	log
37	FA/TA	-1.15	0.39		5	log
38	WC/TNW	0.50	0.22		5	none
39	WC/TL	-0.08	0.44	0.37	4	log
40	TA/ER	0.55	0.15		1	sq.recp.
41	WC/NCE	0.43	0.19		3	none
42	WC/DR	1.92	0.18	2.66	10	sq.rt
43	AVWC/S	-0.75	0.23	0.31	2	log
44	TL/TNW	-0.11	0.57		3	log
45	TL/TA	0.68	0.10		1	sq.rt
46	DEBT/QA	0.64	0.33		2	sq.rt
47	EBIT/AVTL	-0.77	0.39		3	log
48	TA/TNW	0.53	0.13		0	recip
49	QA/TNW	0.80	0.19		5	sq.rt
50	CA/TNW	0.90	0.18		9	sq.recp
51	CL/TNW	-0.29	0.56		2	log
52	AVTNW/S	-1.12	0.48		5	log
53	DEBT/TNW	0.51	0.28		4	sq.rt
54	DEBT/TCE	0.21	0.15		3	none
55	CA/TL	0.35	0.32		1	log
56	AVCR/COS	0.42	0.07		6	sq.rt
57	COS/AVINV	3.88	2.13		1	none
58	AVQA/PDOE	9.08	1.89		2	sq.rt
59	AVQA/S	0.21	0.07		4	none
60	AVCA/S	0.64	0.10		5	sq.rt

		Mean Value	Standard Deviation	Constant	No of Outliers > 3.1 S.D.	Trans- formation
61	S/AVFA	1.62	0.55		5	log
62	S/AVTA	0.45	0.31		4	log
63	S/AVTCE	0.84	0.42		6	log
64	S/AVNCE	0.97	0.45		5	log
65	S/AVINV	0.45	0.10		3	sqrecp
66	DAYS DEBTORS	63.69	21.73		1	none
67	QA/CL	0.91	0.17		5	sq.rt
68	QA/TL	-0.39	0.39		3	log
69	WC/INV	1.19	0.13	2.49	1	log
70	INV/CA	0.50	0.13		2	none
71	QA-CL/PDOE	-16.91	37.29		2	none
72	DIV/OSE1	-3.26	0.56		14	log
73	DIV/OSNI	0.24	0.14		7	none
74	CL/TA	0.62	0.09		0	sq.rt
75	QA/TA	0.32	0.10		2	none
76	CA/TA	0.66	0.13		9	none
77	DEBT/TA	0.14	0.10		3	none
78	DEBT/CA	0.23	0.18		4	none
79	TNI/AVTNW	-0.67	0.18	0.34	5	log
80	INT/EBIT	0.37	0.20		6	sq.rt
81	DR/CR	1.15	0.45		6	none
82	CL/CR	0.65	0.15		2	recip
83	INV/CL	0.92	0.19		4	sq.rt
84	ASSET GROWTH	-0.63	0.26	0.35	3	log
85	PROFIT GROWTH	1.23	0.15	3.12	1	log
86	Z-SCORE	6.45	5.07		0	none
87	BETA	0.91	0.20		5	none
88	TOTAL ASSETS	0.25	0.15		6	sq.recp.
89	NET CAPITAL EMP	0.34	0.20		6	sq.recp.
90	MARKET LIQUIDITY				n/a	none

Note the constant is the amount added to all values in order to make all values positive prior to transformation.

APPENDIX B

RATIO ELEMENT DEFINITIONS

Abbreviation	Definition
AQFA	Aquisitions of Fixed Assets: The change in the value of fixed assets during the trading period plus the depreciation charge.
Asset Growth	Asset Growth: The percentage increase in the net capital employed over the latest trading period.
CA	Current Assets: Traditional definition except for the cash and bank overdraft contra and the valuation of quoted investments at market value.
CF	Cash Flow: Retained profits plus depreciation, minority interests and deferred tax less any capitalised costs.
CL	Current Liabilities: Tradition definition except forcash and bank overdraft contra and the medium term finance adjustment.
COS	Cost of Sales: Employees remuneration, raw materials.
Daysdrs	Days Debtors: Debtors expressed in number of days of annual turnover.
Debt	Debt: All interest bearing debt.
Div	Dividends: Ordinary shareholders dividend
Dr	Debtors
EBIT	Earnings before Interest and Tax
ER	Employees Remuneration (including directors)
FA	Fixed Assets: Excludes any intangible assets.
FF	Fund Flow: Trading profit prior to depreciation, interest and other income.
INV	Inventory: Includes stocks and work in progress.
Mkt Liq	Market Liquidity: A measure of the tradability of a particular share (ref. London Business School).
NCE	Net Capital Employed: Total assets less current liabilities.

(Note: the prefix 'AV' indicates that the average has been calculated from the latest and previous years' balance sheets.)

NI	Net Income: Profit distributable to shareholders.
NW	Net Worth: Ordinary and preference shareholders' capital plus deferred tax, intangible asset adjustment, market value of investments adjustment and reserves.
OSCF	Ordinary Shareholders Cash Flow: Retained profits plus depreciation, deferred tax less any capitalised costs.
OSE	Ordinary Shareholders' Equity: Excludes preference shareholders' interests but includes deferred tax account, intangible assets adjustment and market value of assets adjustment.
OSE1	Ordinary Shareholders' Equity at start of Year
PBT	Profit before Tax
PDOE	Predicted Daily Operating Expense: calculated by dividing the cost of sales by 365.
Profit Growth	Profit Growth: The percentage increase in earnings before interest and tax over the last year.
QA	Quick Assets: Current assets less inventory.
S	Sales
TA	Total Assets: Fixed Assets plus current assets and other assets.
TCE	Total Capital Employed: Net worth plus long term debt and other interest paying debt.
TL	Total Liabilities: All external liabilities, does not include minority interests.
TNI	Total Net Income: Retained profits plus minority interests.
TNW	Total Net Worth: Net worth plus minority interests.
VA	Valued Added: Fundsflow plus employees remuneration.
Z-Score	Z-Score: Derived from Taffler's (1981a) discriminant model.

APPENDIX C

THE STANDARDISED ACCOUNTS

THE STANDARDISED PROFIT AND LOSS ACCOUNT

APPENDIX C I

ABREVI-ATION					
S	SALES		XXX		
-	Less:Bought in Services		XX	)+	COS
VA	VALUE ADDED		XXX		
-	Less:Directors & Employees Remuneration		XX	)+	COS
FF	FUNDS FLOW (Trading Profit)		XXX	)+	ORDINARY SHAREHOLDERS' CASH FLOW; TOTAL CASH FLOW
-	Less:Depreciation	XX			
-	Associated Companies Profits	XX			
-	Other Income	XX	XX		
EBIT	EARNINGS BEFORE INTEREST & TAX		XXX		
XINT	Less:Total Interest		XX		
PBT	PROFIT BEFORE TAX		XXX	)+	ORDINARY SHAREHOLDERS' CASH FLOW; TOTAL CASH FLOW
-	Less:Deferred Tax	XX			
	All Other Tax	XX	XX		
-	PROFIT AFTER TAX		XXX		
-	Less:Minority Interest		XX	)+	TNI
XNI	NET INCOME		XXX	)+	OSNI; TNI
	Less:Preference Dividend	XX		)-	OSNI
EDIV	Equity Dividend	XX	XX		
	RETAINED PROFITS		XXX	)+	ORDINARY SHAREHOLDERS' CASH FLOW; TOTAL CASH FLOW
	(Note:Capitalised Costs)		(XX)	)-	ORDINARY SHAREHOLDERS' CASH FLOW; TOTAL CASH FLOW

COS = cost of sales.
OSNI = ordinary shareholders' net income.
TNI = total net income, i.e. includes minority interests.

APPENDIX C II

THE STANDARDISED BALANCE SHEET

THE ASSETS EMPLOYED

ABREVI-ATION		£	£	
	FIXED ASSETS			
-	Property	XX		
-	Less: Depreciation	XX	XXX	
-	Other fixed assets	XX		
-	Less: Depreciation	XX	XXX	
FA	NET FIXED ASSETS		XXX	
	OTHER ASSETS			
-	Associated companies	XX		
-	Unqoted investments at directors valuation	XX		
-	Inter-group accounts (non-current)	XX		
-	Other assets	XX	XXX	
	CURRENT ASSETS			
XINV	Stocks & W.I.P.	XX		QUICK ASSETS
DR	Debtors & bills receivable	XX		
-	Quoted investments at market value	XX		
-	Short term investments	XX		
CASH	Cash (net of overdraft)	XX		
-	Inter-group accounts (current)	XX		
-	Other current assets	XX		
CA	TOTAL CURRENT ASSETS		XXX	
TA	TOTAL ASSETS EMPLOYED		XXXX	

THE FUNDS EMPLOYED

ABREVIATION		£	£
	SHAREHOLDERS' EQUITY		
	Preference share capital	XX	
-	Ordinary share capital	XX	
-	Reserves	XX	
-	Deferred tax	XX	
-	Intagible assets	(XX)	
ADJINV	Market value of investments adj.	XX	
NW	NET WORTH		XXX
	EXTERNAL FINANCE		
-	Minority interests	XX	
-	Debentures (parent & subsidiary)	XX	
-	Loan stock (parent & subsidiary)	XX	
-	Government grants	XX	
-	Bank & other loans	XX	
-	Inter-group accounts (non-current)	XX	
-	Provisions	XX	
-	Deferred & other liabilities	XX	
	TOTAL LONG TERM DEBT		XXX
OVDT	Bank overdraft (net of cash)	XX	
MTF	Medium term finance	XX	
-	Short term finance & acceptance credits	XX	
CR	Creditors & bills payable	XX	
-	Current & non-current tax	XX	
-	Proposed dividend	XX	
-	Inter-group accounts (current)	XX	
-	Other current libilities	XX	
	TOTAL CURRENT LIABILITIES		XXX
	TOTAL FUNDS EMPLOYED		XXXX

O.S.E.

TOTAL NET WORTH

NET CAPITAL EMPLOYED

DEBT

TOTAL LIABILITIES

Note: O.S.E. = ordinary shareholders' equity.

APPENDIX D

INDUSTRIES INCLUDED IN THE DATABASE

Classification	SEC Group No.
Aircraft and Components	11
Bricks and Roofing Tiles	12
Building Materials/Quarry Products/ Asbestos	14
Cement and Concrete	15
Paint	16
Contracting and Construction	18
Electricals (excluding Light Electronics, Radio and T.V.)	19
Boiler Makers	20
Founders and Stampers	21
Industrial Plant, Engines and Compressors	22
Mechanical Handling	23
Pumps and Valves	24
Steel and Chemical Plant	25
Wires and Ropes	26
Misc. Engineering	27
Machine and Other Tools	28
Heating and Ventilating	30
Instruments	31
Special Steels	33
Light Electronics, Radio and T.V.	35
Floor Covering	37
Furniture and Bedding	38
Household Applicances	39

APPENDIX E

THE RATIO TRANSFORMATIONS AND NORMALITY TESTS

Note: The underlining signifies the best transformation

	RATIO	UNTRANSFORMED CHISQ	SKW	KUR	A	B	RECIPROCAL CHISQ	SKW	KUR	A	B	LOG CHISQ	SKW	KUR	A	B	SQUARE ROOT CHISQ	SKW	KUR	A	B	SQUARE ROOT OF RECIP CHISQ	SKW	KUR	A	B
1	FF / S	65.86	.62	.63	0	5	103.29	.49	.45	7	1	14.48	-.16	.42	0	4	23.74	.21	.49	0	4	27.49	.20	.08	7	1
2	FF / AVTCE	42.23	.56	.68	0	7	291.78	.90	2.37	9	1	30.35	-.36	.82	2	4	25.75	.11	.74	0	6	61.31	.34	.60	11	2
3	FF/ AVTA	36.33	.33	.56	0	4	236.49	.93	2.41	9	1	34.15	-.52	.90	1	4	27.84	-.11	.55	0	5	66.51	.32	.55	12	2
4	VA / S	89.21	.04	-.17	2	1	165.63	.94	1.15	12	5	48.79	-.59	.48	0	4	17.34	-.14	-.23	5	1	114.53	.94	.99	1	7
5	VA / AVTA	47.14	.26	.32	3	1	143.33	.63	.71	16	7	45.96	-.56	.92	0	5	16.89	-.09	.11	6	1	87.23	.42	.30	15	8
6	VA / AVTCE	69.16	.36	.55	10	1	165.11	.80	1.02	16	8	38.14	-.38	.85	1	4	18.47	.11	.54	6	1	71.89	.34	.57	14	9
7	VA / AVNCE	74.33	.57	.91	9	1	155.65	.81	1.11	16	6	35.25	-.36	.80	0	4	31.14	.24	.67	5	1	62.21	.41	.62	12	7
8	EBIT / S	57.44	.43	.68	8	5	84.91	.26	.68	5	1	17.79	.14	.21	8	4	39.35	.43	.86	0	7	23.93	.07	.29	7	1
9	EBIT/AVTA	44.04	.44	1.16	0	10	434.83	1.28	4.42	5	2	29.38	.05	.59	9	4	41.43	.02	.98	0	5	68.53	.22	.60	11	3
10	EBIT/AVTCE	58.85	.56	1.15	1	7	316.18	.99	2.86	6	1	27.79	.04	.85	6	5	35.32	.23	1.03	1	9	56.03	.22	.68	10	2
11	VA / ER	1208.47	1.30	6.02	10	4	63.89	-.72	.93	0	11	133.50	.76	1.05	14	9	308.47	1.03	1.99	13	7	90.07	-.46	.54	13	10
12	PBT / S	62.98	.34	.85	8	5	194.78	.68	2.19	4	2	18.15	-.01	.51	8	5	38.95	.37	.98	0	8	38.57	.22	.72	8	2
13	PBT / AVTA	40.97	.39	1.06	0	8	282.99	1.18	3.43	6	1	27.05	-.09	.66	8	4	28.81	-.02	.91	0	4	67.98	.21	.48	12	1
14	PBT/AVTNW	50.68	.50	1.49	2	12	573.28	.90	3.43	5	1	45.06	.03	1.19	10	5	51.63	.09	1.54	0	9	78.63	-.09	.89	12	1
15	PBT/AVTL	113.60	.96	1.00	0	5	355.37	1.07	2.97	4	1	15.69	-.13	.45	0	3	39.75	.42	.64	0	6	31.94	.18	.13	9	2
16	PBT/AVCL	72.43	.72	.66	0	5	307.98	.55	.81	4	1	10.17	-.10	.23	0	2	28.27	.31	.44	0	6	22.78	.32	.19	4	1
17	PBT/AVTCE	54.97	.58	1.15	0	8	318.90	1.06	3.16	6	1	39.78	-.29	1.17	1	4	48.19	.15	1.07	0	8	52.88	.09	.51	12	1
18	PBT/AVNCE	59.62	.40	1.21	0	10	464.22	1.36	5.31	4	1	35.21	.08	1.15	7	4	38.82	.12	1.26	1	8	63.46	.07	.82	11	1
19	TNI / S	66.51	.37	.85	0	6	220.21	.02	1.39	4	1	29.24	.08	.28	8	4	42.88	.17	.78	0	5	37.58	.02	.34	8	1
20	TNI/AVTA	15.91	-.00	.63	0	6	431.14	1.14	3.91	4	2	21.32	-.08	.21	11	4	20.31	-.29	.79	0	5	62.05	.24	.60	10	2
21	XNI/AVNW	36.90	.15	1.17	0	10	734.21	.45	2.48	5	1	32.97	-.06	.84	11	5	32.82	-.04	1.23	3	7	74.50	.11	1.26	8	1
22	TNI/AVTL	61.48	.55	.58	0	5	310.62	.63	2.02	3	1	17.38	-.12	.41	1	3	28.97	.25	.38	0	6	21.18	.07	.16	6	1
23	TNI/AVCL	33.85	.36	.28	0	6	748.26	1.14	7.34	1	1	19.53	.07	-.16	6	1	29.34	.27	.18	2	4	25.46	.03	.06	4	1
24	TNI/AVTCE	38.80	.26	.99	0	7	393.40	.93	3.24	5	1	27.47	-.05	.52	9	4	31.25	-.08	.95	0	5	54.45	.14	.60	10	1
25	TNI/AVNCE	44.55	.25	1.04	1	7	506.43	1.06	4.92	4	1	40.42	.01	.72	9	3	37.15	-.04	1.06	1	6	54.98	.01	.75	10	1
26	CF / S	65.98	.50	.70	0	4	97.73	.20	1.06	4	1	22.21	.13	.26	6	2	38.17	.25	.59	0	4	21.50	-.02	.10	8	1
27	CF/AVTA	27.33	.02	.54	4	7	220.14	.56	1.34	7	1	25.96	-.09	.30	8	3	20.30	-.09	.71	0	4	42.53	.20	.41	9	1
28	CF / AFA	459.20	1.05	4.44	18	3	3932.71	-1.00	-2.00	1	1	876.10	1.18	9.55	11	1	471.94	.99	4.42	18	3	3491.04	-4.73	*****	1	1
29	CF / AVTL	61.15	.73	.56	1	8	192.38	.53	1.09	4	1	13.60	-.04	.36	0	2	28.66	.33	.47	0	5	21.38	.07	-.07	6	1
30	CF / AVCL	56.84	.56	.36	0	6	486.67	.57	1.97	1	1	13.78	.02	.12	0	1	28.28	.31	.25	0	1	13.90	-.05	-.25	5	1

APPENDIX E - Cont.

RATIO	UNTRANSFORMED CHISQ	SKW	KUR	A	B	RECIPROCAL CHISQ	SKW	KUR	A	B	LOG CHISQ	SKW	KJR	A	B	SQUARE ROOT CHISQ	SKW	KUR	A	B	SQUARE ROOT OF RECIP CHISQ	SKW	KUR	A	B
31 CF / AVTCE	45.83	.46	.99	0	7	272.37	.62	1.52	7	1	23.62	-.01	.32	8	3	30.61	.06	.84	0	4	45.35	.21	.39	9	1
32 CF / AVNCE	39.66	.65	.91	3	7	511.82	1.71	7.91	3	2	23.02	.08	.40	9	3	25.40	.05	.95	0	5	57.92	.14	.50	9	3
33 OSCF/AVOSE	42.26	.43	1.17	1	9	500.36	1.22	6.13	4	1	24.52	.04	.50	10	3	41.46	.08	1.12	1	7	65.43	.02	.79	8	2
34 DR / CA	50.21	-.55	.42	0	1	865.90	2.10	6.93	9	1	146.24	-.94	1.39	14	7	125.38	-1.00	1.10	0	7	290.11	1.15	2.29	17	1
35 DR / XINV	48.88	.35	.32	13	9	728.41	2.13	7.39	7	1	65.22	-.58	1.25	0	4	35.59	.25	.92	0	6	145.56	.62	1.12	15	1
36 CA / CL	61.57	.81	.78	0	9	44.98	.53	.34	1	4	26.34	.12	.42	0	5	33.72	.50	.65	0	6	19.69	.22	.27	0	4
37 FA / TA	81.39	.87	1.08	0	9	81.34	.57	.41	12	4	20.40	-.28	.53	0	5	37.43	.30	.66	0	2	37.71	.30	.11	9	6
38 WC / TNW	25.72	-.44	.56	0	5	2185.40	2.00	16.30	1	1	48.50	-.39	.28	10	1	35.61	-.50	.54	5	4	110.50	.71	1.59	4	1
39 WC / TL	82.15	.88	.83	0	10	788.99	1.00	3.35	4	1	16.76	-.21	.48	0	4	27.45	.38	.72	0	7	40.40	.24	.08	9	2
40 TA / ER	1627.03	1.85	8.87	9	3	55.05	.33	.07	3	1	75.80	.56	.73	12	10	272.43	.97	2.38	14	7	21.55	-.19	.13	9	1
41 WC / XNCE	19.83	-.44	.26	0	3	1172.69	1.25	3.77	3	1	64.02	-.47	.24	11	3	38.78	-.64	.54	2	3	125.30	.65	.72	11	1
42 WC / DR	125.84	.37	1.59	20	7	1679.98	3.93	50.11	2	2	81.77	.53	1.72	14	5	89.02	.24	1.36	20	10	223.33	-.42	2.65	7	2
43 AVWC / S	41.81	.56	.57	1	5	251.87	.58	1.93	1	1	13.93	.02	.43	1	2	27.52	.30	.43	1	5	18.59	-.03	.04	6	1
44 TL / TNW	159.66	.91	.74	12	10	163.26	1.12	1.03	1	6	14.00	.16	.03	0	3	77.13	.82	.58	0	8	49.16	.59	.24	0	3
45 TL / TA	16.22	.19	-.30	0	0	163.26	1.12	1.03	1	6	38.56	-.52	.04	0	1	17.60	-.16	-.28	0	1	105.37	.85	.49	0	4
46 DEBT / QA	255.99	.99	.74	0	4	2435.57	.28	5.28	46	46	621.76	-1.88	2.66	0	0	152.77	-.08	-.21	0	2	1894.98	.67	5.99	46	46
47 EBIT/AVTL	104.98	.96	1.03	0	7	288.09	.69	1.56	5	1	12.03	-.05	.45	0	3	46.58	.46	.72	0	6	21.45	.24	.24	6	1
48 TA / TNW	159.66	.91	.74	12	10	15.45	-.19	-.30	0	0	79.08	.83	.54	0	7	126.05	1.04	.86	1	8	36.57	-.52	.04	0	2
49 QA / TNW	92.02	.97	1.16	0	8	140.74	.55	.86	21	13	44.79	-.44	1.03	0	6	39.63	.36	.74	0	5	67.76	.37	.59	15	13
50 CA / TNW	149.26	1.03	1.53	1	10	102.54	.38	.65	18	12	57.55	-.27	1.12	0	8	94.19	.42	1.14	0	4	51.85	.11	.53	14	9
51 CL / TNW	226.88	1.37	1.62	2	10	122.15	1.00	.85	2	6	24.29	.24	-.02	0	2	107.18	.93	.72	0	6	40.12	.48	.12	0	2
52 AVTNW / S	58.26	.39	.01	12	4	119.00	.46	.25	19	10	16.36	-.09	.62	2	5	31.33	.46	.58	0	5	68.31	.77	1.05	0	9
53 DEBT / TNW	182.33	.46	.13	20	10	2409.07	.65	6.91	46	46	522.76	-1.61	1.89	0	0	133.18	.34	.25	0	4	1713.16	.75	5.21	46	46
54 DEBT/TCE	169.29	.54	-.05	0	3	2420.22	.65	6.86	46	46	664.78	-1.86	2.47	0	0	245.65	-.49	-.41	0	0	1780.99	.79	5.39	46	46
55 CA / TL	84.59	.84	.65	0	9	49.55	.72	.66	0	8	9.26	.06	.45	0	1	32.95	.51	.55	0	5	23.56	.37	.43	0	5
56 AVCR/COS	39.13	.49	.62	0	4	156.19	.89	1.11	5	1	37.66	-.29	.62	0	4	23.62	.08	.49	0	6	67.39	.50	.54	5	1
57 COS/AVINV	221.41	1.05	1.28	13	1	3932.71	-1.00	-2.00	1	1	495.11	1.54	2.81	7	1	256.65	1.13	1.56	11	1	3932.71	-1.11	-1.63	1	1
58 AVQA/PDOE	91.44	.24	1.14	13	2	181.42	.53	1.25	20	12	79.15	-.33	1.78	1	8	67.86	-.14	1.30	10	2	100.23	.46	1.21	16	13
59 AVQA / S	49.73	.00	.65	11	4	193.93	.47	1.12	21	12	88.69	-.54	1.80	0	12	57.65	-.10	1.45	4	5	114.53	.40	1.45	16	12
60 AVCA / S	24.81	.30	.17	7	5	150.34	1.04	1.16	0	7	25.60	-.19	.59	0	5	18.78	.21	.47	0	5	70.02	.62	.79	0	7

APPENDIX E - Cont.

		UNTRANSFORMED					RECIPROCAL					LOG					SQUARE ROOT					SQUARE ROOT OF RECIP				
	RATIO	CHISQ	SKW	KUR	A	B	CHISQ	SKW	KUR	A	B	CHISQ	SKW	KUR	A	B	CHISQ	SKW	KUR	A	B	CHISQ	SKW	KUR	A	B
61	S / AVFA	93.36	.54	.21	13	7	152.03	.62	1.02	22	13	38.80	-.19	.99	0	5	34.38	.53	.71	1	7	107.13	.97	1.52	1	9
62	S / AVTA	74.39	.68	.90	1	7	55.50	.37	.50	13	4	36.76	-.12	.75	0	4	37.83	.32	.89	0	7	41.73	.56	.92	1	4
63	S / AVTCE	76.60	.35	.21	15	12	89.05	.65	.86	11	4	30.52	.11	.92	0	6	43.85	.59	1.13	1	9	57.75	.51	.89	1	4
64	S / AVNCE	94.95	.52	.42	16	11	65.60	.48	.35	12	4	22.76	.06	.64	2	5	73.56	.79	1.03	1	9	36.61	.49	.68	0	4
65	S / AVINV	194.09	.94	1.27	17	13	59.03	.78	.86	1	5	49.12	.52	.81	0	7	131.49	1.09	1.35	0	9	42.78	.20	.48	0	3
66	DAYS DEBTORS	52.98	-.45	.21	0	1	3571.32	-.55	-.78	1	1	221.41	-1.04	1.32	16	4	152.54	-.99	1.04	0	6	611.59	1.62	3.75	10	1
67	QA / CL	68.87	.74	.77	0	8	96.07	.45	.41	17	10	33.26	-.39	.86	0	7	29.52	.22	.68	0	5	75.28	.85	1.14	0	9
68	QA / TL	118.29	.99	1.13	0	8	93.95	.73	.93	12	8	26.72	-.15	.69	0	3	57.48	.47	.74	0	5	70.19	.67	.83	1	7
69	WC / XINV	44.30	.38	.85	11	6	2634.48	.34	6.14	1	1	40.59	.15	.71	10	1	40.83	.31	.69	11	7	143.46	-.16	1.04	9	1
70	XINV / CA	24.92	.02	.52	0	2	134.59	.73	1.18	18	8	82.36	-.84	1.11	0	7	42.34	-.45	.74	0	3	88.31	.63	.92	14	8
71	QA-CL/PDOE	36.71	.08	.50	9	2	3932.71	-1.00	-2.00	1	1	43.73	-.16	.81	7	2	37.52	.04	.76	7	4	1110.82	-.65	7.48	2	1
72	EDIV/OSE1	72.79	.32	.90	14	8	975.80	1.92	9.33	14	14	77.16	-.01	1.36	16	14	90.59	-.11	1.96	0	5	240.40	.51	1.83	18	14
73	EDIV/OSNI	112.46	.46	.75	13	7	3623.10	-1.04	-1.91	23	23	157.02	.99	1.99	25	23	111.41	-.83	1.70	12	7	996.11	-1.03	-.70	23	23
74	CL / TA	34.44	.45	-.08	0	0	120.78	1.01	.87	0	8	20.82	-.35	.01	0	1	8.12	.05	-.21	0	0	60.37	.72	.44	0	5
75	QA / TA	14.68	.05	.28	0	2	176.65	.79	1.37	20	11	86.00	-.85	1.13	1	9	36.37	-.46	.76	0	7	103.39	.64	.94	16	10
76	CA / TA	76.97	-.87	1.08	0	9	219.72	.55	.68	23	16	118.23	-.61	.81	17	16	123.54	-1.10	1.43	0	11	148.60	.65	.98	20	16
77	DEBT / TA	149.95	.58	-.02	0	3	2362.01	.97	8.57	46	46	593.95	-1.75	2.10	0	0	233.00	-.41	-.45	0	0	1988.97	2.58	5.08	0	46
78	DEBT / CA	120.34	.83	.48	0	4	2469.99	.68	6.93	46	46	602.01	-1.80	2.38	0	0	204.47	-.18	-.18	0	1	1721.40	.83	5.72	46	46
79	TNI / AVTNW	44.03	.15	1.18	0	9	743.63	.48	2.53	5	1	33.28	-.03	.88	10	5	37.15	-.11	1.24	2	7	74.95	.14	1.26	8	1
80	XINT/EBIT	204.59	1.07	1.80	16	6	1512.80	1.67	7.62	29	25	216.71	-1.28	1.91	0	0	84.29	.69	.82	0	6	980.15	1.50	4.64	29	27
81	DR / CR	53.10	.36	.82	0	6	348.26	1.08	2.29	22	9	145.64	-.96	1.54	0	11	62.80	-.32	1.07	0	5	177.73	.79	1.46	19	11
82	CL / CR	142.51	.82	.69	14	8	24.47	-.29	-.20	0	2	85.61	.74	.53	0	7	130.54	.98	1.01	0	8	42.92	-.57	.17	0	3
83	XINV / CL	71.62	.77	.72	0	5	135.22	.75	.94	16	11	31.85	-.40	.90	0	8	17.39	.22	.52	0	4	86.34	.93	1.18	0	10
84	ASSET GRTH	65.50	.57	1.24	0	8	349.99	1.09	3.67	3	1	33.36	-.15	.73	11	3	37.09	.21	1.17	0	7	47.94	.16	1.06	9	1
85	PROFIT GRTH	145.89	.33	1.84	20	11	2807.97	-1.11	3.28	1	1	126.75	.19	2.04	16	1	120.36	.19	1.93	18	12	183.70	-.29	2.89	9	1
86	Z-SCORE	22.97	.24	-.37	0	0	3010.07	7.46	*****	2	1	62.69	-.49	.05	10	3	21.72	-.36	-.02	0	3	241.58	.92	1.34	10	2
87	BETA	34.05	-.25	.57	0	5	2988.09	.20	4.18	3	3	107.10	-.52	.56	8	3	88.57	-.57	.70	0	5	269.28	.80	1.36	6	3
88	TOTAL ASSET	1633.67	1.79	5.42	26	8	225.48	.94	.87	16	12	124.16	.82	.25	0	1	521.74	1.24	1.99	24	12	83.61	.68	.31	0	6
S 89	NET CAP EM	1637.53	1.57	4.71	27	8	321.65	1.12	1.28	16	11	107.59	.80	.20	0	1	553.88	1.36	2.31	22	13	102.94	.72	.27	0	5
P.90	EARN YLD	76.88	.34	.79	0	4	3525.57	.48	7.39	21	19	193.89	.18	1.83	24	21	105.47	-.83	2.25	0	23	1101.06	.95	7.77	22	21
91	VAL RATIO	262.38	1.09	1.14	16	9	161.41	1.22	1.29	0	0	51.81	.38	.01	0	3	158.43	1.06	.86	0	8	61.38	.47	-.07	0	0

APPENDIX F

MULTIPLE REGRESSION: THE ASSUMPTIONS AND STATISTICAL TESTS EMPLOYED

This appendix decribes the assumptions and statistical test employed in the analyses referred to in chapter VI. The regression method employed in this study is based upon the least squares criterion which is summarised by Koutsoyiannis (1977: p61) as follows:

> "The rationale of this criterion is easy to understand. It is intuitively obvious that the smaller the deviations from the line of the regression, the better the fit of the line to the scatter of the observations. Consequently from all possible lines we choose the one for which the deviations from the points is the smallest possible. The 'least squares criterion' requires that the regression line be drawn in such a way as to minimise the sum of the squares of the observations from it."

Koutsoyiannis also goes on to establish that the regression estimates derived in this way do actually possess the optimal properties accepted as desirable by traditional statistical theory. (For a more extensive and mathematical description of MRA see Koutsoyiannis (1977:100).)

The assumptions underlying MRA are as follows:

1) the error term 'e' is a random variable, with a mean value of zero and a normal distribution. This means that errors due to bad measurement in the dependent variable, to omitted variables and the mathematical form of the model should be random in nature.

2) the probability distribution for 'e' remains the same over all observations, that is the error term is homoscedastic.

3) the explanatory variables are uncorrelated, that is the model is free from multicollinearity.

4) the model has no specificiation error in that all the important variables appear explicitly in the function and the mathematical form is correctly defined. In other words the model formulated is on a priori grounds correct and that the regression coefficients are

statistically correct estimates of the true population parameters.

This is not an exhaustive list of assumptions although it does cover the important issues. The first assumption concerning the random nature of the error term cannot be tested directly (Koutsoyiannis 1977:179) and therefore it has to be established on a priori grounds. As every effort was made to avoid any errors in the data and the formulation of the model, it is reasonable to assume that this assumption is valid. The second assumption concerning heteroscedasticity was tested by firstly transforming all the variables and bringing in the outliers, and secondly by plotting scatter diagrams of each of the independent variables with the dependent variables. As no wide tails or unusual distributions were found on the scatters it was considered reasonable to conclude that the error term is homoscedastic and thus the second assumption is valid.

The problems of multicollinearity, the third assumption, were avoided in two ways. Firslty by ensuring that all variables entering into a model were measuring a different financial characteristic according to the principal component analysis(see appendix G). In addition the correlation between any two independent variables had to be below a rule of thumb value of .60 and no greater than the variance explained by the model.

The final assumption regarding the specification of the model was adhered to by ensuring that the model was statistically significant in all respects, and by using intuition and judgement when choosing the final models.

The multiple regression analyses were conducted in a stepwise manner on the data described in chapter V. The stepwise technique is a method whereby the most significant explanatory variable enters the model first and this is successively added to by selecting other variables suquentially that explain more variance after taking into account the variance explained by their predecessors. (For more detailed explanation see Nie et al, 1975). The models presented in this thesis were decided upon after conducting numerous stepwise multiple regression analyses with various control criteria eg. excluding certain variables and altering the levels of significance. It is believed that in this way it was possible to derive a "good" model from the data.

The Statistical Significance Tests

When using multiple regression care has to be taken to ensure that the models formulated are statistically correct and provide unbiased estimates of the true models. If the basic tests are violated in anyway it could result in incorrect and spurious results. The tests for significance in MRA can be categorised into three separate aspects as follows:

a) The Over-All Significance of the Model.

It is possible, especially with small samples, to incorrectly believe that the variance explained by the model is statistically significant. The F-Test provides the means for testing whether the causal relationship proposed by the model is significant or whether it could be caused by chance. The F-Value for the model is calculated as follows:

$$\text{F-Value} = \frac{\text{Mean Square Error of Regression Model}}{\text{Mean Square Error of the Residual}}$$

with degree of freedom: v1 = k - 1, v2 - n - k

where k = no. of variables in model + 1,n - total number of observations. This F-Value is then examined to find whether or not it is significant at a given level of confidence.

b) The Significance of the Independent Variables in a Model.

It is quite a common fault to presume that because the overall model is statistically significant all the individual variables in the model are statistically significant. In order to ensure that each of the variables is adding significantly to the variance explained in the dependent variable the F-Test is used as follows:

$$\text{F-Value} = \frac{\text{Mean Square Error of Xi Additional Variation}}{\text{Mean Square Error of Residual}}$$

with Degrees of Freedom, v1 = 1 and v2 = n - k

where k = number of variables in model + 1.
Again the F-Value calculated would be compared with the F-Tables

c) The Regression Coefficients

One of the properties of a multiple regression model is that the model coefficients are unbiased and have minimum variance properties. To test for this a t-value is calculated as follows:

$$\text{t-calc} = \frac{\text{Regression Coefficient i}}{\text{Standard Error of Coefficient i}}$$

This t-value is then compared to the values in a T-Table for a given number of degress of freedom to see whether the coefficient is statistically significant at a given level of confidence.

The above tests establish the significance of a M.R. model but from a utility point of view, the researcher requires to know a) how much of the variation in the dependent variable the model explains and b) what is the relative importance of each variable in the model. The first statistic is given by the coefficient of determination (or, as is it is often called, the adjusted R squared). This represents the amount of variance explained and ranges from 0.0 to 1.00, that is nil and all variance explained respectively. Obviously the lower the variance explained the less useful the model.

The second statistic required is the standard partial regression coefficient (or beta coefficient) for each coefficient. This measures the amount of movement in the dependent variable, measured in standard deviations, caused by one standard deviation movement in an independent variable. When this statistic is calculated for all the independent variables it is then possible to compare the relative importance of each variable as measured by its influence of the dependent variable providing the variables are relatively orthogonal.

APPENDIX G

THE RESULTS OF

THE PRINCIPAL COMPONENT ANALYSIS

ORTHOGANAL FACTOR ANALYSIS

VARIMAX RCTATED FACTOR MATRIX
AFTER ROTATION WITH KAISER NORMALIZATION

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
FFS	.66949	.39694	.04351	.09010	.48279	-.05221	-.08063	-.07056	-.01048	.03707
FFATCE	.89144	-.16702	-.01318	.06743	-.07317	.17877	.13948	-.04451	-.01185	.03025
FFATA	.89268	.15398	.03799	.08207	-.04619	.02116	.09879	-.03966	.03973	.00609
VAS	.14136	.37493	.08083	.04278	.49374	.01304	.73561	.05578	.01189	.02142
VAATA	.28367	.02286	.07227	.01844	-.18988	.10761	.91365	.09032	.03014	.01193
VAATCE	.31864	-.28701	.00527	.00969	-.19539	.25017	.82459	.06139	-.03330	.03296
VAANCE	.24337	-.42288	-.01207	-.05587	-.18021	.10776	.81505	.13296	-.01316	-.01115
EBITS	.67201	.39315	.03531	.15782	.49747	.01108	-.17161	-.08838	-.06416	.04711
EBITATA	.91529	.18424	.04608	.15918	.03358	.08038	-.03391	-.08460	-.02495	.02479
EBITATCE	.92420	-.10973	.00525	.13944	-.00487	.21890	.01617	-.08889	-.06093	.04344
VAER	-.51895	-.11892	.00263	-.05789	-.07609	.04617	.74381	.09892	.04963	-.00342
PBTS	.71548	.43205	.03649	.17485	.39214	.15445	-.13720	-.07459	-.03780	.06847
PBTATA	.88993	.25990	.05332	.17354	.01519	.21630	-.02028	-.06227	-.01649	.05285
PBTATNW	.92412	-.14315	-.01287	.14840	-.02373	.08122	-.01751	-.13143	-.05413	.08191
PBTATL	.71365	.55014	.07814	.16859	.03801	.30070	-.03175	.03155	-.01573	.02401
PBTACL	.69660	.60464	.05602	.20770	.05024	.16069	-.06696	-.06824	-.04164	.02872
PBTATCE	.90412	.02326	.02386	.16173	-.01412	.31689	.01940	-.06585	-.05216	.07144
PBTANCE	.92600	-.06826	.01760	.12033	-.01989	.24435	.01572	-.02899	-.03264	.06352
TNIS	.74284	.45725	.08892	.05343	.39890	.04867	-.10368	.02350	-.01677	.02951
TNIATA	.91605	.25921	.11543	.02400	-.02826	.08453	.05306	.07449	.01421	-.01367
XNIANW	.94299	-.15979	.04545	-.01136	-.06739	-.05058	.03702	-.01401	-.01941	.03505
TNIATL	.73060	.57456	.12859	.04748	-.00190	.21001	.01336	.12694	.00647	-.02126
TNIACL	.71750	.63405	.11191	.08633	.00772	.05981	-.02099	.01961	-.02253	-.01921
TNIATCE	.94001	.01599	.07460	.01314	-.05842	.21072	.07375	.03995	-.01664	.03075
TNIANCE	.94419	-.08147	.07106	-.04311	-.06551	.11796	.07219	.08731	.00999	.02127
CFS	-.72855	-.46418	-.01379	-.02209	-.38595	.03271	.05302	.05799	-.02813	.15027
CFATA	.88519	.23334	.02029	-.01335	-.10472	.00731	.11697	-.01554	.05358	-.20411
CFAQFA	.25616	.01461	.26901	-.09819	-.00488	-.01378	.04944	.07620	.10969	-.03197
CFATL	.71152	.59620	.07063	.02799	-.06131	.16326	.06861	.07540	.04083	-.17232
CFACL	.68371	.65074	.04853	.07539	-.05138	-.01256	.03185	-.05141	.00728	-.16560
CFATCE	.90102	-.03818	-.01858	-.02393	-.12893	.15052	.14395	-.03499	.01482	-.16215
CFANCE	.88934	-.14939	-.02898	-.08549	-.13327	.04376	.14614	.01640	.04293	-.18748
OSCFACSE	.84935	-.24257	-.06838	-.04634	-.12927	-.15779	.11251	-.09380	.01693	-.17264
DRCA	-.03548	-.12457	-.33183	.33079	-.07790	-.03266	.07112	-.01860	.82508	.01180
DRXINV	.03295	-.06241	-.46024	.62965	-.02632	.03939	.04443	.00633	.56897	.04049
CACL	.08153	.57490	.74768	.24524	.06757	.07562	.01351	-.02960	-.01722	.00446
FATA	-.08967	.52767	-.75094	-.09171	.00005	-.17526	-.04576	-.16826	.01900	-.02739
WCTNW	.09619	-.09561	.90420	.22781	.06294	-.05365	-.01608	-.05436	-.03791	.05108
WCTL	.11026	.52945	.76570	.20779	.05616	.21201	.04122	.06954	.02352	.00021
TAER	-.08284	-.02765	.04914	-.00403	-.16374	.09676	.96160	.10118	.00389	.02038
WCXNCE	.12507	-.02171	.92792	.18971	.04160	.15448	.01858	.08162	-.00463	.05249
WCDR	.06940	.37539	.66407	.05407	.05953	.03174	.01512	.03717	-.50975	-.04784
AWCS	-.01634	.36474	.75955	.20754	.42768	.04184	-.08259	-.00055	-.02051	.04218
TLTNW	-.09164	-.89812	-.14791	-.05252	.04083	-.34450	.00294	-.12914	-.01435	[illegible]

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
TLTA	-.08745	-.89801	-.13951	-.05594	-.04449	-.34348	.00508	-.14070	.00331	-.00803
DEBTQA	-.30251	-.12582	-.10334	-.37640	.01947	-.78776	-.15942	-.15922	-.00839	-.01337
EBITAIL	.70883	.57280	.08756	.15259	.05241	.23038	-.04212	.03502	-.01958	.00716
TATNW	.09593	.89875	.15387	.04978	.04129	.34132	-.00116	.12505	.01232	.01678
QATNW	.01792	-.82297	.00345	.50733	.00024	-.10270	.01968	.00912	.08761	-.00076
CATNW	.02922	.89172	-.36908	-.02094	.04571	.14551	-.06996	.00404	-.02827	.02799
CLTNW	-.06109	-.95932	-.12506	-.10169	-.05655	-.15956	.04607	.01137	.01843	-.02777
ATNWS	-.09640	.77173	.10215	.03215	.55628	.10211	-.16572	.03999	.01803	.03339
DEBTINW	-.27272	-.47114	-.09722	-.09163	.03160	-.78476	-.12796	-.11321	.04073	-.04679
DEBTTCE	-.27368	-.48767	-.09836	-.07653	.03410	-.78147	-.11987	-.09510	.03633	-.04764
CATL	.12633	.42274	.71886	.13670	.03521	.39976	.08556	.22155	.04246	-.01990
ACRCOS	-.02850	-.56018	-.05834	-.04594	.64309	.19124	-.05578	-.13758	.00484	-.08313
COSAINV	.08280	-.05988	-.63008	.33749.	-.58386	.04388	-.14805	.02355	.00371	.06949
AQAPDOE	.09986	.01112	.16854	.64185	.69524	.02440	-.11803	.04154	.08664	.04913
ACAS	.01757	-.04788	.18597	.65325	.67955	.02738	-.10268	.07159	.06940	.05719
ACAS	-.11739	-.00293	.57681	.08711	.77043	-.03540	-.12986	.04624	-.01548	.00834
SAFA	.15973	-.62471	.50613	.09387	-.43625	.19113	.13032	.11685	-.03776	.01969
SATA	.19270	-.40731	-.00426	-.01345	-.82997	.13962	.23857	.04602	.04906	-.02389
SATCE	.22542	-.61378	-.04991	-.01802	-.64477	.26302	.22908	.01631	.01031	-.00241
SANCE	.13877	-.72144	-.05646	-.07743	-.59757	.10921	.21119	.09145	.01840	-.03674
SAINV	-.16153	.01759	.68107	-.43924	.51870	-.06683	-.07459	-.00876	-.04988	-.03621
DAYSDRS	-.09402	-.10008	.17659	.27339	.59709	.01461	-.01013	-.00386	.67757	.01990
QACL	.12937	.38972	.24870	.83872	.09042	.11337	-.01307	-.02091	.10331	.02650
QATL	.16778	.27943	.27041	.74172	.06966	.36874	.04146	.16528	.19789	.01594
WCXINV	.13078	.44351	.43600	.68089	.09038	.12406	.00119	-.01921	.00324	.04660
XINVCA	-.09403	.05053	.44360	-.85774	-.04550	-.07438	.03085	-.02221	-.13284	-.05317
QACLPDOE	.17501	.43071	.22265	.79771	-.00603	.13903	-.00290	-.01313	-.04911	.04914
EDIVOSE1	.53964	-.06682	.05133	.07624	-.04355	.04911	.04808	-.06965	.06445	.75178
EDIVCSNI	-.27307	.07369	.00775	.08820	.02060	.03721	.02469	-.00744	.03137	.80589
CLTA	-.02423	-.95107	-.08783	-.14582	-.07307	.01682	.08392	.12045	.05636	-.02879
QATA	.13804	-.43380	.18258	.80858	.01680	.16488	.04462	.10059	.14494	.04015
CATA	.08336	-.53746	.79185	.08443	-.01219	.14919	.08581	.14179	.02584	.00480
DEBTTA	-.31268	-.32584	-.05703	-.08015	.04443	-.84939	-.13264	-.09656	.03118	-.03637
DEBTCA	-.31146	-.15313	-.28198	-.09771	.03535	-.82492	-.14837	-.15055	.01033	-.02175
INIATNW	.94637	-.15993	.04232	-.01110	-.06546	-.04873	.03821	-.01508	-.01568	.03422
XNIEBIT	-.47842	-.36254	-.01967	-.23193	.03084	-.53371	-.03908	-.03093	.02074	-.03849
DRCR	.04542	.41047	.25672	.36505	.08950	-.14733	-.00242	.10207	.61483	.04611
CLCR	.02398	-.19796	.00751	.04282	-.18516	.43809	.12888	-.25269	-.02195	-.11399
XINVCL	-.05920	.41410	.78297	-.38993	.00397	-.00944	.03919	-.03902	-.06418	-.03635
ASSGRTH	.44493	-.07483	.09669	-.09769	-.14059	-.00630	-.14081	-.03067	.28158	-.08113
PROGRTH	.37231	-.03582	.01889	-.04797	-.05915	-.04830	-.00654	-.06068	.05640	-.42269
ZSCR	.42201	.74652	.24101	.35407	.05817	.19340	-.03880	-.00715	-.04844	.01492
BETA	.02413	-.15940	-.12119	-.04394	.06055	.10229	.05395	-.60281	-.11164	-.15127
LCGTA	-.09978	.04070	.05732	.06036	.00516	.17494	.25275	.85900	-.02071	-.00876
LOGNCE	-.11008	-.13942	.02852	.03716	-.01068	.15437	.25604	.85901	-.02102	-.01766
MKTL10	-.09902	.00384	.05564	.01846	.00386	.14811	-.00212	.71628	-.05044	-.10841

	FACTOR 11
FFS	.16781
FFAICE	.08255
FFATA	.14923
VAS	.08798
VAATA	.01816
VAATCE	-.04485
VAANCE	.01163
EBITS	.21983
EBITATA	.22177
EBITATCE	.15695
VAER	-.12147
PBTS	.18107
PBTATA	.17596
PBTATNW	.13447
PBTATL	.18685
PBTACL	.15390
PBTATCE	.13271
PBTANCE	.16775
TNIS	-.05088
TNIATA	-.08526
XNIANW	-.15043
TNIATL	-.01687
TNIACL	-.06082
TNIATCE	-.13149
TNIANCE	-.11149
CFS	.15011
CFATA	-.20458
CFAQFA	-.07854
CFATL	-.10386
CFACL	-.15455
CFATCE	-.23689
CFANCE	-.20847
OSCFAOSE	-.23934
DRCA	-.09061
DRXINV	-.02919
CACL	-.03706
FATA	-.06868
WCTNW	-.03345
WCTL	.00597
TAER	-.05176
WCXNCE	.02043
WCDR	-.02823
AWCS	.02983
TLTNW	-.05193
TLTA	-.06174
DEBTQA	.05234
EBITATL	.22229
TATNW	.05265
QATNW	.00050
CATNW	.02524

	FACTOR 11
CLTNW	.00354
ATNWS	.07853
DEBTTNW	.03318
DEBTICE	.05218
CATL	.06345
ACRCOS	-.35536
COSAINV	-.03239
AQAPDOE	.03701
AQAS	.00960
ACAS	.07012
SAFA	.03241
SATA	-.06716
SATCE	-.11055
SANCE	-.04638
SAINV	.05542
DAYSDRS	-.04148
QACL	-.01848
QATL	.04820
WCXINV	-.03679
XINVCA	-.02302
QACLPDOE	-.02565
EDIVOSE1	.00041
EDIVCSNI	.17443
CLTA	.03151
QATA	.03077
CATA	.03492
DEBTTA	.08750
DEBTCA	.07607
TNIATNW	-.14694
XNIEBIT	-.05215
DRCR	.31918
CLCR	-.67217
XINVCL	-.04514
ASSGRTH	.08386
PROGRTH	.17834
ZSCR	.10451
BETA	.15381
LOGTA	.10650
LOGNCE	.10996
MKTLIQ	.05836

AFTER ROTATION WITH KAISER NORMALIZATION

OBLIQUE FACTOR PATTERN MATRIX

DELTA = 0

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
FFS	.65519	-.26494	-.06124	.47688	.06948	-.06680	-.02011	-.08868	.01359	-.06204
FFATCE	.82384	-.01353	-.00942	-.07157	.00944	.14349	-.10968	-.04528	.03105	.03816
FFATA	.80990	-.24283	.01194	-.04713	.05501	.10663	-.03142	-.06850	.07078	.02374
VAS	.10599	-.25163	-.06271	.61779	.05752	.76978	-.04912	-.01392	-.01468	-.06333
VAATA	.19192	-.14448	.03515	-.06727	.03641	.93811	-.05446	.01676	.01322	.00479
VAATCE	.24954	.09419	.00072	-.08887	-.00406	.84284	-.12502	.02531	-.02070	.00993
VAANCE	.21603	.04255	.00007	-.07148	-.06575	.84013	.05627	.11213	.02042	.03171
EBITS	.64109	-.27072	-.07630	.46836	.13097	-.15903	-.08248	-.09889	.00319	-.10465
EBITATA	.81674	-.26660	.00454	.00274	.12432	-.02484	-.09855	-.10514	.05221	-.03380
EBITATCE	.83712	-.06075	-.00626	-.03106	.07612	.02180	-.16492	-.08570	.02071	-.01054
VAER	-.52394	.07809	-.00291	.04204	-.02952	.76220	.00740	.05764	-.04167	.04455
PBTS	.64354	-.23048	-.07251	.36636	.12710	-.13877	-.25116	-.09695	-.01441	-.06894
PBTATA	.76612	-.21684	-.00083	-.01123	.12196	-.02570	-.26800	-.09225	.02077	-.02282
PBTATNW	.88566	-.06127	-.00558	-.05791	.10358	-.00080	-.00466	-.12263	-.01902	-.00929
PBTATL	.54704	-.30579	-.02444	.01975	.12492	-.05684	-.44606	-.02172	.04622	-.06334
PBTACL	.55708	-.31171	-.04148	.02467	.20481	-.07611	-.29974	-.12069	.04050	-.10592
PBTATCE	.79233	-.06154	-.00707	-.03827	.08952	.01265	-.30778	-.07648	-.00744	-.01245
PBTANCE	.83893	-.09193	.00018	-.04410	.04282	.01247	-.21022	-.03155	.00284	.01135
TNIS	.73899	-.05918	-.02587	.40614	.04527	-.12126	-.13596	.00677	.02469	-.07368
TNIATA	.86408	-.03069	.06092	-.01228	.02133	.02901	-.11627	.05011	.08943	-.02125
XNIANW	.98746	.15636	.05889	-.06116	-.00979	.03492	.14822	.00252	.02702	.00023
TNIATL	.61558	-.16464	.02478	.01098	.04147	-.02725	-.35005	.07570	.09310	-.06609
TNIACL	.63109	-.16392	.01352	.01378	.12610	-.04493	-.19254	-.03102	.09036	-.11388
TNIATCE	.89988	.14006	.04868	-.04446	-.01948	.04858	-.18621	.03492	.03377	.00069
TNIANCE	.93826	.11840	.06072	-.04899	-.07823	.04992	-.06657	.09119	.04426	.02938
CFS	-.68533	-.00609	.08670	-.41975	-.05227	.06281	.05301	.07349	-.20835	.02926
CFATA	.78990	.06103	-.00902	-.06107	.02834	.10065	-.02936	-.03749	.28283	.02319
CFAQFA	.24209	.01237	.27191	.01298	-.11427	.03362	.00803	.06172	.05516	.08573
CFATL	.55369	-.11336	-.02131	-.02602	.05617	.03107	-.30672	.02165	.24871	-.03422
CFACL	.56184	-.10797	-.03480	-.02427	.15587	.01454	-.11843	-.10353	.23967	-.08733
CFATCE	.81607	.23372	-.02019	-.08747	-.01667	.12590	-.10928	-.03514	.22847	.04201
CFANCE	.83808	.20478	-.01358	-.08794	-.07884	.13238	.02821	.02668	.25434	.07275
OSCFAOSE	.85691	.23315	-.02518	-.09491	.00052	.12311	.28222	-.06931	.23310	.04722
DRCA	-.10234	-.04153	-.19638	-.05053	.12441	.06123	-.01479	-.04814	-.00778	.92148
DRXINV	-.03343	-.02929	-.38740	-.02919	.47517	.04225	-.03504	-.00475	-.03311	.67196
CACL	-.05469	-.16460	.66041	.04342	.30443	-.00115	-.18199	-.10051	.02150	-.14097
FATA	-.05516	-.12232	-.78325	.03754	-.03171	-.03190	.00973	-.18822	.02706	-.01964
WCTNW	.06065	.03495	.90640	.01216	.26228	-.00805	.14837	-.06878	-.04208	-.08521
WCTL	-.05583	-.17514	.67451	.03829	.22165	.01051	-.32965	-.00348	.02842	-.08392
TAER	-.13953	-.04733	.01557	-.02840	.03282	.98781	-.03314	.03347	-.02794	-.01875
WCXNCE	.03514	-.01190	.90491	-.00014	.17503	.00083	-.11023	.05360	-.03760	-.04872
WCOR	.02851	-.01567	.52939	.03322	.23546	.01203	-.02635	.01793	.06288	-.63890
AWCS	-.07323	-.11092	.66217	.39685	.22136	-.08896	-.09771	-.03645	-.03903	-.11280

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
TLTA	.08060	.29472	.00590	-.05554	-.05102	.05593	.61466	-.05708	-.02288	.11579
DEBTQA	-.07847	-.19171	-.02667	.01436	-.26144	-.09913	.83459	-.13157	-.00534	-.07520
EBITATL	.54947	-.36559	-.01767	.03274	.12045	-.06205	-.37716	-.01887	.06589	-.07987
TATNW	-.07240	-.29092	.01287	.05302	.04184	-.05140	-.61507	.03913	.01422	-.10041
QATNW	.07293	.25683	.10554	-.04532	.45827	.05060	.39997	.08201	-.01342	.22628
CATNW	-.04579	-.26729	-.48954	.06607	.00493	-.09673	-.41949	-.05748	-.00852	-.12099
CLTNW	.06856	.28190	.00658	-.05917	-.14669	.07542	.42270	.09552	.00001	.15086
ATNWS	-.13662	-.24536	-.05197	.56105	.01856	-.18721	-.33046	-.00499	-.03382	-.08404
DEBTTNW	-.04634	-.05688	.01279	.01087	-.00151	-.06061	.96463	-.05407	.02516	.03865
DEBTTCE	-.04805	-.06913	.00978	.01240	.01114	-.05224	.96842	-.03460	.02635	.03652
CATL	-.06866	-.16308	.62152	.02941	.09513	.03352	-.51901	.15417	.04886	-.03421
ACRCOS	.06201	.69897	-.04750	.68098	-.10979	-.05601	-.04658	-.05423	.03181	.13382
COSAINV	.07835	.04523	-.56200	-.63328	.33994	-.15951	-.01686	.04264	-.05345	.07377
AQAPDOE	.11482	.05127	.08458	.65785	.58210	-.10794	.05634	.06820	-.05443	.11788
AQAS	.04795	.10013	.10588	.64275	.59853	-.09434	.07448	.10388	-.07055	.10603
ACAS	-.07132	.00977	.48982	.75426	.05622	-.12348	.06703	.06423	-.03132	-.04738
SAFA	.09646	.15119	.59684	-.47304	.05716	.11930	-.00289	.13320	-.00822	.02875
SATA	.10328	.10357	.12290	-.82883	-.01899	.22572	-.04028	.03583	.04958	.11014
SATCE	.16136	.28902	.07609	-.63957	-.05959	.21647	-.11276	.03332	.01318	.12238
SANCE	.12327	.22370	.07799	-.59160	-.11142	.20624	.07583	.12317	.04355	.12573
SAINV	-.12302	-.03676	.63257	.53300	-.44254	-.07334	.02800	-.01234	.01476	-.12243
DAYSDRS	-.12186	.01255	.21474	.62006	.06283	-.01594	-.04519	-.01722	-.03727	.73811
QACL	-.01162	-.08788	.18238	.03829	.84472	-.01600	-.12265	-.05842	-.00113	.08061
QATL	-.02421	-.08887	.20318	.03314	.65707	.00749	-.39862	.12538	.01211	.21031
WCXINV	.00111	-.07378	.35211	.04258	.71541	-.00537	-.14898	-.06425	-.02240	-.05265
XINVCA	-.05617	-.03808	.44916	.00017	-.80779	.02095	-.01924	-.04434	.04571	-.22465
QACLPDOE	.04528	-.07047	.13895	-.06205	.84442	-.00698	-.14365	-.04890	-.02050	-.08498
EDIVCSE1	.75699	-.00207	.08320	-.08390	-.04547	.05566	-.02079	-.09240	-.74668	.08507
EDIVOSNI	-.04449	-.18999	.01728	-.03137	-.02801	.03785	-.07931	-.04277	-.85578	.02352
CLTA	.06388	.27497	.03076	-.06612	-.23662	.09196	.21746	.19649	.00495	.19877
QATA	.06852	.14095	.21442	-.04191	.72653	.04685	.03782	.12911	-.03332	.25188
CATA	.03958	.13624	.83519	-.04126	.02681	.07462	.01853	.15652	-.00418	.06223
DEBTTA	-.08740	-.17770	.03305	.02015	.02806	-.06228	.99724	-.05065	.01838	-.00436
DEBTCA	-.08988	-.20284	-.20855	.01862	.01979	-.07786	.91506	-.11253	.00414	-.03146
TNIATNW	.98921	.15291	.05598	-.05897	-.01131	.03625	.14555	.00118	.02815	.00466
XNIEBIT	-.29065	.04548	.06039	.03939	-.16102	-.00029	.64536	.01044	-.00214	.01076
DRCR	-.08526	-.63195	.26706	.06825	.22228	-.00434	.00012	.02103	-.00773	.55973
CLCR	-.05881	.84127	.05798	-.13693	.07115	.09624	-.39088	-.23834	.08819	.06617
XINVCL	-.07919	-.14058	.73509	.01999	-.32270	.02343	-.12463	-.10315	.04949	-.20526
ASSGRTH	.36205	-.13658	.16516	-.15717	-.18617	-.15311	-.02988	-.04164	.12679	.30199
PROGRTH	.18497	-.20215	.03127	-.05106	-.02963	.00467	.05069	-.06033	.47636	.05995
ZSCR	.25269	-.30560	.11602	.02910	.37881	-.05714	-.35210	-.07513	.04013	-.14348
BETA	-.13286	-.00041	-.06852	.05181	-.02843	-.11921	-.09087	-.60370	.14233	-.05219
LOGTA	-.05283	-.14552	-.06328	.05276	.01664	.18084	-.15070	.86041	.01892	-.05328
LOGNCE	-.04245	-.09178	-.06719	.03572	-.01567	.18903	-.08267	.87651	.02280	-.02752
[illegible]	-.07177	-.04927	-.03716	.02010	-.00660	-.07378	-.13174	.73927	.11870	-.06997

	FACTOR 11
FFS	.02992
FFATCE	-.24427
FFATA	-.03314
VAS	.15513
VAATA	.07669
VAATCE	-.14664
VAANCE	-.20247
EBITS	-.06819
EBITATA	-.14319
EBITATCE	-.32525
VAER	.11654
PBTS	-.04696
PBTATA	-.10618
PBTATNW	-.27312
PBTATL	.03582
PBTACL	.12480
PBTATCE	-.25705
PBTANCE	-.29843
TNIS	.21684
TNIATA	.19256
XNIANW	.03420
TNIATL	.27819
TNIACL	.38151
TNIATCE	.02742
TNIANCE	.00719
CFS	-.31841
CFATA	.29470
CFAQFA	.12741
CFATL	.37615
CFACL	.48826
CFATCE	.09432
CFANCE	.06451
OSCFAOSE	.08850
DRCA	.18648
DRXINV	.05057
CACL	.34227
FATA	.33578
WCTNW	-.00990
WCTL	.25475
TAER	.10892
WCXNCE	-.05734
WCDR	.12736
AWCS	.13006
TLTNW	-.37766
TLTA	-.36552
DEBTQA	.19593
EBITATL	.04730
TATNW	.37845
QATNW	-.47121

	FACTOR 11
CLTNW	-.49918
ATNWS	.28751
DEBTTNW	-.00648
DEBTTCE	-.03232
CATL	.10029
ACRCCS	-.26095
COSAINV	-.00358
AQAPDOE	-.15364
AQAS	-.16390
ACAS	-.13803
SAFA	-.38780
SATA	-.10048
SATCE	-.28238
SANCE	-.32898
SAINV	-.03434
DAYSDRS	.03601
CACL	.15858
QATL	-.00350
WCXINV	.20057
XINVCA	.13528
QACLPDOE	.16012
EDIVCSE1	.02193
EDIVCSNI	-.01518
CLTA	-.55493 x
QATA	-.35694
CATA	-.35193
DEBTTA	.06596
DEBTCA	.15019
TNIATNW	.03095
XNIEBIT	.05507
DRCR	.19865
CLCR	.20698
XINVCL	.33302
ASSGRTH	-.03991
PROGRTH	-.17286
ZSCR	.24350
BETA	-.38056
LOGTA	-.00919
LOGNCE	-.11007
MKTLIQ	-.03701

APPENDIX G2 - Cont

FACTOR PATTERN CORRELATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
FACTOR 1	1.00000	-.10997	.08928	-.05308	.13623	.06224	-.29984	-.12406	.26033	.05427
FACTOR 2	-.10997	1.00000	-.01599	-.20879	-.15445	.17836	.24258	.04638	-.00153	.16208
FACTOR 3	.08928	-.01599	1.00000	.13148	.06270	.04978	-.11222	.12215	.02537	-.07615
FACTOR 4	-.05308	-.20879	.13148	1.00000	.13214	-.18839	-.07338	-.05512	-.03962	-.08802
FACTOR 5	.13623	-.15445	.06270	.13214	1.00000	-.05632	-.29326	.01991	-.08539	.16068
FACTOR 6	.06224	.17836	.04978	-.18839	-.05632	1.00000	-.07471	.16793	.03055	.07138
FACTOR 7	-.29984	.24258	-.11222	-.07338	-.29326	-.07471	1.00000	-.03007	-.07859	.16918
FACTOR 8	-.12406	.04638	.12215	-.05512	.01991	.16793	-.03007	1.00000	-.07229	.07423
FACTOR 9	.26033	-.00153	.02537	-.03962	-.08539	.03055	-.07859	-.07229	1.00000	-.02908
FACTOR 10	.05427	.16208	-.07615	-.08802	.16068	.07138	.15918	.07423	-.02908	1.00000
FACTOR 11	-.02526	-.34609	-.00125	.13788	.03678	-.09739	-.26981	-.07486	.07255	-.20008

	FACTOR 11
FACTOR 1	-.02526
FACTOR 2	-.34609
FACTOR 3	-.00125
FACTOR 4	.13788
FACTOR 5	.03678
FACTOR 6	-.09739
FACTOR 7	-.26981
FACTOR 8	-.07486
FACTOR 9	.07255
FACTOR 10	-.20008
FACTOR 11	1.00000

AFTER ROTATION WITH KAISER NORMALIZATION

DELTA = 0

OBLIQUE FACTOR STRUCTURE MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
FFS	.67530	-.48764	.06168	.52654	.25670	-.19039	-.34131	-.23307	.16811	-.11670
FFATCE	.89333	-.00293	.06764	-.16722	.13139	.23289	-.29588	-.09886	.24477	.12551
FFATA	.89277	-.30732	.08588	-.05404	.19577	.11803	-.34569	-.15711	.28705	.04220
VAS	.15629	-.33935	.08200	.55096	.15608	.59001	-.30562	.03618	.02379	-.12373
VAATA	.29387	-.02862	.10277	-.20188	.04412	.93682	-.24825	.14780	.10100	.04414
VAATCE	.32907	.25948	.06753	-.29350	-.00864	.92012	-.19023	.16213	.07082	.11668
VAANCE	.23984	.28775	.05273	-.30060	-.11802	.91557	.01859	.24537	.08256	.16377
EBITS	.68100	-.50434	.05245	.53928	.32880	-.27800	-.38929	-.25063	.14569	-.14720
EBITATA	.91968	-.36548	.09094	.03095	.29045	-.02602	-.41145	-.21273	.25982	-.01241
EBITATCE	.92974	-.08725	.08100	-.08559	.22505	.09380	-.36471	-.15922	.22984	.07226
VAER	-.51235	.23890	-.00770	-.08425	-.13653	.73680	.11003	.24837	-.15171	.05838
PBTS	.73268	-.48129	.05915	.43767	.36220	-.21792	-.54063	-.23031	.14737	-.12745
PBTATA	.90415	-.35842	.09713	.02553	.32714	-.00761	-.55731	-.18591	.23045	-.02912
PBTATNW	.92709	-.07639	.05942	-.10800	.21474	.05330	-.23322	-.20964	.19461	.09626
PBTATL	.73505	-.53106	.09024	.12117	.36853	-.06623	-.73872	-.11221	.21636	-.15266
PBTACL	.71600	-.56140	.05337	.14970	.40340	-.13163	-.64506	-.23051	.20857	-.18356
PBTATCE	.91913	-.14339	.09214	-.06621	.27866	.08687	-.51374	-.14437	.20443	.03367
PBTANCE	.93384	-.12672	.09337	-.09119	.21641	.09455	-.41117	-.10520	.21668	.07533
TNIS	.75714	-.37315	.11331	.44971	.24800	-.18050	-.47613	-.15207	.22091	-.14493
TNIATA	.92417	-.21835	.16254	-.01572	.17548	.08102	-.46125	-.06406	.33562	-.03447
XNIANW	.94103	.09157	.12193	-.15373	.04979	.12612	-.12317	-.10545	.28031	.09861
TNIATL	.74845	-.43482	.14064	.08856	.25112	-.01158	-.68411	-.03157	.29357	-.16947
TNIACL	.73326	-.46263	.10827	.11630	.28645	-.07726	-.58605	-.15882	.29092	-.20522
TNIATCE	.95119	.00830	.14807	-.11267	.12946	.15965	-.43315	-.05290	.28804	.03739
TNIANCE	.94730	.03575	.15123	-.13875	.04837	.16913	-.30638	-.00234	.29833	.08295
CFS	-.72748	.30633	-.03382	-.43561	-.20156	.14053	.39375	.24094	-.39497	.10169
CFATA	.87665	-.10689	.06304	-.10054	.11050	.14765	-.35843	-.15283	.51694	.01881
CFAQFA	.25657	-.02314	.29089	.01571	-.05371	.07358	-.08808	.06072	.13699	.04191
CFATL	.71789	-.38112	.07709	.03337	.22006	.04106	-.64220	-.08659	.44049	-.14017
CFACL	.68771	-.40265	.03715	.06164	.25901	-.03069	-.51643	-.23240	.42806	-.17584
CFATCE	.89527	.13327	.05311	-.19795	.06055	.23784	-.32835	-.11955	.46553	.09311
CFANCE	.87327	.16414	.04898	-.22344	-.03162	.25044	-.17809	-.06261	.48453	.14343
OSCFAOSE	.82678	.22293	.00336	-.23358	-.03301	.20377	.05016	-.17043	.45053	.16877
DRCA	-.03818	.05412	-.27547	-.10869	.25342	.08059	.09814	.00963	-.05472	.90980
DRXINV	.04178	.00356	-.41057	-.06543	.56745	.03824	-.02623	.01843	-.10249	.76139
CACL	.11781	-.41558	.70189	.28561	.40909	-.07238	-.48687	-.04938	.04701	-.28324
FATA	-.10352	-.25894	-.80726	.02973	-.06020	-.17289	-.01316	-.32412	.03539	-.08580
WCTNW	.12103	-.00821	.90928	.15770	.26870	.00098	-.04662	.03223	-.03141	-.08157
WCTL	.14816	-.40207	.73514	.25958	.37793	-.01621	-.58475	.06434	.05822	-.24152
TAER	-.07074	.09763	.05976	-.17245	-.02352	.97026	-.11725	.21206	-.02667	.01900
WCXNCE	.15656	-.06933	.94098	.14544	.26499	.05431	-.26801	.16957	-.01835	-.09156
WCDR	.09272	-.22171	.60715	.20568	.18341	-.03326	-.31843	.02249	.09130	-.67487
AWCS	.01590	-.33499	.73298	.59555	.34540	-.18829	-.31437	.00363	-.05544	-.23501
TLTNW	-.12434	.60266	-.09360	-.23689	-.26730	.11195	.79992	-.01151	-.06456	.32789

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
TLTA	-.11946	.60698	-.08421	-.23950	-.26996	.11479	.79791	-.02212	-.06800	.34171
DEBTQA	-.34666	-.04659	-.15444	.01903	-.48850	-.23658	.83642	-.20159	-.04710	-.06647
EBITATL	.72595	-.58402	.09371	.14485	.35199	-.09018	-.69259	-.11887	.23233	-.17250
TATNW	.12869	-.60453	.09942	.23794	.26534	-.11056	-.79910	.00715	.06478	-.33137
QATNW	.01268	.49544	.08140	-.15614	.33082	.13445	.45773	.15891	-.10607	.51349
CATNW	.04435	-.55855	-.43666	.18284	.14238	-.21329	-.54841	-.17161	.03328	-.30216
CLTNW	-.09180	.62690	-.05165	-.27278	-.30872	.19355	.66885	.14976	-.04596	.36526
ATNWS	-.07411	-.57638	.04702	.72332	.21604	-.35998	-.46480	-.08314	-.05023	-.29985
DEBTTNW	-.31721	.17513	-.10927	-.03500	-.27352	-.15196	.97540	-.08767	-.06214	.18017
DEBTTCE	-.31838	.17275	-.10865	-.03588	-.26179	-.14165	.97855	-.06578	-.06586	.18590
CATL	.16307	-.33940	.71029	.19958	.30123	.07415	-.68161	.23898	.07665	-.19445
ACRCOS	-.03085	.65583	.01628	.47894	-.09736	-.02164	.18830	-.05586	.01112	.21190
COSAINV	.08314	.10803	-.62549	-.65178	.25577	-.06199	.00874	-.00863	-.06035	.22971
AQAPDOE	.12515	-.12002	.20348	.71212	.69091	-.21519	-.12244	.04637	-.12546	.20083
AQAS	.04425	-.05340	.22057	.68976	.68374	-.18977	-.07855	.09916	-.16332	.20482
ACAS	-.10403	-.11903	.58316	.82902	.15394	-.23217	.00297	.07924	-.09448	-.10849
SAFA	.16700	.38662	.56505	-.50898	.00970	.33003	.05307	.28024	.01094	.15961
SATA	.18737	.35094	.03343	-.90934	-.11315	.44213	.03039	.13937	.11086	.22369
SATCE	.22255	.54315	.01691	-.79092	-.13230	.45635	.04353	.13907	.07613	.27387
SANCE	.12315	.54469	.00940	-.75868	-.22949	.43278	.24797	.22133	.07415	.29815
SAINV	-.16444	-.09113	.66594	.58980	-.37005	-.14065	.06889	.01956	.01303	-.29623
DAYSDRS	-.08427	-.02402	.23410	.60919	.27661	-.08242	.02617	.04526	-.10804	.65652
QACL	.17047	-.30512	.24021	.22291	.92779	-.08848	-.43760	-.02887	-.05051	.12628
QATL	.21055	-.25213	.29272	.16798	.83622	.02356	-.59960	.18858	-.03020	.22453
WCXINV	.17507	-.32291	.41573	.24868	.79913	-.07395	-.48003	-.02691	-.04356	-.05096
XINVCA	-.11307	-.00064	.41000	-.00006	-.81282	.04466	.09652	-.02637	.13322	-.43133
QACLPDOE	.21847	-.30265	.20445	.12504	.89752	-.06545	-.48697	-.03425	-.04602	-.02325
EDIVOSE1	.59374	-.05416	.10531	-.09746	.13146	.09208	-.17233	-.10391	-.53116	.13049
EDIVCSNI	-.21388	-.17860	-.00745	.04002	.08878	-.01470	-.02970	.03070	-.85430	.00129
CLTA	-.05011	.62034	-.00160	-.29246	-.33114	.25743	.50599	.26885	-.02976	.38108
QATA	.16293	.21446	.25261	-.03956	.74103	.12449	-.04842	.22468	-.11473	.47426
CATA	.09585	.27996	.84915	-.03633	.04897	.21272	.03669	.30600	-.01139	.12141
DEBTTA	-.35588	.02773	-.08798	.02004	-.24146	-.19234	.95311	-.09160	-.07816	.10909
DEBTCA	-.35417	-.05078	-.32763	.01797	-.23783	-.23865	.87207	-.19136	-.08102	.05893
TNIATNW	.94425	.08912	.11933	-.15237	.05033	.12712	-.12512	-.10689	.28185	.10252
XNIEBIT	-.51047	.23279	-.04330	-.00916	-.38375	-.05673	.76793	.02799	-.11195	.06740
DRCR	.05517	-.65321	.25174	.24729	.43257	-.11055	-.18638	.06208	-.04739	.42380
CLCR	.04490	.71466	.04222	-.24952	.03392	.24374	-.23809	-.16502	.13639	.09747
XINVCL	.00183	-.27739	.73168	.17999	-.25483	-.00915	-.25142	-.05364	.12259	-.43707
ASSGRTH	.42980	-.09139	.13824	-.15453	-.07338	-.08207	-.05939	-.07633	.23656	.25607
PROGRTH	.33287	-.12861	.03736	-.06773	-.03173	.01472	-.02408	-.10440	.51640	.05973
ZSCR	.45457	-.60651	.21617	.23016	.55901	-.13600	-.71484	-.13134	.12902	-.24894
BETA	.00783	.10311	-.12490	.01015	-.07053	.04239	.05300	-.56195	.13471	-.04306
LOGTA	-.09105	-.12217	.07787	.01207	.07555	.29098	-.21922	.88017	-.04368	-.02431
LOGNCE	-.10736	-.08316	.06277	-.04528	.01386	.32365	-.09992	.90581	-.04817	.04069
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.06393	-.14543	.72068	.05292	-.05057

	FACTOR 11
FFS	.20541
FFATCE	-.25628
FFATA	.02956
VAS	.27785
VAATA	.03594
VAATCE	-.25168
VAANCE	-.34519
EBITS	.14512
EBITATA	-.01917
EBITATCE	-.27444
VAER	.01498
PBTS	.17312
PBTATA	.04024
PBTATNW	-.26745
PBTATL	.27872
PBTACL	.35105
PBTATCE	-.16825
PBTANCE	-.23650
TNIS	.34087
TNIATA	.21591
XNIANW	-.09539
TNIATL	.43404
TNIACL	.51681
TNIATCE	-.00548
TNIANCE	-.06358
CFS	-.40578
CFATA	.26306
CFAQFA	.09105
CFATL	.50298
CFACL	.58701
CFATCE	.00820
CFANCE	-.06114
OSCFAOSE	-.10236
DRCA	.01809
DRXINV	-.05566
CACL	.50348
FATA	.46496
WCTNW	-.03344
WCTL	.43639
TAER	.03805
WCXNCE	-.01616
WCOR	.28163
AWCS	.28982
TLTNW	-.67806
TLTA	-.67094
DEBTQA	.06564
EBITATL	.29889
TATNW	.67895
QATNW	-.71670
CATNW	.68253

	FACTOR 11
CLTNW	-.77076
ATNWS	.57612
DEBTTNW	-.24042
DEBTTCE	-.26408
CATL	.30086
ACRCCS	-.41690
COSAINV	-.09706
AQAPDOE	-.09961
AQAS	-.13428
ACAS	-.03782
SAFA -	-.53359
SATA	-.29631
SATCE	-.49363
SANCE	-.56704
SAINV	.06399
DAYSDRS	-.01307
QACL	.24823
QATL	.11259
WCXINV	.31434
XINVCA	.17435
QACLPDOE	.26432
EDIVCSF1	-.07390
EDIVCSNI	.00045
CLTA	-.79132
QATA	-.46402
CATA	-.44257
DEBTTA	-.12356
DEBTCA	.00193
TNIATNW	-.09735
XNIEBIT	-.13108
DRCR	.32303
CLCR	.00807
XINVCL	.45736
ASSGRTH	-.05564
PROGRTH	-.10279
ZSCR	.49850
BETA	-.29209
LOGTA	.02114
LOGNCE	-.12737
MKTLIQ	-.00558

APPENDIX H

LINEAR DISCRIMINANT ANALYSIS: THE ASSUMPTIONS AND STATISTICAL TESTS EMPLOYED

Linear Discriminant Analysis (LDA) is a technique that is able to analyse the characteristics of two or more groups and create a model based on those characteristics which best differentiate between the groups in question. The end result from using this technique is a model that transforms a set of characteristics into a single variable, normally called a z-score. Once the z-score for an observation has been computed, it is then compared with a predetermined z-score cutoff value. Depending upon whether the observation's z-score is greater or less than this cutoff value, the observation is then categorised as belonging to a particular group. This technique has been widely employed, but in the finance area the research has concentrated on creating models that best discriminate between failed and non-failed companies. The discriminating variables used in these studies were the financial characteristics of the companies, (Taffler,1976; Altman,1968; Deakin,1972 and Edmister,1972 are examples). Further examples of how L.D.A. has been used in the finance area are consumer credit assessment, bond ratings (see Foster, 1978 for review) and to a much lesser extent in investment appraisal (Walters,1959 and Schick and Verbrugge,1975).

The first step in LDA is to establish the groups that are to be analysed and then to decide on the variables that are likely to be the best discriminators. In this study the groups analysed are "low valued" and "high valued" companies and the variables are the financial ratios described in chapter V. The objective of the analysis is to ascertain which linear combination of variables best discriminates between companies with high and low share values. The final model takes the following form:

$$z = C_0 + C_1R_1 + C_2R_2 + \ldots C_nR_n$$

where z = the discriminant score

C = the discriminant coefficients for n variables

R = the discriminatory variables

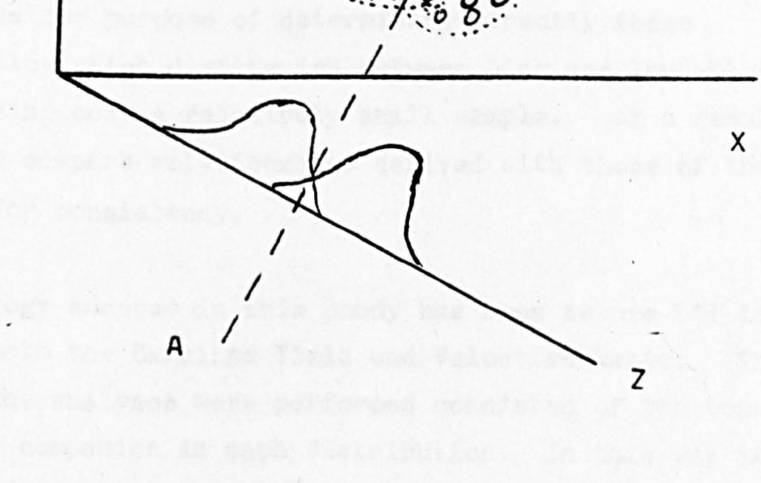
By comparing the discriminant score for a given observation with the z-scale it is then possible to attach a probability to which group the observation is likely to come from.

This is best demonstrated in geometric fo m. Figure H.1 shows two groups of data plotted on a graph using variables X and Y. It can be seen that the data forms two highly correlated groups with a slight overlap in the middle. The graph shows that neither X nor Y can alone discriminate between the two groups with any degree of success. However, if a line A is drawn through the two groups at a point that minimises the overlap and a line Z is drawn perpendicular to A, it can be seen that the dimensions of X and Y have been transformed into one variable represented by line Z. To emphasize this transformation further, the distributions of the two groups have been drawn on line Z, thus revealing two distinct groups with only a small overlap. Obviously the smaller the overlap in the middle the less the error term of the model. The point where line A crossed line Z is the cutoff point between the two groups.

FIGURE H.1

Linear Discriminant Analysis

A Diagramatic Example



By using LDA it is possible to compute the z-value for any observation by using variables X and Y. This z-value would then be compared with the line Z to see which group the observation was likely to belong. In addition the more this z-value differs from the cutoff point the higher the probability of the observation belonging to that particular group.

This general principle of transforming two variables X and Y to one dimension, Z, can be applied to many variables, although the optimum is normally between five and seven. Lachenbruch(1975) suggests it is unusual to have more than 4 or 5 in a model. For more technical discussion of LDA the reader is referred to Tatsuoka(1970) or Cooley and Lohnes(1971).

The Use of LDA for Valuing Shares

As previously stated this study describes how LDA has been used to discriminate between high and low valued companies on the basis of financial ratios. The purpose is to find a linear combination of financial characteristics that best discriminate between the two groups and thus indicate which are the important variables that influence share values. The proposition which underlies the analysis is that even after allowing for market imperfections, there should be some sort of consensus of opinion as to which factors determine the market valuation of a stock.

The use of LDA should not be considered as a substitute for multiple regression and should be viewed as a method for unravelling the complexities of share valuation in its own right. Use of this technique has the purpose of determining directly those characteristics which distinguish between high and low valued companies using only a relatively small sample. As a result it will be useful to compare relationships derived with those of the multiple regression for consistency.

The methodology adopted in this study has been to use LDA to create models for both the Earnings Yield and Valuation Ratio. The groups upon which the analyses were performed consisted of the top sixty and bottom sixty companies in each distribution. In this way it was possible to discriminate between high and low valued companies. Obviously, the characteristics upon which the models are based are the independent variables referred to in chapter V.

The use of LDA in this manner has been heavily criticised by Eisenbeis (1977) and by Altman (1981) who argue that some major assumptions are violated and therefore the technique is not appropriate for this type of research. However, all of their arguments can to some extent be disregarded providing the purpose and the subsequent application of the models are clearly defined. In the follwing section we examine each of these arguments in turn.

The Assumptions and Statistical Tests

One of the basic assumptions put forward by Eisenbeis (1977) in his article decribing the pitfalls of LDA is that the groups being examined should be descrete and indentifiable. In the application of LDA in this thesis we use "segmented continuous variables" to form the groups with the cut-off points for these groups are subject to the researchers whim. Eisenbeis goes so far as to state that the Walter study is a prime example of the violation of the principles of LDA. In his paper Eisenbeis quotes four main reasons for his criticism:

1) the groups are arbitrary and not truly distinct and therefore allow scope for manipulation.

2) by using only the top and bottom parts of a distribution this excludes the middle and therefore the discriminant function can only be used to compare whether a given observation appears to be more like the upper of lower portions.

3) the error rates are not meaningful "since to select the example one must already know which firms are from which part and this is precisely what one is trying to predict".

4) finally, "such problems do not lend themselves to predictive discriminant analysis because they involve forming groups on the basis of a variable that is in fact observable at the same time".

Although some of these criticisms are well founded and supported by Altman (1981), they are not considered sufficiently strong to invalidate the use of LDA in this study. We would argue that LDA has a wide number of applications and that providing one is careful in the interpretation of the results and limits are set to the subsequent use of such models it is possible to use LDA as an exploratory tool. More specifically the following points can be argued in reply to Eisenbeis's criticism:

1) although the cut-off limits for groups are choosen arbitarily providing there is logic in the underlying principle for choosing

these groups then LDA is an appropriate technique for finding the differences between the groups. In this study the emphasis is on identifying the factors which distinguish high and low share values.
2) our derived models are not used to classify companies as either having high or low share values.
3) the error rates are meaningful as their purpose is to establish the extent to which the models explain the underlying relationships and not merely to determine predictive ability. A high error rate indicating poor discriminatory power has the same implication as for all LDA models.
4) lastly the models are not used for prediction purposes and therefore we do not try to predict what is already known.

For valid application of LDA as Eisenbeis points out 1) the variables used should be multivariate normal and 2) the group dispersion matrices should be equal across all groups. The first of these assumptions is difficult to test in practice for although there are many univariate distribution tests, there are few multivariate normality tests. The solution suggested in the literature is that the data should be transformed on a univariate basis to improve univariate normality and this should have the desired effect of increasing the probability of multivariate normality. It was with this in mind that all the variables in the database were transformed where necessary (see chapter V).

The second assumption of equal group dispersion matrices was tested using the Bartlett-Box test criterion (see Cooley and Lohnes, 1977: 230). Unfortunately it was found that the hypothesis that the dispersion matrices were equal could not be supported at the 5% level of confidence. Whilst this is a disappointing result several other studies eg. Taffler(1976) and Sudarsanam(1981) with similar results argue that this does not appear to lead to serious bias in the subsequent application of the models. In view of this we do not believe that the violation of this assumption is a serious problem and consequently believe our analyses to be acceptable from the exploratory point of view.

The other criteria employed for testing our LDA models are as follows:
1) the independent variables were selected on the basis of the Mahalanobis D squared statistic, which was transformed into a F-statistic for ease of interpretation (Morrison, 1969). The variable with the largest F-value was selected providing it was

statistically significant.

2) the individual variables had to be measuring different financial characteristics. Despite arguments that multicollinearity is not important in LDA (eg. Eisenbeis, 1977:883) it was considered for the purpose of this study to be more appropriate to limit the variables to one per factor.

3) the influence of each variable in a model was measured by the Mosteller and Wallace (1963) method, which computes the percentage contribution of each variable to the Mahalanobis distance between the two groups. This is the method recommended by Joy and Tollefson (1975) and Taffler (1976).

4) the percentage of the observations misclassified was used as a measure of how much discriminatory power the model possessed. Note that problems with prior probabilities did not arise as the prior probability of an observation coming from either group was equal and there were no misclassification costs.

5) finally, in order to test the stability of the models created and to daetermine whether any individual observations were causing any untoward influence on the model, a Lachenbruch holdout test was performed (Lachenbruch, 1967). It was found that when this test was performed on both models no bias was present in that the resulting classifiction matrix was identical to that obtained by resubstituting the data from which the model was derived into the wodel.

In conclusion we would argue that by keeping to the above assumptions and controlling criteria the models created can be interpreted as being statistically valid and significant. We shall now examine the statistics relating to the models presented in chapter VI in more detail.

The Earning Yield Model

The LDA performed on the top sixty and the bottom sixty companies in the earning yield distribution produced the following model (table H.1):

$$Z = -1.28 + 8.05 \times DIV/NI - 1.15 \times \text{Market Liquidity}$$

Table H.1 shows the statistics obtained from the stepwise LDA package (SPSS Version 6.0). It can be seen that the most significant variable in the model is the dividend payout ratio, DIV/NI, contributing 87.5% of the distance between the group means. The

TABLE H.1

DISCRIMINANT ANALYSIS

Earning Yield Model

Step No.	Variable	F Value	% Cont
1	DIV/NI	62.04	87.5
2	Market Liquidity	15.31	12.5
			100.0

Misclassification Matrix

Actual Group	No. of Comp.	Predicted Group High EY	Predicted Group Low EY
High E.Y.	60	51	9
%	100	85.0	15.0
Low EY	60	16	44
%	100	26.7	72.3

Total Correctly classified 79.2%

Actual Model

$$Z = -1.28 + 8.05 \times DIV/NI - 1.15 \times MKT\ LIQ.$$

other variable, market liquidity, contributed only 12.5%. The F-values for both variables entering the model at each step and in the final model are statistically significant.

Table H.1 also includes the misclassification matrix obtained when the model is used on the data that created the model. The overall ability of the model to correctly classify these companies is 79.2%, which compares favourably with the 50% expected by chance alone. However, when the arbitrary manner by which the groups were formed is taken into account, this percentage is considered to be low, indicating that the model is not that effective in discriminating between the two groups. Further this percentage is lower than the 87% found by the Walter's (1959) study.

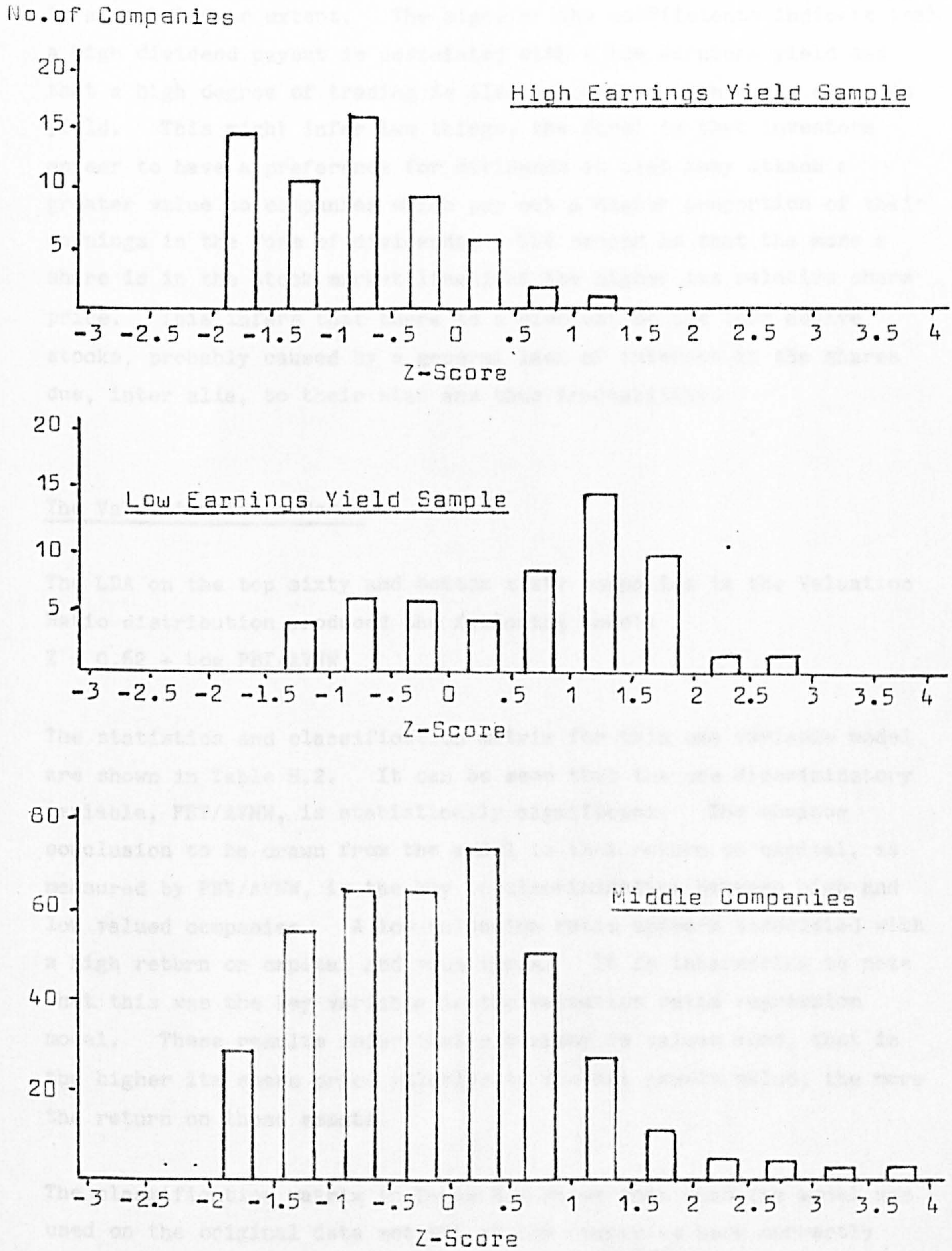
A more detailed examination of the misclassification matrix reveals that the model was able to classify the high yielding companies more accurately than the low yielding companies (85% and 73% respectively). This infers that the factors which influence whether a company has a low or high earnings yield are not only the factors included in the model. It is quite reasonable to expect that for certain "high flying" companies, growth potential leads to a the low earnings yield rather than just dividend policy alone.

The extent of the misclassification can be seen diagrammaticcally in figure H.2 where the histograms of the two groups are provided. The low yielding group can be seen to extend much further over the zero cut off point than the high yielding group giving a slightly skewed appearance. The historgram drawn at the foot of the page shows how the companies in the middle of the sample have been classified. The balance can be seen to be slightly skewed towards the high yielding group with 55% of this middle group falling to the left of the zero cut off point.

One final statistic, which provides a measure of how well the discriminant model explains the earnings yield distribution, is the Spearman's Rank Correlation Coefficient (Yoemans 1968:302). This correlation coefficient is computed by ranking companies on their z-scores and Earnings Yields, and then comparing the difference in ranks. In this instance the correlation coefficient squared was .253, which is not very different from the R-squared of .26 found in the regression analysis.

Figure H.2

HISTOGRAMS OF EARNINGS YIELD MODEL Z-SCORES



These results suggest that dividend payout is the main factor that distinguishes a low yielding company from a high yielding company in terms of their earnings yield. In addition the amount of active trading in a share would appear to have some discriminatory power but to a much lesser extent. The signs of the coefficients indicate that a high dividend payout is associated with a low earnings yield and that a high degree of trading is also associated with a low earnings yield. This might infer two things, the first is that investors appear to have a preference for dividends in that they attach a greater value to companies which pay out a higher proportion of their earnings in the form of dividends. The second is that the more a share is in the stock market limelight the higher its relative share price. This infers that there is a discount on the less active stocks, probably caused by a general lack of interest in the shares due, inter alia, to their size and thus tradeability.

The Valuation Ratio Model

The LDA on the top sixty and bottom sixty companies in the Valuation Ratio distribution produced the following model:

$Z = 0.62 + \text{Log PBT/AVNW}$

The statistics and classification matrix for this one variable model are shown in Table H.2. It can be seen that the one discriminatory variable, PBT/AVNW, is statistically significant. The obvious conclusion to be drawn from the model is that return on capital, as measured by PBT/AVNW, is the key to discriminating between high and low valued companies. A low valuation ratio appears associated with a high return on capital and vice versa. It is interesting to note that this was the key variable in the valuation ratio regression model. These results infer that a company is valued more, that is the higher its share price relative to its net assets value, the more the return on those assets.

The classification matrix in Table H.2 shows that when the model was used on the original data set 95% of the companies were correctly classified. This high success rate reflects that the model is very accurate even though it is based on only one variable. Nevertheless it should be noted that this accuracy test does have an upward bias, and that the original group selection technique would accentuate this bias. A closer look at the mislcassification matrix reveals that the

TABLE H.2

Discriminant Analysis

Valuation Ratio Model

Step No.	Variable	F Value	% Cont
1	PBT/AVTNW	168.9	100.0

Misclassification Matrix

Actual Group	No. of Comp.	Predicted Group High VR	Low VR
High VR	60	55	5
%	100.0	91.7	8.3
Low VR	60	1	59
%	100.0	1.7	98.3

95% of companies correctly classified

Actual Model

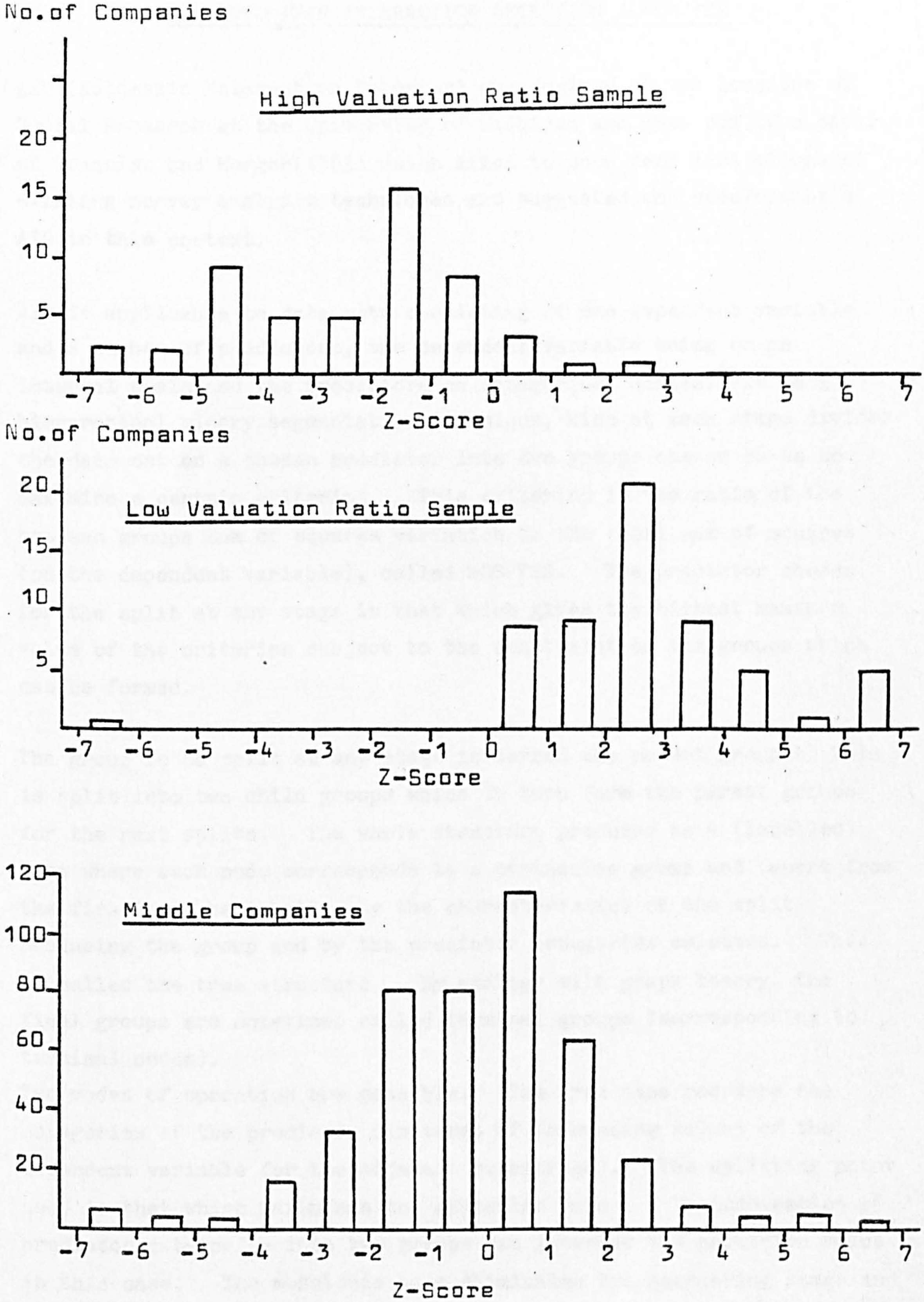
Z = o.62 + Log(PBT/AVTNW)

high valuation ratio group had more companies misclassified than the low valuation ratio group (8.3% and 1.7% respectively). This suggests that not all companies with a high valuation ratio (ie.low share price relative to asset value) have a low return on capital, and that other factors have some influence on the share price of these companies. On the other hand these results imply that companies are only highly valued, (ie. have low valuation ratios), when they have a high return on capital.

In figure H.3 the histograms of the two samples are shown. It can be seen that the overlap between the two groups is far less than that of the Earnings Yield model, reflecting the increased discriminatory power of the model. Below the two sample histograms, the histogram for the middle portion of companies is drawn and it can be seen clearly to lie between the two peaks of the sample distributions. From this it is reasonable to conclude that the z index not only applies to the high and low valued groups, but can be employed to rank all companies on a relative basis. Further evidence to reinforce this conclusion is that the Spearmans rank correlation squared between the Z-score and Valuation Ratio is .47 indicating a strong relationship. This .47 is very similar to the amount of variance explained by the return on capital variable in the multiple regression model, .46.

Figure H.3

HISTOGRAM OF THE VALUATION RATIO MODEL Z-SCORES



APPENDIX I

THE AUTOMATIC INTERACTION DETECTION ALGORITHM

AID (Automatic Interaction Detector) was devised at the Institue of Social Research at the University of Michigan and grew out of a paper of Sonquist and Morgan(1963) which aimed to show some limitations of existing survey analysis techniques and suggested the development of AID in this context.

AID is applicable to data sets consisting of one dependent variable and a number of predictors, the dependent variable being on an interval scale and the predictors on categorical scales. It is a hierarchical binary segmentation technique, wich at each stage divides the data set on a chosen predictor into two groups chosen so as to maximise a certain criterion. This criterion is the ratio of the between groups sum of squares variation to the total sum of squares (on the dependent variable), called BSS/TSS. The predictor chosen for the split at any stage is that which gives the highest maximum value of the criterion subject to the constraint on the groups which can be formed.

The group to be split at any stage is termed the parent group. This is split into two child groups which in turn form the parent groups for the next splits. The whole structure produced is a (labelled) tree where each node corresponds to a particular group and (apart from the first) can be labelled by the characteristics of the split producing the group and by the predictor categories selected. This is called the tree structure. By analogy with graph theory, the final groups are sometimes called terminal groups (corresponding to terminal nodes).
Two modes of operation are possible. The free case reorders the categories of the predictor (in terms of increasing values of the dependent variable for the adjacent categories). The splitting point used is that which maximises the criterion value. No combination of predictor categories into two groups can increase the criterion value in this case. The monotonic case eliminates the reordering stage and so constrains the new groups to the original adjacencies.

Three cut-off rules operate to limit the extent of splitting. The size of the child groups has to be greater than a specified value (minimum group size) for a split to occur; the total sum of squares, TSS, of the parent group must be greater than a fixed proportion of the original TSS; and the BSS/TSS (where TSS is the original TSS) must be greater than a fixed value. Recommended values are given for these by Sonquist and Morgan but they can be set at any level by the user. Without any cut-off rules the technique would be of little use in terms of the final groups produced as these would correspond to cells in the original cross-classification of predictors. This suggests the use of AID as a data reduction device forming the set of final groups at any specified stage of the splitting process.

The ratio of the sum of all BSS produced at each stage to the TSS is called the Explanation of AID. Sometimes it is preferred to express this as a ratio of the total between cell sum of squares, called the explainable variation, which when the cut-off rules are varied would give an upper bound of 1 for the explanation, this occurring when all values of the cut-off rules are set to zero.

Description of the Algorithm

1. The total input sample is considered the first (and indeed only) group at the start.

2. Select that unsplit sample, group i, which has the largest total sum of squares.

$$TSS_i = \sum^{N_i} Y^2 - \frac{\left(\sum^{N_i} Y_i\right)^2}{N_i}$$

Y = the dependent variable
where Ni = the number of observations in group i

such that for the i'th group

$TSSi > R\ (TSS_T)$ and $Ni > M$

where R is an arbitrary parameter (normally $.01 < R < .10$) and M is an arbitrary integer (normally $20 < S < 40$).

The requirement is made to prevent groups with little variation in them, or small numbers of observations, or both, from being split. That group with the largest total sum of squares (around its own mean) is selected, provided that this quantity is larger than a specified fraction of the original total sum of squares (around the grand mean), and that this group contains more than some minimum number of cases (so that any further splits will be credible and have some sampling stability as well as reducing the error variance in the sample).

3. Find the division of the Ck classes of any single predictor Xk such that combining classes to form the partition p of this group i into two nonoverlapping subgroups on this basis provides the largest reduction in the unexplained sum of squares. Thus, choose a partition so as to maximize the expression

$$(n_1\bar{Y}_1^2 + n_2\bar{Y}_2^2) - N_i\bar{Y}_i^2 = BSS_{ikp}$$

$$\text{where } N_i = n_1 + n_2$$

$$\text{and } \bar{Y}_i = \frac{n_1\bar{Y}_1 + n_2\bar{Y}_2}{N_i}$$

for group i over all possible binary splits on all predictors, with restrictions that (a) the classes of each preictor are ordered into descending sequence, using their means as a key and (b) observations belonging to classes which are not contiguous (after sorting) are not placed together in one of the new groups to be formed. Restriction (a) may be removed, by option, for any predictor Xk.

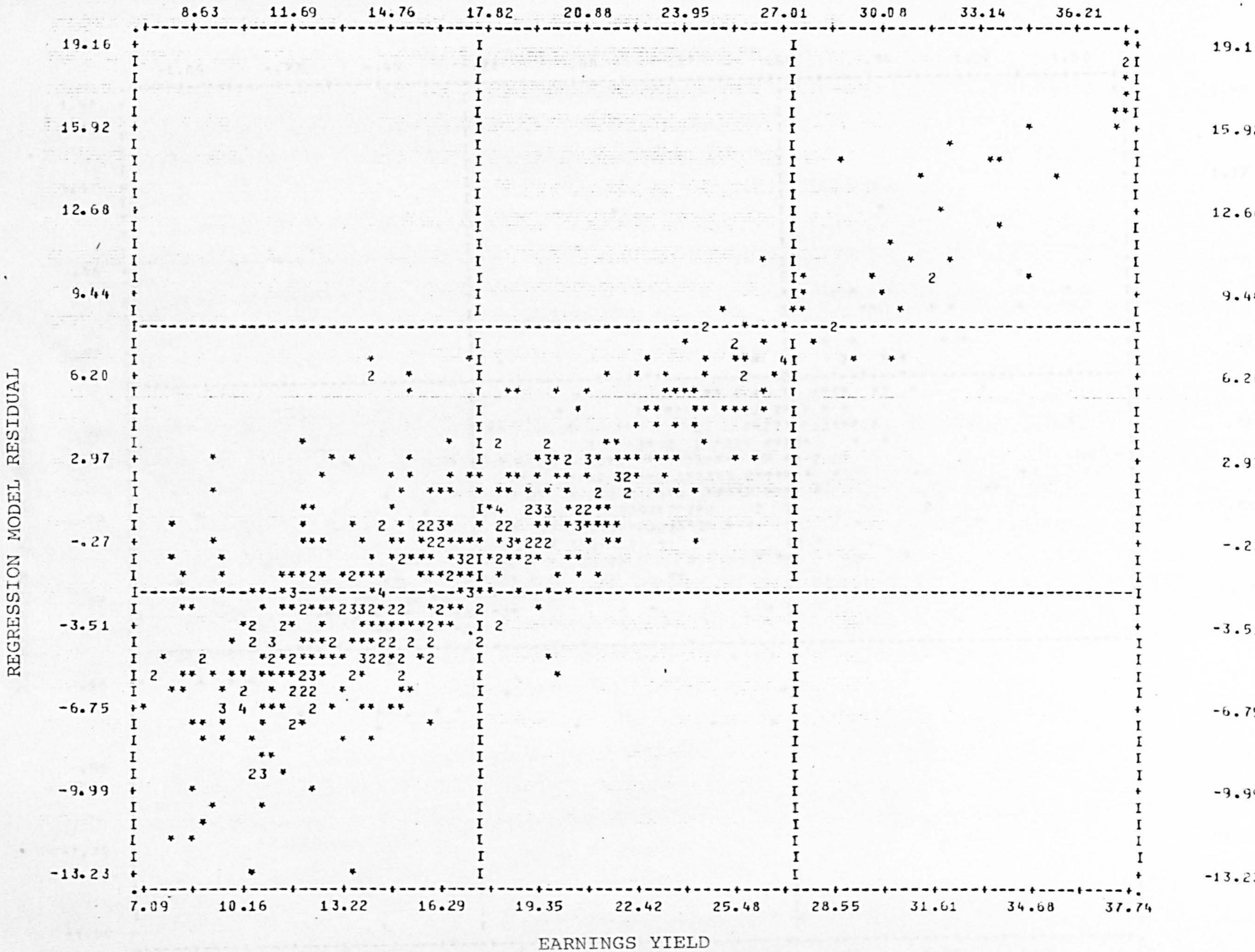
4. For a partition p on variable k over group i to take place after the completion of step 3, it is required that

$$BSS_{ikp} > Q(TSS_T)$$

where Q is an arbitrary parameter in the range $.001 < Q < r$, and TSS_T

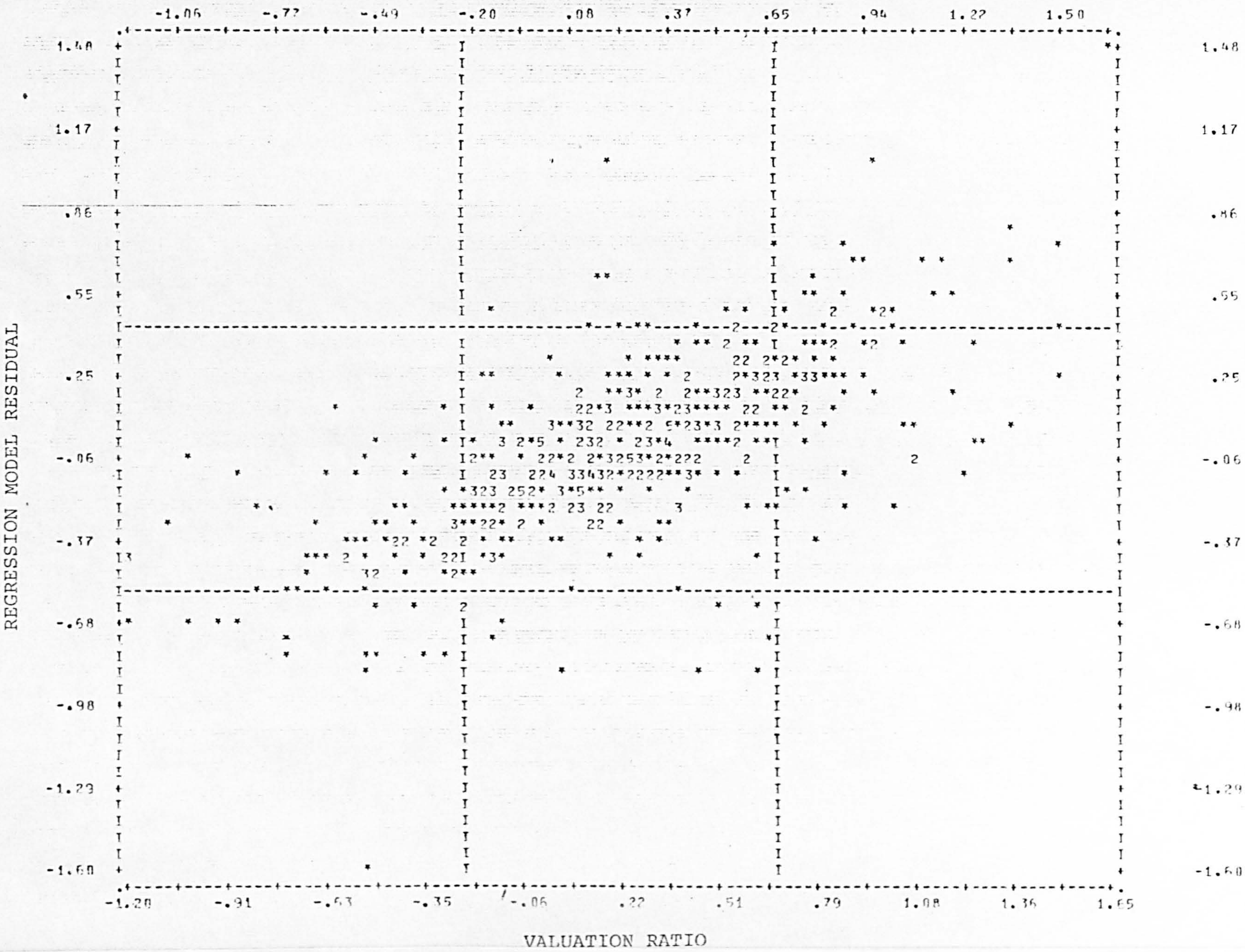
is the total sum of squares for the input sample. Otherwise group i is not capable of being split; that is, no variable is "useful" in rducing the predictive error in this group. The next most promising group (TSSj = maximum) is selected via step 2 and step 3 is then applied to it, etc.

5. If there are no more unsplit groups such that requirement (2 above) is met, or if, for those groups meeting it, requirement (4 above) is not met (i.e., there is no "useful" predictor), or if the number of currently unsplit groups exceeds a specified input parameter, the process terminates.



SCATTERGRAM OF EARNINGS YIELD REGRESSION MODEL

Appendix J.1.


-1.06 -.77 -.49 -.20 .08 .37 .65 .94 1.22 1.50
1.48
1.17
.86
.55
.25
-.06
-.37
-.68
-.98
-1.29
-1.60
-1.20 -.91 -.63 -.35 -.06 .22 .51 .79 1.08 1.36 1.65
REGRESSION MODEL RESIDUAL
VALUATION RATIO

APPENDIX K

LIST OF COMPANIES IN THE DATABASE

1 A.P.V.HLDGS
2 ABERDEEN CONSTRUCTION GROUP
3 ABERTHAW ^ BRIST CHANN PORTL CEM CO
4 ALBRIGHT ^ WILSON
5 ALLEBONE ^ SONS
6 ALLEN(EDGAR)BALFOUR
7 ALLIED BREWERIES
8 ALLIED INSULATORS
9 ALLIED POLYMER GROUP
10 ALLIED TEXTILE COMPANIES
11 ALPINE HLDGS
12 AMALGAMATED DISTILLED PRODUCTS
13 AMALGAMATED INDUSTRIALS
14 AMALGAMATED POWER ENGINEERING
15 ANCHOR CHEMICAL CO
16 ANDERSON STRATHCLYDE
17 ANDRE SILENTBLOC
18 ARMITAGE SHANKS GROUP
19 ASH ^ LACY
20 ASSOCIATED BISCUIT MANUFACTURERS
21 ASSOCIATED BOOK PUBLISHERS
22 ASSOCIATED BRITISH FOODS
23 ASSOCIATED ENGINEERING
24 ASSOCIATED NEWSPAPERS GROUP
25 ASSOCIATED PAPER INDUSTRIES
26 ASSOCIATED PORTLAND CEMENT MANF
27 ATKINS BROS(HOSIERY)
28 AULT ^ WIBORG GROUP
29 AURORA HLDGS
30 AUTOMOTIVE PRODUCTS
31 AVERYS
32 AVON RUBBER CO
33 AYRSHIRE METAL PRODUCTS
34 BABCOCK ^ WILCOX
35 BAIRD(WILLIAM)^ CO
36 BAKER PERKINS HLDGS
37 BAMFORDS
38 BANRO CONSOLIDATED INDUSTRIES
39 BARR(A.G.)^ CO
40 BARROW HEPBURN GROUP
41 BARTON ^ SONS
42 BASS CHARRINGTON
43 BATH ^ PORTLAND GROUP
44 BBA GROUP
45 BEALES(JOHN)ASSOCIATED COMPANIES
46 BEATSON,CLARK ^ CO
47 BEECHAM GROUP
48 BELL(ARTHUR)^ SONS
49 BEMROSE CORP
50 BENFORD CONCRETE MACHINERY
51 BERWICK TIMPO
52 BESTOBELL
53 BETT BROS
54 BIBBY(J.)^ SONS
55 BICC
56 BIFURCATED ENGINEERING
57 BIRMID QUALCAST
58 BIRMINGHAM MINT
59 BLACK ^ EDGINGTON
60 BLACKMAN ^ CONRAD
61 BLAGDEN ^ NOAKES(HLDGS)
62 BLAKEY'S(MALLEABLE CASTINGS)
63 BLUEMEL BROS
64 BLUNDELL-PERMOGLAZE HLDGS
65 BOC INT
66 BODDINGTONS BREWERIES
67 BODYCOTE INTERNATIONAL
68 BOND STREET FABRICS
69 BONSER ENGINEERING
70 BOOSEY ^ HAWKES
71 BOOT(HENRY)^ SONS
72 BORDER BREWERIES(WREXHAM)
73 BOWATER CORP
74 BOWTHORPE HLDGS
75 BPB INDUSTRIES
76 BRADY LESLIE
77 BRADY INDUSTRIES
78 BRAMMER(H.)^ CO
79 BRENT CHEMICALS INTERNATIONAL

80 BRICKHOUSE DUDLEY
81 BRIDON
82 BRIGHT(JOHN)GROUP
83 BRISTOL EVENING POST
84 BRITISH ENKALON
85 BRITISH LEYLAND
86 BRITISH MOHAIR SPINNERS
87 BRITISH PRINTING CORP
88 BRITISH ROLLMAKERS CORP
89 BRITISH STEAM SPECIALTIES GROUP
90 BRITISH SUGAR CORP
91 BRITISH SYPHON INDUSTRIES
92 BRITISH TAR PRODUCTS
93 BRITISH VENDING INDUSTRIES
94 BRITISH VITA CO
95 BRITTAINS
96 BROCKHOUSE
97 BROCKS GROUP OF COMPANIES
98 BRONX ENGINEERING HLDGS
99 BROOKE TOOL ENGINEERING(HLDGS)
100 BROWN BROS CORP
101 BROWN(JOHN)^ CO
102 BROWN(MATTHEW)^ CO
103 BRUNTONS(MUSSELBURGH)
104 BSR
105 BTR
106 BUCKLEY'S BREWERY
107 BULGIN(A.F.)^ CO
108 BULLOUGH
109 BULMER(H.P.)
110 BULMER ^ LUMB(HLDGS)
111 BUNZL PULP ^ PAPER
112 BURCO DEAN
113 BURNETT ^ HALLAMSHIRE HLDGS
114 BURRELL ^ CO
115 BURY ^ MASCO(HLDGS)
116 BUTTERFIELD-HARVEY
117 CADBURY SCHWEPPES
118 CAMREX(HLDGS)
119 CANNING(W.)
120 CAPE INDUSTRIES
121 CAPPER-NEILL
122 CARAVANS INTERNATIONAL
123 CARCLO ENGINEERING GROUP
124 CARLESS CAPEL ^ LEONARD
125 CARLTON INDUSTRIES
126 CARPETS INTERNATIONAL
127 CARR'S MILLING INDUSTRIES
128 CARRINGTON VIYELLA
129 CARRON CO(HLDGS)
130 CATALIN
131 CAWDAW INDUSTRIAL HLDGS
132 CELESTION INDUSTRIES
133 CENTRAL ^ SHEERWOOD
134 CHAMBERLAIN GROUP
135 CHAMBERLAIN PHIPPS
136 CHLORIDE GROUP
137 CHUBB ^ SON
138 CHURCH ^ CO
139 CLARKE CHAPMAN
140 CLAY(RICHARD)^ CO
141 CLAYTON DEWANDRE HLDGS
142 CLAYTON,SON ^ CO(HLDGS)
143 CLIFFORD(CHARLES)INDUSTRIES
144 COATES BROS ^ CO
145 COATS PATONS
146 COCKSEDGE(HLDGS)
147 COHEN(A.)^ CO
148 COLE(R.H.)
149 COLLINS(WILLIAM)^ SONS(HLDG)
150 COMBEN GROUP
151 COMPAIR
152 COMPTON(J.)SONS ^ WEBB(HLDGS)
153 CONCENTRIC
154 CORAH
155 CORNERCROFT
156 CORY(HORACE)^ CO
157 COSALT
158 COSTAIN(RICHARD)
159 COURTAULDS

160 CRANE FRUEHAUF
161 CREST NICHOLSON
162 CRODA INTERNATIONAL
163 CROPPER(JAMES)^ CO
164 CROSSLEY BUILDING PRODUCTS
165 CROUCH(DEREK)(CONTRACTORS)
166 CROWTHER(JOHN)GROUP
167 CULTER GUARD BRIDGE HLDGS
168 DAVENPORTS'BREWERY(HLDGS)
169 DAWSON INTERNATIONAL
170 DE LA RUE CO
171 DELTA METAL CO
172 DENBYWARE
173 DERITEND STAMPING CO
174 DERRITRON
175 DESOUTTER BROS(HLDGS)
176 DEW(G.)^ CO
177 DEWHURST ^ PARTNER
178 DICKINSON ROBINSON GROUP
179 DISTILLERS CO
180 DOBSON PARK INDUSTRIES
181 DORMAN SMITH HLDGS
182 DOWNING(G.H.)^ CO
183 DOWNS SURGICAL
184 DUBILIER
185 DUFAY BITUMASTIC
186 DUNBEE-COMBEX-MARX
187 DUNFORD ^ ELLIOTT
188 DUNHILL(ALFRED)
189 DUNLOP HLDGS
190 DUPLE INTERNATIONAL
191 DUPORT
192 DURAPIPE INTERNATIONAL
193 DYKES(J.)(HLDGS)
194 E.R.F.(HLDGS)
195 EARLY(CHARLES)^ MARRIOTT(WITNEY)
196 EAST LANCASHIRE PAPER GROUP
197 EDBRO(HLDGS)
198 ELECTRICAL ^ INDUSTRIAL SECURITIES
199 ELLIOTT(B.)^ CO
200 ELLIOTT GROUP OF PETERBOROUGH
201 ELLIS ^ GOLDSTEIN(HLDGS)
202 ELSON ^ ROBBINS
203 ENERGY SERVICES ^ ELECTRONICS
204 ENGLISH CARD CLOTHING CO
205 ENGLISH CHINA CLAYS
205 EUCALYPTUS PULP MILLS
207 EVA INDUSTRIES
208 EVER READY CO(HLDGS)
209 EVERED ^ CO HLDGS
210 EVODE HLDGS
211 EXPANDED METAL CO
212 F.P.A.CONSTRUCTION GROUP
213 FAIRBAIRN LAWSON
214 FAIRCLOUGH CONSTRUCTION GROUP
215 FARNELL ELECTRONICS
216 FEB INTERNATIONAL
217 FEDERATED CHEMICAL HLDGS
218 FEEDEX
219 FENNER(J.H.)^ CO(HLDGS)
220 FIDELITY RADIO
221 FISONS
222 FLIGHT REFUELLING(HLDGS)
223 FLUIDRIVE ENGINEERING CO
224 FODENS
225 FOGARTY(E.)^ CO
226 FOLKES(JOHN)HEFO
227 FOSECO MINSEP
228 FOSTER(JOHN)^ SON
229 FOTHERGILL ^ HARVEY
230 FRANCIS INDUSTRIES
231 FRENCH KIER HLDGS
232 G.E.I.INTERNATIONAL
233 G.H.P.GROUP
234 GARDNER(L.)^ SONS
235 GARNAR SCOTBLAIR
236 GASKELL ^ CO(BACUP)
237 GESTETNER HLDGS
238 GIBBONS DUDLEY
239 GLASS ^ METAL HLDGS

240	GLENLIVET DISTILLERS
241	GLYNWED
242	GOLDREI(CH.)FOUCARD ^ SON
243	GOUGH COOPER ^ CO
244	GRAMPIAN HLDGS
245	GREEN'S ECONOMISER GROUP
246	GUEST,KEEN ^ NETTLEFOLDS
247	GUINNESS(ARTHUR)SON ^ CO
248	HADEN CARRIER
249	HALL ENGINEERING(HLDGS)
250	HALL(MATTHEW)^ CO
251	HALLAM,SLEIGH ^ CHESTON
252	HARDYS ^ HANSONS
253	HARRIS ^ SHELDON GROUP
254	HARRISON(JAMES)HLDGS
255	HARRISON ^ SONS
256	HAWKER SIDDELEY GROUP
257	HAWKINS ^ TIPSON
258	HENDERSON(P.C.)GROUP
259	HEPWORTH CERAMIC HLDGS
260	HESTAIR
261	HICKING PENTECOST ^ CO
262	HICKSON ^ WELCH(HLDGS)
263	HIELD BROS
264	HIGHAMS
265	HIGHLAND DISTILLERIES CO
266	HIGSONS BREWERY
267	HILL ^ SMITH
268	HOLLAS GROUP
269	HOLT LLOYD INTERNATIONAL
270	HOMFRAY ^ CO
271	HOPKINSONS HLDGS
272	HOUSE OF LEROSE
273	HOVERINGHAM GROUP
274	HOWARD MACHINERY
275	I.D.C.GROUP
276	ICL
277	IMPERIAL CHEMICAL INDUSTRIES
278	IMPERIAL GROUP
279	IMPERIAL METAL INDUSTRIES
280	INTERNATIONAL COMBUSTION(HLDGS)
281	INTERNATICNAL PAINT CO
282	INVERESK GROUP
283	INVERGORDON DISTILLERS(HLDGS)
284	J.B.HLDGS
285	JEROME(S.)^ SONS(HLDGS)
286	JOHNSON,MATTHEY ^ CO
287	JOHNSON-RICHARDS(H.^ R.)TILES
288	JONES(A.A.)^ SHIPMAN
289	K SHOES
290	KAYSER BONDOR
291	KELSEY INDUSTRIES
292	KLEEMAN INDUSTRIAL HLDGS
293	LADIES PRIDE OUTERWEAR
294	LAFARGE ORGANISATION
295	LAING(JOHN)^ SON
296	LAIRD GROUP
297	LAMBERT HOWARTH GROUP
298	LANKRO CHEMICALS GROUP
299	LAPORTE INDUSTRIES(HLDGS)
300	LE BAS(EDWARD)
301	LEAD INDUSTRIES GROUP
302	LEBUS(HARRIS)
303	LEC REFRIGERATION
304	LEE(ARTHUR)^ SONS
305	LEE COOPER GROUP
306	LESNEY PRODUCTS ^ CO
307	LEY'S FOUNDRIES ^ ENGINEERING
308	LEYLAND PAINT ^ WALLPAPER
309	LILLEY(F.J.C.)
310	LINCROFT KILGOUR GROUP
311	LINDUSTRIES
312	LINER CONCRETE MACHINERY CO
313	LIVERPOOL DAILY POST ^ ECHO
314	LLOYD(F.H.)HLDGS
315	LOCKER(THOMAS)(HLDGS)
316	LONDON BRICK CO
317	LONDON ^ MIDLAND INDUSTRIALS
318	LONDON ^ NORTHERN GROUP
319	LONSDALE UNIVERSAL

320	LOVELL(Y.J.)(HLDGS)
321	LOW ^ BONAR GROUP
322	LYONS(J.)^ CO
323	M.K.ELECTRIC HLDGS
324	M.K.REFRIGERATION
325	MCCLEERY L'AMIE GROUP
326	MCCORQUODALE ^ CO
327	MACDONALD MARTIN DISTILLERIES
328	MACKAY(HUGH)^ CO
329	MACLELLAN(P.^ W.)
330	MACPHERSON(DONALD)GROUP
331	MANDERS(HLDGS)
332	MARCHWIEL HLDGS
333	MARLEY
334	MARSHALL CAVENDISH
335	MARTIN(ALBERT)HLDGS
336	MARTIN-BLACK
337	MATTHEWS(BERNARD)
338	MEARS BROS HLDGS
339	MELVILLE,DUNDAS ^ WHITSON
340	MENTMORE MANUFACTURING CO
341	METAL BOX
342	METAL CLOSURES GROUP
343	METALRAX(HLDGS)
344	METTOY CO
345	MIDLAND INDUSTRIES
346	MINING SUPPLIES
347	MITCHELL,SOMERS
348	MIXCONCRETE(HLDGS)
349	MONK(A.)^ CO
350	MONO CONTAINERS
351	MONTFORT(KNITTING MILLS)
352	MORGAN CRUCIBLE CO
353	MORGAN-GRAMPIAN
354	MOSS ENGINEERING GROUP
355	MOSS(ROBERT)
356	MOWLEM(JOHN)^ CO
357	MUIRHEAD
358	MYSON GROUP
359	NEEDLERS
360	NEIL ^ SPENCER HLDGS
361	NEILL(JAMES)HLDGS
362	NEWARTHILL
363	NEWBOLD ^ BURTON HLDGS
364	NEWEY GROUP
365	NEWMAN INDUSTRIES
366	NEWMANS TUBES
367	NEWS INTERNATIONAL
368	NOBLE ^ LUND
369	NORCROS
370	NORTH BRITISH STEEL GROUP (HLDGS)
371	NORWEST HOLST
372	NOTTINGHAM MANUFACTURING CO
373	NU-SWIFT INDUSTRIES
374	OFREX GROUP
375	OLYMPIA(REDACRE)
376	OSBORN(SAMUEL)^ CO
377	OXLEY PRINTING GROUP
378	PARKLAND TEXTILE(HLDGS)
379	PATERSON(R.)^ SONS
380	PAULS ^ WHITES
381	PEGLER-HATTERSLEY
382	PENTOS
383	PETBOW HLDGS
384	PHILLIPS PATENTS(HLDGS)
385	PICKLES(WILLIAM)^ CO
386	PILKINGTON BROS
387	PITTARD GROUP
388	PLAXTON'S(SCARBOROUGH)
389	PLESSEY CO
390	PORK FARMS
391	PORTALS HLDGS
392	PORTSMOUTH ^ SUNDERLAND NEWSPAPERS
393	PRATT(F.)ENGINEERING CORP
394	PRESS(WILLIAM)^ SON
395	PRESTIGE GROUP
396	PYE HLDGS
397	RACAL ELECTRONICS
398	RANDALL(J.^ L.)
399	RANK ORGANISATION

400	RANKS HOVIS MCDOUGALL
401	RANSOME HOFFMANN POLLARD
402	RANSOMES SIMS ^ JEFFERIES
403	RATCLIFFS(GREAT BRIDGE)
404	RAWLINGS BROS
405	READICUT INTERNATIONAL
406	READY MIXED CONCRETE
407	RECKITT ^ COLMAN
408	RECORD RIDGWAY
409	REDFEARN NATIONAL GLASS
410	REDMAN HEENAN INTERNATIONAL
411	REED INTERNATIONAL
412	REED ^ SMITH HLDGS
413	RENOLD
414	REVERTEX CHEMICALS
415	REXMORE
416	REYROLLE PARSONS
417	RICHARDS
418	RICHARDSON WESTGARTH ^ CO
419	ROBERTSON FOODS
420	ROCKWARE GROUP
421	ROLLS-ROYCE MOTORS HLDGS
422	ROTAFLEX(GB)
423	ROTAPRINT
424	ROTHMANS INTERNATIONAL
425	ROTORK
426	ROWNTREE MACKINTOSH
427	ROYAL WORCESTER
428	RUBEROID
429	RUGBY PORTLAND CEMENT CO
430	SALE TILNEY ^ CO
431	SANDERSON KAYSER
432	SCAPA GROUP
433	SCOTT ^ ROBERTSON
434	SCOTTISH ^ UNIVERSAL INVESTMENTS
435	SELINCOURT
436	SENIOR ENGINEERING GROUP
437	SERCK
438	SHARPE(W.N.)
439	SHAW CARPETS
440	SHAW(FRANCIS)^ CO
441	SHEEPBRIDGE ENGINEERING
442	SHILOH SPINNERS
443	SIDLAW INDUSTRIES
444	SIEBE GORMAN HLDGS
445	SILENTNIGHT HLDGS
446	SILHOUETTE(LONDON)
447	SINDALL(WILLIAM)
448	600 GROUP
449	SMITH ^ NEPHEW ASSOCIATED COS
450	SOLICITORS'LAW STATIONERY SOCIETY
451	SOUTHERN CONSTRUCTIONS(HLDGS)
452	SPEAR ^ JACKSON INTERNATIONAL
453	SPENCER(GEORGE)
454	SPILLERS
455	SPIRAX-SARCO ENGINEERING
456	SPOONER INDUSTRIES
457	SQUIRREL HORN
458	STAFLEX INTERNATIONAL
459	STANDARD FIREWORKS
460	STAVELEY INDUSTRIES
461	STEETLEY CO
462	STONE-PLATT INDUSTRIES
463	STONEHILL HLDGS
464	STOREY BROS ^ CO
465	STREETERS OF GODALMING
466	STROUD RILEY DRUMMOND
467	SUMNER(FRANCIS)(HLDGS)
468	SUMRIE CLOTHES
469	SUTCLIFFE,SPEAKMAN ^ CO
470	T.P.T.
471	TACE
472	TARMAC
473	TAYLOR WOODROW
474	TECALEMIT
475	TERN-CONSULATE
476	THERMAL SYNDICATE
477	THORN ELECTRICAL INDUSTRIES
478	TILBURY CONTRACTING GROUP
479	TOLLEMACHE ^ COBBOLD BREWERIES

480 TOMATIN DISTILLERS CO
481 TOOTAL
482 TOWLES
483 TRAFFORD CARPETS(HLDGS)
484 TRANSPARENT PAPER
485 TRIDANT GROUP PRINTERS
486 TRIEFUS ^ CO
487 TRIPLEX FOUNDRIES GROUP
488 TUBE INVESTMENTS
489 TUNNEL HLDGS
490 TURNER MANUFACTURING CO
491 TURNER ^ NEWALL
492 TURRIFF CORP
493 UKO INTERNATIONAL
494 UNICORN INDUSTRIES
495 UNILEVER
496 UNITED BISCUITS(HLDGS)
497 UNITED ENGINEERING INDUSTRIES
498 UNITED GAS INDUSTRIES
499 UNITED NEWSPAPERS
500 UNITED SPRING ^ STEEL GROUP
501 UNITED WIRE GROUP
502 VALOR CO
503 VANTONA GROUP
504 VICKERS
505 VINERS
506 VISCOSE DEVELOPMENT CO
507 W.G.I.
508 WADDINGTON(JOHN)
509 WADKIN
510 WARD ^ GOLDSTONE
511 WARD(THOS.W.)
512 WARD WHITE GROUP
513 WARDLE(BERNARD)^ CO
514 WARNE WRIGHT ^ ROWLAND
515 WARREN(JAMES)^ CO
516 WATTS,BLAKE,BEARNE ^ CO
517 WEDGWOOD
518 WEIR GROUP
519 WESTBRICK PRODUCTS
520 WESTINGHOUSE BRAKE ^ SIGNAL CO
521 WESTLAND AIRCRAFT
522 WESTON-EVANS GROUP
523 WEYBURN ENGINEERING CO
524 WHATLINGS
525 WHESSOE
526 WHILEY(GEORGE M.)
527 WHITBREAD ^ CO
528 WHITECROFT
529 WHITELEY(B.S.^ W.)
530 WHITTINGHAM(WILLIAM)(HLDGS)
531 WILKES(JAMES)
532 WILKINSON MATCH
533 WILLIAMS(JOHN)OF CARDIFF
534 WILMOT-BREEDEN(HLDGS)
535 WILSON BROS
536 WILSON(CONNOLLY)HLDGS
537 WIMPEY(GEORGE)^ CO
538 WINN INDUSTRIES
539 WITTER(THOMAS)^ CO
540 WOLF ELECTRIC TOOLS(HLDGS)
541 WOLSTENHOLME BRONZE POWDERS
542 WOLVERHAMPTON ^ DUDLEY BREWERIES
543 WOODHEAD(JONAS)^ SONS
544 WOODHOUSE ^ RIXSON(HLDGS)
545 YORK TRAILER HOLDINGS
546 YORKSHIRE CHEMICALS
547 YOUNG ^ CO,'S BREWERY

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