CAPITAL MARKET THEORIES AND PRICING MODELS: EVALUATION AND CONSOLIDATION OF THE AVAILABLE BODY OF KNOWLEDGE

by

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SUMMARY

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The study investigates whether the main capital market theories and pricing models provide a reasonably accurate description of the working and efficiency of capital markets, of the pricing of shares and options and the effect the risk/return relationship has on investor behaviour. The capital market theories and pricing models included in the study are Portfolio Theory, the Efficient Market Hypothesis (EMH), the Capital Asset Pricing Model (CAPM), the Arbitrage Pricing Theory (APT), Options Theory and the Black-Scholes (B-S) Option Pricing Model.

The main conclusion of the study is that the main capital market theories and pricing models, as reviewed in the study, do provide a reasonably accurate description of reality, but a number of anomalies and controversial issues still need to be resolved.

The main recommendation of the study is that research into these theories and models should continue unabated, while the specific recommendations in a South African context are the following: (1) the benefits of global diversification for South African investors should continue to be investigated; (2) the level and degree of efficiency of the JSE Securities Exchange SA (JSE) should continue to be monitored, and it should be established whether alternative theories to the EMH provide complementary or better descriptions of the efficiency of the South African market; (3) both the CAPM and the APT should continue to be tested, both individually and jointly, in order to better understand the pricing mechanism of, and risk/return relationship on the JSE; (4) much South

African research still needs to be conducted on the efficiency of the relatively new options market and the application of the B-S Option Pricing Model under South African conditions.

KEY TERMS:

Efficient Market Hypothesis (EMH); Portfolio Theory; Arbitrage Pricing Theory (APT); Capital Asset Pricing Model (CAPM); Black-Scholes; Options; Diversification; Risk; Return; Accounting Theory.

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CHAPTER 1

THE SCOPE AND PURPOSE OF THE STUDY

1.1 INTRODUCTION

The aim of this chapter is to discuss the scope and purpose of the study. The chapter commences with an outline of the background to the study, whereafter the problem is defined. The third aspect to be covered is the establishment of the main purpose and supplementary purposes of the study, and this is followed by the motivation for and importance of the study. The method of study is then outlined and the chapter ends with a description of the organisation of the study.

1.2 BACKGROUND TO THE STUDY

The development of modern finance theory started in the 1950s and was refined during the following decades resulting in a unified framework of finance theory during the 1980s. The rapid development of finance theory, especially the formation of theories defining the nature and working of capital markets, resulted in the establishment of flexible pricing models which are widely applied in capital markets. The establishment of options markets had a dramatic impact on finance theory. Research in the field of the pricing of options provided additional important advances in the development of pricing models.

The major advances in modern finance theory were the development of Portfolio Theory, the Efficient Market Hypothesis, the Capital Asset Pricing Model, the Arbitrage Pricing Theory and the Black-Scholes Option Pricing Model. With reference to Harrington (1987:1-4), Van Horne (1992:3-5) and Milne (1995:4-8), the development of the major capital market theories and pricing models are summarised below.

The development of **Portfolio Theory**, based on the work of Markowitz (1952,1959), revolutionised finance theory and was the first step in the development of pricing models. The basic idea behind Portfolio Theory is that the risk of an investment should be considered on the basis of its contribution to the overall risk of a portfolio of investments and not according to deviations in the individual investment's expected return. Therefore the efficient diversification of investment portfolios will result in a reduction of the level of risk associated with a given expected return.

The development of the **Efficient Market Hypothesis (EMH)**, based primarily on the work and findings of Fama (1970), had a major impact on how the workings of the capital market were viewed. The basic suggestion of the EMH is that, since the capital market is efficient, the changes in the prices of securities are uncorrelated and the security prices fully reflect the price implications of all publicly available information in an unbiased manner.

A further development was the extension of Markowitz's (1952,1959) work by Sharpe (1964), assisted by the efforts of Treynor (1961), Lintner (1965) and Mossin (1966), resulting in the now well-known **Capital Asset Pricing Model (CAPM)**. The main principle of the CAPM is that some of the risk underlying an investment can be diversified away by holding a portfolio of investments. Further, the expected return on an investment is equal to the sum of the risk-free rate of return and a risk premium derived from the investment's sensitivity to the risk of the market as a whole. The development of the CAPM had a major impact on the selection and the measurement of the performance of individual investments and portfolios of investments.

A further important development was Black and Scholes's (1973) contribution of an option pricing model. Known as the **Black-Scholes (B-S) Option Pricing Model**, this model is based on the same basic principles as the CAPM. The development of the B-S model expanded the use of pricing models since it can also be applied with other financial instruments such as bonds, foreign currency, etcetera.

The development of the **Arbitrage Pricing Theory** by Ross (1976) as a rival/alternative to the CAPM, further contributed to the development of finance theory. The APT differs from the CAPM in that it does not only take the market risk factor into account, but also relies on a number of, yet undetermined, risk factors. The development of the APT has created a great deal of interest, and even controversy, in the field of asset pricing, insofar as to determine all the risk factors to be taken into account in the pricing of assets, and whether or not it is more flexible and useful than the CAPM.

Finance theory is continuing to develop through new ideas, techniques and research, and all the major capital market theories and pricing models are examined by academics, researchers and investment practitioners on an ongoing basis. The controversy and debate surrounding these theories and models, especially with regard to the EMH, CAPM, APT and the B-S Option Pricing Model, continue unabated.

1.3 DEFINITION OF THE PROBLEM

As indicated in the preceding section, the main capital market theories and pricing models have been developed and refined during the past fifty years. Since their development, the research and debate over these theories and pricing models have been ongoing with the result that today there is an enormous volume of research and academic literature on these subjects. The volume of research conducted to date and the extensive literature available, show that there is a definite need to attempt to consolidate the available body of knowledge before this task becomes too voluminous.

The consolidation of the available knowledge and a review of the extensive body of research will enhance knowledge of the subject in South Africa and will serve as a basis for future South African research on the issues concerned. It should, however, be noted that the usefulness of such a consolidation of knowledge is not only limited to South Africa, but may also be useful on an international scale. Most of the research undertaken to date and most of the debate surrounding the various subjects, in the broad context of capital market theory, have taken place on an international scale outside the borders of South Africa.

This gives rise to the definition of the problem of this study:

> **Does the available body of knowledge and evidence from empirical research on the main capital market theories and pricing models show that these theories and models provide a reasonably accurate description of reality?**

The importance of such a consolidation of the available body of knowledge and a review of research is confirmed by Griffen (1987:4,5) who is of the opinion that such a merging of research can serve a broad educational objective in that

> it filters and translates a large body of work written mostly by academics to satisfy scholarly endeavours. Doubtless, that scholarly focus has merit, but for the non-academics many points of broader interest are lost because the reader has neither the means nor the inclination to decipher the researcher's technical language. Periodically research needs to be summarized and coherently organized to enhance and broaden people's understanding, particularly those who have an enduring interest in financial reporting. An organized and coherent translation helps researchers and readers alike.

The sub-problems of the study can be summarised as follows:

- How do the existing capital market theories and pricing models describe and explain the nature and working of the capital market?
- Has research shown that these theories and models are valid and that they have descriptive and predictive ability?
- Have recent studies and research led to new developments of importance in the broad context of capital market theory?
- Can the recent research and developments be summarised and consolidated to provide a framework for future research?
- Where should future research, especially under South African conditions, be directed in this field of study?

This study will attempt to consolidate the available subject-related knowledge and provide a comprehensive review of the subject-related research. Within this framework, the study will also attempt to provide answers to the sub-problems.

1.4 PURPOSE OF THE STUDY

With the problem areas as specified in the preceding section in mind, the purpose of this study is to review the development of the major capital market theories and pricing models within the context of accounting theory and investment decision-making, investigate and analyse the research done and identify new developments in these theories and pricing models. This would then be used as a basis to determine whether these theories and pricing models provide an accurate description of reality and to identify areas of possible future research.

1.5 MOTIVATION FOR AND IMPORTANCE OF THE STUDY

The large volume of literature and research on the various capital market theories and pricing models, identified in sections 1.2 and 1.3 above, revolutionised the area of finance theory. When reviewing the literature and research, the importance of these theories and pricing models is emphasised. Evidence of this can, for example, be found in the works of Myers (1973:49), Clark *et al.* (1979:181), Seneque (1987:28) and Viljoen (1996:40). This point of view is also clearly illustrated by the following references:

> Two of the most exciting developments in microfinance and capital markets have been the efficient market hypothesis and the capital asset pricing model (Bicksler 1977:xiii).
>
> The pricing of capital assets has been the subject of intensive research by scholars and practitioners over the last thirty years (Gourley *et al.* 1987:219).
>
> Arbitrage pricing theory and Black and Scholes (1973) option pricing theory are two of the most recent possibilities suggested for use in describing investor behaviour (Harrington 1987:94).

Notwithstanding the fact that these theories and models were developed a number of decades ago, much debate and even controversy still surround them and the research continues unabated. Evidence of this can, for example, be found in the work of

Casabona (1986:iii), Blume (1993:8), Karnosky (1993:56) and Ross (1993:11).

The following references elucidate this point of view:

> Development of portfolio theory ... an empirically testable capital asset pricing model (CAPM), along with the efficient market hypothesis, has generated an enormous volume of accounting research (Spoede 1982:1).
>
> The now generally recognized controversy over the efficient market hypothesis (EMH) ... must be seen as being existent in tandem with the controversy over the validity of the CAPM (Seneque 1987:30).
>
> Arbitrage pricing theory (APT) was first developed in 1976 ... However, as with the CAPM, there are major difficulties with testing its validity which have not yet been overcome (Allison 1991:121).

The motivation for the review and consolidation of the available knowledge is that it provides a proper understanding of the subject of capital market theory and pricing models and serves as background information for the analysis of recent developments in the latter part of the study.

This study differs from past research in that it does not concentrate on one or two areas of the subject, but attempts to incorporate all the related aspects of the subject into one logical unit. Such an up-to-date consolidation of information and analysis of recent developments have, to the researcher's knowledge, not as yet been done. The Human Sciences Research Council (HSRC) has confirmed that to date this has not been done in South Africa.

1.6 THE RESEARCH APPROACH

The study will consist mainly of a literature study, that is, a study of the theoretical aspects and published empirical tests of the major capital market theories and pricing models, within the context of accounting theory. The topic of the study and its related aspects are covered in a wide range of literature sources, including books, professional journals, theses, dissertations and technical reports.

The topic of the study will be investigated as follows:

- A literature study to review the development and historical research of accounting theory, capital market theories and pricing models.

- A literature study to review and analyse the recent developments.

- A summary of the current knowledge of all the major capital market theories and pricing models investigated, in an attempt to identify areas of possible future research, especially in a South African context.

The main reason for making use of a literature study only is that in an attempt to establish current knowledge and to define possible areas for future research, it is necessary to review the development and testing of the capital market theories and pricing models and to evaluate recent research and developments in order to determine the future direction of the theoretical developments and empirical research in this area.

The literature study will be conducted as follows:

- Intensive consultation and assimilation of the existing literature and empirical evidence.

- Critical evaluation of the literature and empirical evidence.

- A summary of the literature and empirical evidence leading to conclusions and recommendations that contribute to the field of study.

Saenger (1991:6,7), however, notes a number of limitations in such a literature study and review of empirical research. These limitations can be summarised as follows:

- There may be publication bias, in that certain issues, events, circumstances, etcetera receive greater recognition and more attention than others.
- Important research may have never been published, may have gone out of print or may have been edited in such a manner that it detracts from its value.
- The retrieval of information may be in accordance with preconceived ideas.
- The researcher may show preference for those authors who supports his/her point of view.
- The researcher's communication skills may be limited.

In addition to these limitations, the availability of literature sources, the language barrier and the researcher's judgement of the importance and relevance of the research performed contribute to the limitations of a literature study and review of empirical research

1.7 ORGANISATION OF THE STUDY

The study consists of six chapters:

- **Chapter 1** describes the scope and purpose of the study. The chapter starts with the background to study, followed by the definition of the problem, the purpose of the study and the motivation for and importance of the study. Thereafter the research approach is discussed.

- **Chapter 2** focuses on the role of the capital market theories and pricing models in the formulation of an accounting theory (the market-based approach to the development of an accounting theory) and their role in investment decision-making. The chapter starts with an explanation of the concepts "capital market theories", "accounting theory" and "investment decision-making". This is followed by a review of the historical background to the development of the capital market theories, pricing models and investment decision-making, the role of the theories and models in the formulation of an accounting theory and the importance thereof for investment decision-making.

- **Chapter 3** concentrates on the development of the main capital market theories and commences with an investigation of the role of the capital market theories in investment decision-making. Of special importance in this section is the relationship between risk and return and their effect on investment decisions. Thereafter the development of the two major capital market theories is investigated. Firstly, the nature of Portfolio Theory and its implications for the risk/return relationship are examined. An important aspect of the chapter then follows, that is, the review of the empirical research related to Portfolio Theory up to the early 1980s. From this review the conclusions about Portfolio Theory are summarised. Secondly, the development of the Efficient Market Hypothesis and the forms and degrees of market efficiency are examined. This is followed by an examination of the tests of market efficiency, the efficient market anomalies, the implications of the Efficient Market Hypothesis and the misconceptions about market efficiency. The final section of the examination of the Efficient Market Hypothesis reviews the empirical research, and the conclusions drawn from it, related to capital market efficiency up to the early 1980s.

- **Chapter 4** consists of an examination of the development of the three major pricing models, that is, the Capital Asset Pricing Model, the Arbitrage Pricing Theory and the Black-Scholes Option Pricing Model and an investigation of Options Theory. The chapter starts with the Capital Asset Pricing Model, that is, its nature, assumptions, parameters, how it describes risk and its application in investment decision-making. The final sections on the Capital Asset Pricing Model deal with the testing of the validity of the model, a review of the empirical research related to it, up to the early 1980s, and the conclusions drawn from it. Next the Arbitrage Pricing Theory is examined, including its nature, how it describes risk, its application in investment decision-making and how it compares with the Capital Asset Pricing Model. The final part of this section considers the tests of the validity of the model, reviews the empirical research related to the model up to the early 1980s and draws conclusions from it. Finally, options markets, the nature, types and value of options and the application of the Black-Scholes model in the pricing of options are examined. This is followed by a review of the tests on and results of empirical research related to option markets and the Black-Scholes model up to the early 1980s, ending with the conclusions that can be drawn from it.

- **Chapter 5** reviews recent developments in and recent research related to the capital market theories and pricing models examined in chapters 3 and 4. Included in this is some alternative theories to the Efficient Market Hypothesis and the possible role of options in the stock market crash of October 1987. The chapter also draws conclusions from the recent empirical research conducted on each of the capital market theories and pricing models.

- **Chapter 6** provides a summary of the literature study, that is, within the context of accounting theory, the nature and implications of investment decision-making and the principles of Portfolio Theory, the Efficient Market Hypothesis, the Capital Asset Pricing Model, the Arbitrage Pricing Theory, Options Theory and the Black-Scholes Option Pricing Model. This is followed by the main conclusions that can be drawn from the empirical research on the above. The chapter ends with recommendations for future research in a South African context.

1.8 SUMMARY

The aim of this chapter was to provide information on the scope and purpose of the study. The chapter started with the background to the study, followed by a definition of the problem of the study and a discussion of the purpose, motivation for and importance of the study. The last two sections of the chapter dealt with the research approach that is going to be adopted and the organisation of the study.

CHAPTER 2

CAPITAL MARKET THEORIES AND PRICING MODELS WITHIN THE CONTEXT OF ACCOUNTING THEORY AND INVESTMENT DECISION-MAKING

2.1 INTRODUCTION

According to Weston and Copeland (1992:193) capital markets, to be able to efficiently allocate scarce capital resources, should price securities only on economic grounds based on publicly available information.

Accounting information, especially as contained in interim and annual financial reports, is an important source of information available to capital markets since it provides information about the financial performance and condition of business entities. As such, and to be useful for capital market investment decision-making, accounting information should be both relevant and reliable.

The importance of the usefulness of accounting information is emphasised by the American Institute of Certified Public Accountants (Belkaoui 1992:23) in its definition of accounting:

> Accounting is a service activity. Its function is to provide quantitative information, primarily financial in its nature about economic entities that is intended to be useful in making economic decisions, in making resolved choices among alternative courses of action.

Thus, by implication, the value of accounting information can be established by measuring the impact of new publicly available information on security prices on capital markets. Capital market theories, combined with the application of pricing models, provide a basis according to which various accounting policies, disclosure practices and accounting methods can be evaluated through measuring the impact of alternative accounting policies, practices and methods on security prices (Firth 1977:140).

The main focus of this chapter is, therefore, on the role of the market-based approach to the formulation of accounting theory, since accounting information is an important aid to capital markets in its function of efficient allocation of capital resources and it is an essential investment tool which enables investors in capital markets to hold optimal investment portfolios which reflect their risk-return preferences. This chapter commences with descriptions of the concepts "capital market theories", "pricing models", "accounting theory" and "investment decision-making" to provide a frame of reference for the ensuing sections. Following on this is a review of the background to the development of those capital market theories and pricing models which, apart from being essential elements in the market-based approach to the formulation of accounting theory, are also the main focus of this study.

It should be noted as this stage that the market-based approach to the formulation of accounting theory is but one of many such approaches, hence the various approaches to the formulation of accounting theory are summarised in the next section with specific emphasis on the market-based approach.

In addition, and of particular importance to this study, the need for and importance of capital market theories and pricing models in investment decision-making are discussed, with specific reference to the role of accounting information.

2.2 THE CONCEPTS "CAPITAL MARKETS THEORIES", "PRICING MODELS", "ACCOUNTING THEORY" AND "INVESTMENT DECISION-MAKING"

According to Kam (1990:45,46,485,486) theories, hypotheses and models can be viewed as synonyms in their role of explaining and predicting what happens in reality.

The American Accounting Association (AAA) (Wolk *et al.* 1989:155) defines theory as "... a cohesive set of hypothetical, conceptual and pragmatic principles forming a general frame of reference for a field of study".

Rees (1995:38) describes the role of theory as follows:

> In understanding the world of accounting and finance, there is a role for descriptions of current practice. There is also a need for informed prescriptions as to how to improve that practice.
>
> Theoretical development requires a postulated model which either describes why things work as they do rather than simply how, or what reaction can be expected from a given set of circumstances. Put simply, it either explains or predicts.

The main purpose of theory is seen by Hendriksen and Van Breda (1992:16) as:

> To provide a framework for the development of new ideas and new procedures and to help in making choices among alternative procedures. If these objectives are met, it is not necessary that theory be based completely on practical concepts or that it be restricted to the development of procedures that are completely workable and practical in terms of current technology.

Although no definitive definitions exist for the concepts "capital market theories", "pricing models", "accounting theory" and "investment decision-making" the following sections attempt to provide reasonable descriptions of these concepts.

2.2.1 The concept "capital market theories"

Capital market theories are concerned with explaining and predicting the relationship between expected return and risk on investments in capital markets, the effect of investor's efficiently diversified portfolios on the market pricing mechanism and whether the market is able to ensure that security prices fully and correctly reflect all available information (Fama 1976:136,258,320).

2.2.2 The concept "pricing models"

The purpose of capital market pricing models are to accurately predict the fair value of securities based on estimates of the expected returns on risky securities in market equilibrium. These models therefore attempt to explain the relationship between risk, return and value based on the behaviour of efficient capital markets (Weston & Copeland 1992:401,436; Rees 1995:153).

2.2.3 The concept "accounting theory"

Using the various definitions of accounting theory (Wolk *et al.* 1989:3; Kam 1990:490; Belkaoui 1992:178; Hendriksen & Van Breda 1992:21), accounting theory can be described in the following manner.

Accounting theory constitutes a coherent set of concepts, models and hypotheses on which the establishment of accounting techniques are based. These serve as a frame of reference for the establishment of accounting concepts and principles in the standard-setting process, with the ultimate aim of providing logical, useful and verifiable financial information.

At this point in time no comprehensive theory of accounting exists. Different theories have been and are continually proposed depending on the approach followed (Belkaoui 1992:56).

2.2.4 The concept "investment decision-making"

With specific reference to capital markets, investment decision-making refers to the process of using information to assess the performance and prospects of firms with the aim of investing in or divesting of its securities. Information is essential in the decision-making process to ensure that investment in securities provides an adequate return to compensate for the risk involved. The essential element of investment decision-making is to ensure that the expected return on the investment justifies the level of risk involved (Dobbins *et al.* 1994:5; Rees 1995:ix,157; Scott 1997:4).

With these descriptions of relevant concepts as point of departure, the historical development of capital market theories, pricing models and investment decision-making are now reviewed.

2.3 THE HISTORICAL BACKGROUND TO THE DEVELOPMENT OF CAPITAL MARKET THEORIES, PRICING MODELS AND INVESTMENT DECISION-MAKING

Prior to the 1950s the traditional methods for capital market investment decisions and investment portfolio management were rule-of-thumb, the intrinsic value of securities (fundamental analysis) and trends or patterns in security prices (technical analysis) (Anderson 1978:6,10). Investors and investment managers concentrated on the return on investments and the role of risk was not properly understood, if considered at all (Harrington 1987:5; Dobbins *et al.* 1994:1,2).

Investors used the rule-of-thumb method as a basis to manage their portfolios, while they used the intrinsic values of securities and trends or patterns in security prices as a basis for selection of securities to buy, hold or sell. The two basic methods used for security selection were fundamental analysis and technical analysis (Anderson 1978:7).

In using fundamental analysis, investors studied the firm, industry and economy to invest in securities when their market prices were below intrinsic value and to sell securities when market prices rose above their intrinsic values. In contrast to this, technical analysis does not concentrate on the factors influencing individual securities and the factors reflected in market prices, but focuses purely on price trends or patterns (Anderson 1978:9).

Investors, using technical analysis, based their investment decisions on observable price patterns that repeated themselves over time. These patterns were used to determine whether capital markets underpriced or overpriced securities. Investors, therefore, maintained or increased the value of their investment portfolios by charting the past prices of securities in an effort to identify security price trends or patterns that might be used as signals to buy, hold or sell securities (Anderson 1978:10).

Since the 1950s academics, theorists and researchers started questioning and testing the traditional assumptions concerning the pricing of securities on capital markets. This lead to an unification of theory concerning capital markets, business finance and investment decision-making. New developments, such as Portfolio Theory (PT), the Efficient Market Hypothesis (EMH), the Capital Asset Pricing Model (CAPM), option pricing and the Arbitrage Pricing Theory (APT) concentrated not only on return on investment but rather on the use of information by investors to form expectations about the risk and return on securities (Anderson 1978:6,12,13).

Modern portfolio theory, based on the work of Markowitz (1952,1959), concentrates as much on investment risk as on investment return. Further, investment in securities is evaluated in terms of the security's effect on the investor's entire portfolio of investments (Harrington 1987:5,6; Dobbins *et al.* 1994:2).

Fundamental to modern portfolio theory is the postulate that, under conditions of uncertainty, investment in a security should not by judged purely on the basis of its relationship between risk and return, but rather in relation to its contribution on the overall risk of the portfolio of investments (Van Horne 1992:4). Thus, depending on the investor's desired level of risk, investors construct portfolios of investments that render the highest return for a specific level of risk (Harrington 1987:9-11; Linley 1992:3).

In contrast with modern portfolio theory, the traditional investment theory evaluated investment in securities under the assumption of perfect certainty without any clear or defined approach in assessing the effects of risk. Based on the assumption of perfect certainty about future returns, investors were urged to hold one-security portfolios which would render the highest return for a specific investment period (Anderson 1978:33; Linley 1992:8).

Following on Markowitz's work on the relationship between risk and return and the efficient diversification of investments, Sharpe (1964), Lintner (1965) and Mossin (1966) developed the Capital Asset Pricing Model (CAPM). The CAPM describes the relationship between risk and return in efficient capital markets based on the postulate that the prices of securities in capital markets will adjust until securities with the same level of risk offer the same expected return (Anderson 1978:70; Sharpe 1985:xix).

Weston and Copeland (1992:403) summarise the significance of the CAPM as follows:

> It provides a measure of the risk of an individual security which is consistent with portfolio theory. It enables us to estimate the undiversifiable risk of a single asset and compare it with the undiversifiable risk of a well-diversified portfolio.

After the development of the CAPM, academics, theorists and researchers shifted their focus to the idea of efficient capital markets and the performance of the pricing mechanism of capital markets (Firth 1977:14).

At first the focus was on whether successive price changes in capital markets were uncorrelated. Later on, after the evidence supported a random walk for price changes, the focus shifted to how the market priced securities to achieve a random walk (Anderson 1978:13,14).

This led Fama (1970), building on the earlier work of Samuelson (1965), to introduce the Efficient Market Hypothesis (EMH) (Milne 1995:8). The EMH asserts that security price changes are uncorrelated as capital markets are efficient and rapidly incorporates all relevant new information into security prices in an unbiased manner (Anderson 1978:14; Hendriksen & Van Breda 1992:169).

The EMH is the prevailing description of the effect of publicly available information on security prices and argues that no abnormal returns can be made on capital markets by using publicly available information. Abnormal returns can only be obtained through change or by using insider information (Milne 1995:8).

With the opening of the first, and still the largest, options exchange in Chicago in 1973 came another important development in modern investment theory, namely option pricing (Anderson 1978:7). Two different but equivalent pricing models for determining fair market values of options are the Black-Scholes Model, developed by Black and Scholes in 1973, and the binomial model developed by Cox, Ross and Rubinstein in 1979 (Weston & Copeland 1992:446). The binomial model, however, falls outside the scope of this study.

The Black-Scholes Model, which is quite similar to the CAPM, is used to price call options in efficient markets, but can also be used to determine put option prices, including the more difficult American put option prices (Weston & Copeland 1992:446; Milne 1995:7).

Finally, due to dissatisfaction with some theoretical and empirical weaknesses of the CAPM, the APT was developed by Ross in 1976. Unlike the CAPM, which deems the capital market as the only source of risk (Linley 1992:19), the APT uses a number of factors, for example unexpected changes in interest rates, to explain returns on securities (Weston & Copeland 1992:422).

Although Ross did not specify the various factors which may affect security returns nor provided instructions how these factors should be measured (Linley 1992:3), it is potentially a more flexible and meaningful alternative to the CAPM, with less empirical testing limitations (Milne 1995:6).

Due to the recognition of the relationship between risk and return and the explanation of the effect of individual securities on investors' portfolios, these modern capital market theories and pricing models have proved popular since they provide a coherent framework for capital market investment and investment decision-making (Harrington 1987:5; Milne 1995:11).

Since the 1980s the focus of investment theory has shifted to the effect of efficient market anomalies and imperfections in the pricing of securities as well as the effect of the globalization of capital markets on investment decision-making (Van Horne 1992:5).

Following on the historical background to the development of capital market theories, pricing models and investment decision-making, the formulation of accounting theory and the role of capital markets and pricing models therein can now be considered.

2.4 THE ROLE OF CAPITAL MARKETS AND PRICING MODELS IN THE FORMULATION OF ACCOUNTING THEORY

The various approaches to the formulation of accounting theory can be labelled as either descriptive or prescriptive. According to Belkaoui (1992:58,109) the various approaches can be classified in the following manner.

- Traditional approaches
    - Non-theoretical approaches
        - Pragmatic (informal) approach
        - Authoritarian approach
    - Theoretical approaches
        - Deductive approach
        - Inductive approach
        - Ethical approach
        - Sociological approach
        - Economic approach
- Modern approaches
    - Regulatory approach
    - Events approach
    - Behavioural approach
    - Human information processing approach
    - Positive approach

- Predictive approach
  - Prediction of an economic event approach
  - Prediction of market reaction: market-based approach

In the following sections the methodologies used in these approaches and the various approaches themselves are summarised, with particular emphasis on the market-based approach in its role in the formulation of accounting theory and its relevance to the subject of the study.

2.4.1 Methodologies for the formulation of accounting theory

Accounting theories can be classified as either being a descriptive theory of accounting or a prescriptive theory of accounting, depending on the methodology used. Hendriksen and Van Breda (1992:17) summarises these two methodologies as follows.

a. Descriptive theories

Descriptive (positive) accounting theories attempt to describe the way things are at present, that is, they attempt to explain what financial information is made available to users of accounting data and how this information is communicated.

b. Prescriptive theories

Prescriptive (normative) accounting theories attempt to prescribe the way things should be rather than what is, that is, they attempt to explain what financial information ought to be made available and how this information ought to be communicated.

Belkaoui (1992:57) confirms the need for both methodologies in the formulation of accounting theory. Descriptive theory is needed to justify existing accounting practices, while prescriptive theory is needed to justify the improvement of existing accounting practices or the adoption of new accounting practices.

Following from this, the various approaches to the formulation of accounting theory are examined.

2.4.2 Approaches to the formulation of accounting theory

This section provides a brief discussion of the various approaches to the formulation of accounting theory with specific reference to the role of the market-based approach.

2.4.2.1 Non-theoretical approaches

a. Pragmatic (informal) approach

The pragmatic approach to the formulation of accounting theory examines accounting techniques and principles from the viewpoint of their practical usefulness. Accordingly, the usefulness to users of accounting information and the relevance to decision-making is the main criteria for the selection of accounting techniques and principles (Belkaoui 1992:58).

Advocates of the usefulness criterion and therefore the pragmatic approach include Fremgen (1967), Beams (1968), Mueller (1967) and Cowan (1968). Critics of this approach, including Skinner (1972), attack the usefulness criterion since this leads to conflicting accounting practices and principles due to the different information needs of the various decision-makers and users of accounting data (Saenger 1991:34).

b. Authoritarian approach

The authoritarian approach also seeks to provide practical solutions to accounting problems and is employed mostly by professional accounting bodies through their attempts to regulate accounting practices. This approach emphasises the viewpoint that accounting theory must be practical to be useful, and that this is the basis for accounting having any function at all (Saenger 1991:35; Belkaoui 1992:59).

Neither the pragmatic nor the authoritarian approach has resulted in the formulation of a single unified accounting theory. This does not mean that non-theoretical approaches can be ignored because practical considerations will always be a part of the field of accounting (Saenger 1991:35; Belkaoui 1992:59).

2.4.2.2 Theoretical approaches

a. Deductive approach

The deductive approach to the formulation of accounting theory emphasises the importance of objectives in the development of accounting practices and principles, since different objectives may require different principles (Hendriksen & Van Breda 1992:16). The deductive approach, therefore, starts with the basic objectives, postulates and premises of accounting and through logical inference formulates accounting rules and practices. Through empirical application of these logically derived conclusions the theory is then tested to ensure it meets the demands of practice (Belkaoui 1992:60).

Critics of the deductive approach claim that it is too far removed from reality to provide the basic accounting rules and practices, and it has the disadvantage that if any of the basic objectives, postulates and premises of accounting are false then the resulting theory may also be false (Hendriksen & Van Breda 1992:16).

The deductive approach is usually prescriptive (normative) and has a number of advocates, including Paton (1922), Sweeney (1936), Alexander (1950), Edwards and Bell (1961), and Sprouse and Moonitz (1962) (Saenger 1991:36; Belkaoui 1992:60).

b. Inductive approach

The inductive approach is primarily descriptive (positive) and is based on drawing generalised conclusions from specific observations and measurements. This approach constructs new accounting practices and principles based on observations of real financial data of firms when there is sufficient recurrence of relationships between the observed phenomena (Belkaoui 1992:61; Hendriksen & Van Breda 1992:16).

Unlike the deductive approach, the validity of inductive theories rely on empirical verification (Belkaoui 1992:61). The process of induction starts with the formulation of an hypothesis, based on a possible relationship between observed phenomena, empirical testing of the hypothesis leading to conclusions regarding confirmation of the hypothesis as being true, or abandonment of the hypothesis as having failed. A confirmed hypothesis constitutes a theory (Henderson *et al.* 1992:5).

The inductive approach has a distinct advantage in that researchers are not restricted by existing practices and principles, but are allowed to make and test any observations they may consider relevant (Hendriksen & Van Breda 1992:17).

Proponents of the inductive approach include Hatfield (1927), Gilman (1939), Littleton (1953) and Ijiri (1975) (Saenger 1991:37).

The main disadvantage of the inductive process is that researchers may be influenced by preconceived ideas regarding the data to be observed and the relationships to perceive. Further, observations of accounting data are likely to differ from firm to firm, and this results in difficulties in determining relationships that can lead to useful generalisations (Hendriksen & Van Breda 1992:17).

It is generally considered that the deductive and inductive approaches are not competitive approaches, but can be used together in a complementary manner. Although some theorists hold the viewpoint that one approach may dominate the other, for example Kaplan (1972) favours induction and Hakansson (1969) favours deduction, it can be concluded that almost all theories will be based on both deductive and inductive reasoning (Wolk *et al.* 1989:35-38; Saenger 1991:38).

c. Ethical approach

The concepts justice, fairness, truth and equity have been identified by Scott (1941) as the main criteria in the ethical approach for the formulation of an accounting theory. Other proponents of the ethical approach have rejected some of the concepts, for example Yu (1976) perceived only fairness and justice as ethical norms, while Patillo (1965) and Spacek (1962) consider only fairness to be a basic standard against which all accounting principles and practices should be measured (Saenger 1991:39; Belkaoui 1992:62).

In conclusion, the ethical approach should not be seen in isolation since, according to Belkaoui (1992:63), fairness is a desirable objective in any approach to the formulation of an accounting theory. The ethical approach, as such, cannot produce sound accounting practices and principles, but, due to the subjective nature of what can be deemed as fair and what not, it does mean that other approaches should not ignore the basic ethical principles (Saenger 1991:39).

d. Sociological approach

The sociological approach to the formulation of accounting theory emphasises the welfare of society as a whole, and that this should form the basis for evaluating accounting principles and practices (Saenger 1991:39,40). Socioeconomic issues, such as the costs of environmental pollution and unhealthy working conditions, need to be taken into account when accounting reporting principles and techniques are evaluated and established (Hendriksen & Van Breda 1992:10).

Among the proponents of the social role of accounting are Littleton and Zimmerman (1962) and Ladd (1963), and they stressed that accounting should serve the public interest (Belkaoui 1992:63).

Due to increased interest in the impact of the activities of firms on the social environment, it can be expected that the sociological approach will play a major role in the future formulation of accounting theory (Belkaoui 1992:63). Devine (1960) and Rappaport (1964), in particular, consider the establishment of a statement of socially orientated accounting objectives as fundamental to the development of a general accounting theory (Saenger 1991:40).

e. Economic approach

According to the economic approach, the choice between alternative accounting techniques depends on the particular economic situation and their impact on the national economy (Belkaoui 1992:64). The economic approach can be divided between two different approaches, namely the macro-economic and the micro-economic approach (Hendriksen & Van Breda 1992:9).

The macro-economic approach concentrates on explaining the effect of various reporting alternatives on economic activities and economic measurement at an industry or national level. Sweden is the most typical example of a country that bases its accounting policies and practices on macro-economic goals. The micro-economic approach is concerned with explaining the effect of various reporting alternatives on economic activities and economic measurement at the level of the firm. Advocates of this approach argue that, since financial information has inevitable economic consequences, it does not matter how financial information is disclosed as long as it is disclosed in full.

The formulation of accounting theory and the development of accounting practices and principles have in general been in the form of a combination of approaches rather than a single approach. This has resulted from the combined and sometimes competitive attempts by accounting theorists, professional accounting bodies and governmental organisations to establish the concepts, principles and practices of accounting (Belkaoui 1992:64,65).

This has given rise to new (modern) approaches to the formulation of accounting theory based on both empirical and conceptional reasoning. These new approaches are more reliant on empirical verification than the traditional approaches as method of resolving accounting issues and problems. Each of these new approaches are innovative and unique in their way of looking at accounting problems, each with their own methodologies and interests, "... causing accounting to become a multi paradigmatic science in a constant state of crisis" (Belkaoui 1992:109,162,163).

2.4.2.3 Modern approaches

a. Regulatory approach

The regulatory approach is concerned with the establishment and enforcement of accounting standards for financial reporting (Belkaoui 1992:74). Although these standards are not accounting theories, there have been attempts in recent years to provide the standards with a formalised theoretical underpinning - known as a conceptual framework. This theoretical foundation is important since it is mainly the quality, and improvement in quality, of reported information that is being regulated (Saenger 1991:43).

Although there is debate whether, or to what extent, accounting should be regulated, the setting of standards is a reality in the field of accounting. The process of setting standards can be divided into three approaches (Belkaoui 1992:74,85).

i. **The free-market approach**. The market of supply and demand for information is considered to be the best mechanism for determining the types of information to be disclosed, to whom it should be disclosed and the accounting standards which the information should conform to. Leftwich (1980) and Kripke (1980) support this approach and conclude that without regulation market pressures would be sufficient to ensure adequate accounting disclosure (Belkaoui 1992:85-87).

ii. **Private-sector regulation**. This approach considers that the public interest in accounting will be best served if standards are set by the private sector, for example the Financial Accounting Standards Board (FASB) in the United States. Brown (1982) deems the participation by the FASB as essential, while Kaplan (1980) and others oppose the involvement of the FASB. Arguments against private-sector regulation include the lack of statutory authority and enforcement power and possible lack of independence from large accounting firms and companies (Belkaoui 1992:87-89).

iii. Public-sector regulation. Public-sector regulation has to some extent become a reality in most countries. Advocates of this approach include Burton (1980) and Chetkovich (1980), who conclude that a degree of government intervention is necessary to protect public interest through leadership and statutory control. Opponents include Mosso (1980) and Watts (1980), and their criticisms include the possible politicisation of standard-setting and high corporate costs associated with compliance with government regulation of information (Belkaoui 1992:89-92).

Due to the conflicting interests of the parties involved in standard-setting, and the limitations and benefits of each approach, the process of standard-setting will probably remain a combination of all three approaches. However, a distinct problem that has to be guarded against and solved is the problem of standards overload, that is, too many standards and standards being too detailed and rigid (Belkaoui 1992:98).

b. Events approach

The events approach is concerned with providing the information about economic events that is needed for decision-making. This approach is not concerned with what information the user wants, but to provide information about significant economic events to users, to enable users to translate the information into accounting information suitable for the particular decisions involved (Wolk *et al.* 1989:41; Belkaoui 1992:110). The result of the events approach is that information in accounting reports are representative of the real world and not distorted through the possible manipulative use of alternative accounting techniques (Belkaoui 1992:111).

Utilisation of the events approach could result in a large increase in the information content of financial reports due to the number of possible events, which may have monetary and/or non-monetary characteristics, relevant to decision-making (Saenger 1991:46; Belkaoui 1992:111).

The events approach has the advantage that more information is made available about economic events that may be relevant to a wide range of users, but it may result in information overload. Supporters of the event approach include Sorter (1969) and Johnson (1970) (Belkaoui 1992:110,113).

c. Behavioural approach

The behavioural approach to the formulation of accounting theory is concerned with what information users require for decision-making and how this information influences the behaviour of the individual or groups (Hendriksen & Van Breda 1992:11,12). The behavioural approach has generated much enthusiasm, with the choice of accounting practices and techniques being evaluated against their economic and sociological impact. Most studies in behavioural accounting have not attempted to establish a theoretical framework for accounting, but have in stead focused on the behavioural effects of accounting information and users' problems in processing the information (Belkaoui 1992:114).

Dyckman, Gibbins and Swieringa (1978) classified the research on the behavioural effects of accounting information into five areas (Belkaoui 1992:115,116):

i. **The adequacy of disclosure**. These studies include those conducted by Horngren (1956), Cerf (1961), Buzby (1974) and Belkaoui and Kahl (1978). The results indicated that financial statements are, in general, understandable and comprehensible and thus disclosure is adequate.

ii. **The usefulness of information included in financial statements**. The results of the studies conducted by Chandra (1974), Libby (1975) and Belkaoui (1979,1980), show that users of financial statements do not, in general, rely only on financial statements for their informational needs, but rather that the relatively important items are disclosed in the financial statements.

iii. **The attributes about corporate reporting practices**. The results of the studies by, Brenner and Shuey (1972) and Godurn (1975) highlighted the differences in attitudes between various professional accounting groups about the issue of reporting.

iv. Materiality judgements. The results of studies conducted by, for example, Woolsey (1973), Dyer (1973) and Dickhaut and Eggleton (1975) show that individuals have different judgements regarding materiality and that a number of factors affect materiality.

v. The decision effects of alternative accounting procedures. The results of these studies generally show that the effect on decision-making of alternative accounting procedures depends on the nature of the task, environment and users of the information. Studies in this field include those of Jensen (1966), Barrett (1971) and Belkaoui and Cousineau (1977). A new direction of research in behavioural accounting is concerned with agency theory, that is, the costs of monitoring and enforcing relationships between different parties. These parties include management, owners, government and creditors, and examples of agency relationships are bond covenants, management compensation contracts and income taxes (Wolk *et al.* 1989:42,43).

d. Human information processing approach

This approach, which is closely related to the behavioural approach, is concerned with the quality of the accounting information presented to users, their ability to make use of the information and the cost of producing the information (Wolk *et al.* 1989:43; Belkaoui 1992:118).

Four different approaches to researching human information processing have been identified, and can be summarised as follows (Belkaoui 1992:119-124).

i. The lens model approach. This model was developed by Brunswick (1952) and has been used in research to examine various accounting decision problems, including (1) materiality judgements, reasonableness of forecasts and uncertainty disclosures, (2) bankruptcy and price predictions, and (3) the impact of accounting changes and feedback methods. Relevant studies include those of Rockness and Nikolai (1977), Zimmer (1980) and Brown (1981).

ii. The probabilistic judgement approach. This approach, also known as the Bayesian approach, is concerned with the way decision-makers process information and the choice of techniques which they apply to estimate subjective probabilities. The studies of Ward (1976), Snowball and Brown (1979) and Biddle and Joyce (1981) are examples of research of this approach.

iii. Predecisional behaviour, that is, the process of defining the problem, identifying the information required and searching for the information. Few accounting studies have been conducted using this approach, and some of the areas researched include modelling expert financial analysis and the strategies used by managers in evaluating performance reports. Studies in this field include those of Biggs (1979), Weber (1980) and Libby and Lewis (1982).

iv. The cognitive style approach. This approach is concerned with the factors that influence the quality of decision-makers' judgements. Accounting studies using this approach include those of Vasarhelyi (1977), Weber (1980) and Belkaoui (1981,1982), and have focused on classifying users of accounting information according to their cognitive style, and then designing information systems to suite the cognitive style of these users.

e. Positive approach

The positive approach to the formulation of accounting theory is based on the initial studies of Beaver (1966) and Ball and Brown (1968), but developed largely through the influential research of Watts and Zimmerman (1978,1986,1990). The positive approach attempts to make good predictions of real-world events (Henderson *et al.* 1992:326, 327,360; Scott 1997:221,222).

The positive approach is thus concerned with explaining why certain accounting practices and procedures are chosen by managers, standard setters and others, based on a comparison of the costs and benefits of the alternative procedures and practices.

Positive accounting theory does not attempt to prescribe to individuals or constituencies what they should do, but it ultimately attempts to understand and predict accounting policy choices (Scott 1997:219-221).

The predictions made according to positive accounting theory can largely be organised around three opportunistic hypotheses, as formulated by Watts and Zimmerman (1986) (Scott 1997:221-222).

i. **The bonus plan hypothesis**. According to this hypothesis managers of firms with bonus plans will tend to select accounting procedures that increase current reported earnings if their bonus is related, at least in part, to reported net income.

ii. **The debt covenant hypothesis**. According to this hypothesis managers of firms are likely to shift reported earnings from future periods to the current when the firm is close to violating accounting-based debt covenants. Therefore, to prevent or postpone such violations, management may adopt accounting policies to raise current earnings.

iii. **The political cost hypothesis**. According to this hypothesis managers are likely to choose accounting policies which, when political costs face the firm, defer reported earnings from current to future periods. Examples of these political costs are, (1) attracting excessive media and consumer attention, (2) special regulations or taxes, and (3) foreign competition.

Positive accounting theory has generated a large amount of empirical research. Studies include those of Lev (1979), which supports the positive approach in explaining why different firms may choose different accounting policies; Healy (1985), who found evidence in favour of the bonus plan hypothesis; Sweeney (1994) reported results confirming the debt covenant hypothesis; and Jones (1991), who found evidence in favour of the political cost hypothesis (Scott 1997:223-225).

Other studies argue that these three hypotheses do not only exist in opportunistic form, but also in efficiency form. The studies of Christie and Zimmerman (1994) and Dechow (1994) supports the viewpoint that accounting policies are not only chosen for management's own advantage (opportunistic), but also to improve a firm's flexibility (efficiency) (Scott 1997:227,228). Positive accounting theory does not only have supporters but also critics, including Christenson (1983), Holthausen and Leftwich (1983), and more recently Sterling (1990) (Henderson *et al.* 1992:360).

f. Predictive approach

The predictive approach to the formulation of accounting theory, which is of great importance to this study, is concerned with the usefulness of accounting information for the prediction of future events.

In the search for criteria to use as a basis for choosing between different methods of accounting measurement, the predictive ability of accounting information came to the foreground through the study of Beaver, Kennelly and Voss (1968). This approach uses the criterion of predictive ability to choose between various accounting methods based on the ability of a particular method to predict events which may be useful to decision-makers. It focuses on the evaluation of the methods of accounting measurement to determine which method would be most decision-useful and, therefore, enable decision-makers to make better decisions (Saenger 1991:51; Belkaoui 1992:139).

The predictive approach has attracted much attention from empirical studies and the areas these studies investigated can be classified into two main categories (Belkaoui 1992:139; Henderson *et al.* 1992:287,288).

- The behaviour of accounting variables over time; with the aim of establishing the ability of accounting information to explain and predict economic events.
- The relationship between capital markets and accounting information; with the aim of establishing the ability of accounting information to explain and predict capital market reaction to the disclosure of accounting information.

1. <u>The prediction of an economic event approach</u>

The predictive approach has been tested and applied in accounting research in the following ways.

i. Time-series analysis. These studies include examinations of the behaviour of reported earnings and tests of the predictive ability of past reported annual and quarterly earnings. Studies include those of Brown and Rozeff (1979), Dopuch and Watts (1972), Griffin (1977) and Collins and Hepwood (1980) (Belkaoui 1992:140; Henderson *et al.* 1992:289,290).

ii. Relevance of earnings forecasts. The research is centred on the predictive accuracy of earnings forecasts by analysts, management and statistical models. If these forecasts are found to be inaccurate, they would be of little use to investors and capital markets, and at this point in time the results of research are inconclusive. Studies on the relevance of earnings forecasts include those of Cragg and Malkiel (1968), Elton and Gruber (1972) and Brown, Hughes, Rozeff and Vanderweide (1980) (Belkaoui 1992:141; Henderson *et al.* 1992:290).

iii. Distress prediction. Prediction of financial distress is a very important application of the predictive approach. Two well-known studies are those of Beaver (1966) and Altman (1973). Despite their limitations, Beaver's univariate study based on a single set of accounting ratios and Altman's multivariate study based on five accounting ratios have shown that financial distress can be reasonably accurately predicted (Belkaoui 1992:142; Rees 1995:298-305).

iv. Information decomposition measures. The investigations of the predictive ability of information decomposition measures have centred on the areas of corporate bankruptcy and corporate takeover. Information decomposition measures express the stability over time of financial statement decomposition and the results of studies by Lev (1969), Belkaoui (1976) and others have pointed to the usefulness of this approach (Belkaoui 1992:144).

v. **Explaining corporate restructuring behaviour**. Research in this are focussed on the characteristics of acquired and non-acquired firms and the results of these studies, for example Tzoannos and Samuels (1972), Rege (1984) and Palepu (1986), have shown, despite limitations similar to those experienced with distress prediction, the usefulness of various accounting ratios in predicting takeovers (Belkaoui 1992:144; Rees 1995:280,281).

vi. **Credit and bank-lending decisions**. The predictive approach has been used to predict credit evaluations and research in this field includes the studies of Clarkson (1962), Ewert (1980) and Dietrich and Kaplan (1982). This approach has also been extended by Sinkey (1975) and Pettaway and Sinkey (1980) to estimate and predict financial distress for commercial banks (Belkaoui 1992:145).

2. <u>The prediction of market reaction: market-based approach</u>

The market-based approach is concerned with reactions of security prices on capital markets to accounting information, especially with the aim of establishing the relevance of accounting information and evaluating accounting measurement procedures. This view is emphasised by Gonedes (1972) and Beaver and Dukes (1972), who contend that capital market reactions to accounting information may be used as a basis for selecting accounting policies and for the evaluation of alternative accounting policies according to their information content (Wolk *et al.* 1989:5,211; Belkaoui 1992:145,146).

Belkaoui (p.146) justifies the use of the predictive approach to the formulation of accounting theory through the role of accounting information in capital markets. Hendriksen and Van Breda (1992:168,169) describe the role and objectives of accounting information as to ensure optimal allocation of capital resources and, secondly, to ensure that investors are able to hold optimal portfolios of securities according to their risk-return preferences.

The research into the predictive approach to the formulation of accounting theory evaluates and tests accounting policies and techniques on the basis of capital market reactions, using the theory and methodologies provided by Portfolio Theory, the Efficient Market Hypothesis, the Capital Asset Pricing Model, Arbitrage Pricing Theory and option pricing (Belkaoui 1992:149; Hendriksen & Van Breda 1992:168).

Since this study is concerned with an in-depth analysis of research conducted on capital market theories and pricing models, which will be detailed in chapters 3, 4 and 5, no review of the research conducted on these theories and models is provided at this stage. It is, however, useful to briefly list the results of the research regarding the role of accounting information in capital markets.

According to Henderson *et al.* (1992:291,295) most of this new area of accounting research can be labelled as information content studies. These studies investigate the role of new accounting information in security price movements on capital markets. They (p.295,296) further identified three areas which have to be simultaneously investigated to establish the impact of accounting information announcements of the behaviour of security prices. Models used for such investigations need to be employed in the following areas:

i. The degree of capital market efficiency. The research is concerned with whether security prices react when new accounting information is announced and whether this reaction is of the correct "size".

ii. The expectation of accounting information. The research is concerned with the application of the models to establish the component of the accounting information announcements which has already been expected by capital markets to be able to determine the new (unexpected) component of the accounting information announcement. This concerns the fundamental assumption that capital markets are efficient and only reacts to new (unexpected) information not yet reflected in security prices.

iii. The measurement of normal returns on investments. In this case, research is concerned with the application of models to establish what the normal investment returns, as compensation for the risk of investing, are. It is important to establish whether any abnormal returns have been gained due to the announcement of new accounting information.

It can, therefore, be said that the research about the information content of accounting information announcements assumes that capital markets are efficient in their processing of information, and that this assumption can be used to measure the impact of new (unexpected) accounting information in security prices.

Wolk *et al.* (1989:5,211) summarises the evidence from capital market research as follows:

- New information concerning accounting earnings affect security prices, and this information is rapidly incorporated into security prices in an unbiased manner.
- Changes in accounting policies and methods, which merely have a cosmetic effect on earnings, do not seem to affect security prices.
- Changes in accounting policies and methods, which have either a direct or indirect influence on cash flows, do affect security prices.
- There may be some merit in choosing certain accounting methods and policies in preference to others, where alternatives exist, due to the effect of indirect cash flow consequences on security prices.
- Accounting information is useful for assessing risk ,since accounting-based risk measures are closely linked to capital market risk measures, for example, variability in market returns is highly correlated with expectations of accounting earnings and announcements of unexpected accounting earnings.

To conclude this chapter the application of capital market theories and pricing models in the investment decision-making process is now examined.

2.5 THE NEED FOR AND IMPORTANCE OF CAPITAL MARKET THEORIES AND PRICING MODELS IN INVESTMENT DECISION-MAKING

Capital market investment decision-making relates to uncertain future events, and accounting information is an important means for investors to formulate own expectations about the amount, timing and uncertainty of future cash flows. These cash flows can be either in the form of dividends or the proceeds from the disposal of investments. Further, for the efficient allocation of capital resources, both the users and the suppliers of capital require relevant and reliable information to establish whether, and at what price, to invest or lend (Kam 1990:53-55).

Capital market theories and pricing models provide investors with the means to fully and properly make use of all information available for investment decision-making. These theories and models facilitate the proper understanding of the relationship between investment risk and return in uncertain capital markets. These theories and pricing models also explain the effect of new information on expectations regarding a security's risk and return. Lastly, models can be used to determine investment and portfolio values and these theories and models significantly improve investors' understanding of the behaviour and pricing mechanism of capital markets (Hendriksen & Van Breda 1992:178, 182,184,243).

Henderson *et al.* (1992:291) also make the point that if investors have a proper understanding of the role of new information in capital markets, they might be able to make extremely profitable investment decisions if they have access to information before it is made public.

According to Rees (1995:153,154) the importance of capital market theories and pricing models for investment decision-making can be summarised as follows:

- Pricing models and capital market theories provide investors with improved insight into the pricing process on capital markets.
- The methodology and basic techniques of pricing models and capital market theories enable investors to make better use of investment opportunities.
- It enables investors to choose between a passive or active investment strategy, depending on their informed perception of the efficiency of capital markets.

In conclusion it can be stated that capital market theories and pricing models provide investors with the means to improve their investment decision-making and portfolio selection. Improved investment decision-making also leads to more optimal allocation of resources in a free economy.

2.6 SUMMARY

In this chapter capital market theories and pricing models were examined within the context of accounting theory and investment on capital markets.

The first part of the chapter described the concepts "capital market theories", "pricing models", "accounting theory" and "investment decision-making" to provide a frame of reference for the remainder of the chapter. In the second instance, the background to the development of the most important capital market theories and pricing models was reviewed. This established the role of these theories and pricing models, the role of information and the risk/return relationship in investing on capital markets. The discussion then focused on the various approaches to the formulation to an accounting theory. This discussion culminated in a review of the market-based approach to the formulation of accounting theory wherein the importance and role of accounting information in capital markets were established. This chapter concluded with an examination of the role and importance of the capital market theories and pricing models in investment decision-making.

The conclusion reached is that investors find real benefit through the application of these theories and models, as these theories and models facilitate improved investment and portfolio selection through improved usage of the available information.

Viewed as a whole, this chapter attempted to establish, through an investigation of the various approaches to the formulation of an accounting theory and the available capital market theories and pricing models, the importance of information, theories and models in investment decision-making, and in particular, for investment on capital markets.

In an attempt to provide a deeper understanding of the role of these concepts in investment decision-making, the next chapter focuses on the relationship between investment risk and return, Portfolio Theory and the Efficient Market Hypothesis.

CHAPTER 3

THE DEVELOPMENT OF CAPITAL MARKET THEORIES

3.1 INTRODUCTION

The main focus of this chapter is on three important aspects of investment in capital markets, namely:

- Investors dislike risk and the more risky the investment the greater the return expected by investors (Dobbins *et al.* 1994:6).
- Investors should not view investment in individual securities in isolation, but rather as a component of the total investment in a portfolio of securities (Sharpe 1985:120).
- Investors require financial information to evaluate investment opportunities (Rees 1995:153).

The first section of this chapter is concerned with the first aspect, namely the relationship between risk and return of investment in capital markets. According to Dobbins *et al.* (1994:6) there exists a trade-off between risk and return which results in investors expecting a higher expected return for more risky investment opportunities.

The second aspect, the implications of Portfolio Theory and diversification for investment decision-making, is examined in section two of this chapter. Markowitz (1952) showed that rational investors wishing to maximise their utility of wealth can, when investing in efficient markets, reduce the risk of their investments by holding well-diversified portfolios of securities and accordingly reduce the level of risk associated with a given expected level of return.

The third aspect, and final section of this chapter, deals with a major assumption of modern investment management - that of the efficiency of capital markets. The Efficient Market Hypothesis (EMH) suggests that capital markets incorporate new information immediately and correctly in security prices. It is therefore implied that the prices of securities in efficient capital markets are the best estimates of the securities' true value. Further, market efficiency implies that investors cannot systematically gain abnormal profits, nor incur abnormal losses, if they act on the basis of publicly available information (Weston & Copeland 1992:93, 94).

A further important part of this chapter is the analysis and classification of research conducted on Portfolio Theory and the EMH. The research on these theories, together with those on the pricing models, are the main areas of emphasis in this study.

As a starting point, the role of the capital market theories in investment decision-making is examined.

3.2 THE ROLE OF CAPITAL MARKET THEORIES IN INVESTMENT DECISION-MAKING

According to Weston and Copeland (1992:92) the main role of capital markets can be described as follows:

- Facilitating the investment process by providing a continuous marketplace where security prices are tested on an ongoing basis and where buying and selling transactions can occur efficiently at a relatively low cost.
- Providing a relatively stable marketplace for securities whereby, through its continuous operations and the resultant frequent and relatively small changes in

security prices, investors are protected against volatile security prices.

- To facilitate the allocation of investment capital, capital markets need to value securities correctly. If securities are mispriced and capital markets are not run efficiently, it may result in the markets becoming speculative and this may result in many investors not investing their funds in capital markets (Firth 1977:1,2).

Portfolio Theory, the first major capital market theory, provides a guideline for investors in their capital market investment decision-making. According to Portfolio Theory, investors should not invest all their funds in one security. All securities should be viewed in the context of being part of a portfolio and, thus, it is not the risk and return of the security that is important, but rather its contribution to the overall risk and return of the portfolio. Decisions to buy or sell securities should also only be taken after the diversification effect has been taken into account, that is, what the effect of the decision will be on the overall risk and return of the portfolio (Sharpe 1985:120; Linley 1992:8).

On the other hand, the second major capital market theory, the EMH, provides investors with a guideline about how efficient capital markets price securities. Keane (1983:2,3) provides the following summary of the role and importance of the EMH for investment decision-making. Capital markets create wealth through the optimal allocation of investment capital and therefore the prices of securities provide investors with useful signals of how to construct their portfolios of investments. If the market is inefficient in its pricing of securities, investor attention would be drawn away from efficient diversification towards looking for opportunities of possible exploitation of the perceived inefficient pricing of securities. The importance of the EMH to investors is that the reliable pricing of securities enables investors to concentrate on the construction of optimal portfolios in line with their risk/return preferences, rather than attempting to outperform the market.

To fully understand the implications of the main capital market theories, it is necessary to first examine the concepts "investment" and "capital market" and how the concepts "risk", "return" and "uncertainty" affect capital market investment decision-making.

3.2.1 The concepts "capital market", "investment", "risk", uncertainty" and "return"

3.2.1.1 The concept "capital market"

The capital market, also known as the securities market, is the market where the suppliers of capital (investors) and the demanders of capital (companies and the government) meet to trade in financial assets (securities), that is, shares, government bonds, options, currencies, etcetera. The capital market, therefore, enables investors to trade in securities and it enables companies and the government to raise capital (Hendriksen & Van Breda 1992:168; Rees 1995:154; O'Brien & Srivastava 1995:3).

3.2.1.2 The concept "investment"

Sharpe (1985:2) defines investment as:

> The sacrifice of something now for the prospect of something later ... Investment is the sacrifice of certain present value for (possibly uncertain) future value.

The most important aspect of investments is that the investor should be compensated for the risk taken, that is, the investment should provide an adequate return in terms of income and capital growth (Rees 1995:157).

3.2.1.3 The concept "risk"

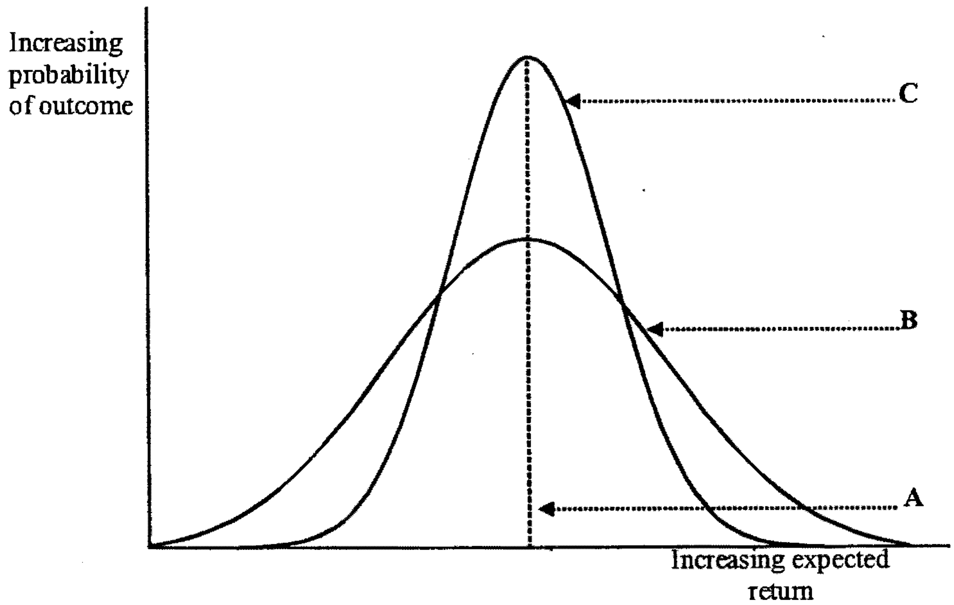
According to Linley (1992:9) and Van Horne (1992:12) risk is the possibility that the actual return on an investment will be different from the expected return on that investment, and that it is possible to attach probabilities to these expected outcomes.

Rees (1995:158) further states that:

> The variability in returns is taken to represent the risk of the investment to investors since the variability reflects the uncertainty attached to returns.

Risk can be measured, either by the average (or mean) variance or the standard deviation of returns from their expected values. Standard deviation indicates how far the actual returns have deviated from the expected returns and is the measure which is preferred for investment analysis. Standard deviation is an estimate of the likely divergence of actual returns from the expected returns and the larger the spread of divergence, the more risky the investment (Sharpe 1985:122,123; Broadbent 1992:8). This is illustrated in figure 3.1 and its calculation is shown by formula 3.1.

Figure 3.1 Standard deviation as a measure of risk



where:

A = The average expected return, which is the same for both investments

B = Investment with more risk, due to its greater distribution of expected returns (larger standard deviation)

C = Investment with less risk as there is less variability in its expected returns (smaller standard deviation)

Source: Harrington (1987:7) and Broadbent (1992:8).

Formula 3.1 Standard deviation of an investment

$$\sigma^2 = \sum_{i=1}^{n} P_i \left(E\left(R\right) - R_i\right)^2$$

where:

σ^2	=	Standard deviation
n	=	Number of possible outcomes
P_i	=	Probability of i th return
$E(R)$	=	Average expected return
R_i	=	Probable ith expected return

Source: Harrington (1987 : 20).

3.2.1.4 <u>The concept "uncertainty"</u>

Uncertainty arises when there are various possible expected returns on an investment, but little evidence exists to predict the possible expected returns, therefore, the alternative possible outcomes cannot be identified and the investor is unable to estimate the probability distribution of the expected returns (Clark *et al.* 1979:117; Drury 1992:320).

3.2.1.5 <u>The concept "return"</u>

The actual return on an investment, during a certain period, is the income received during the period together with any change in the value of the investment (Henderson *et al.* 1992:292,293). This is expressed in formula 3.2:

Formula 3.2 Actual return on an investment

$$R_t = \frac{D_t + (P_t - P_{t-1})}{P_{t-1}}$$

where:

R_t	=	Actual return for period t
D_t	=	Dividends (or interest) received during period t
P_t	=	Market price at the end of period t
P_{t-1}	=	Market price at the beginning of period t
$P_t - P_{t-1}$	=	Capital gain or loss during period t

Source: Harrington (1987:6), Henderson *et al.* (1992:293) and Dobbins *et al.* (1994:5,6).

The expected return on an investment is merely the weighted average of probable expected returns (Sharpe 1985:126), which can be expressed as:

Formula 3.3 Expected return on an investment

$$E(R) = \sum_{i=1}^{n}(R_i P_i)$$

where:

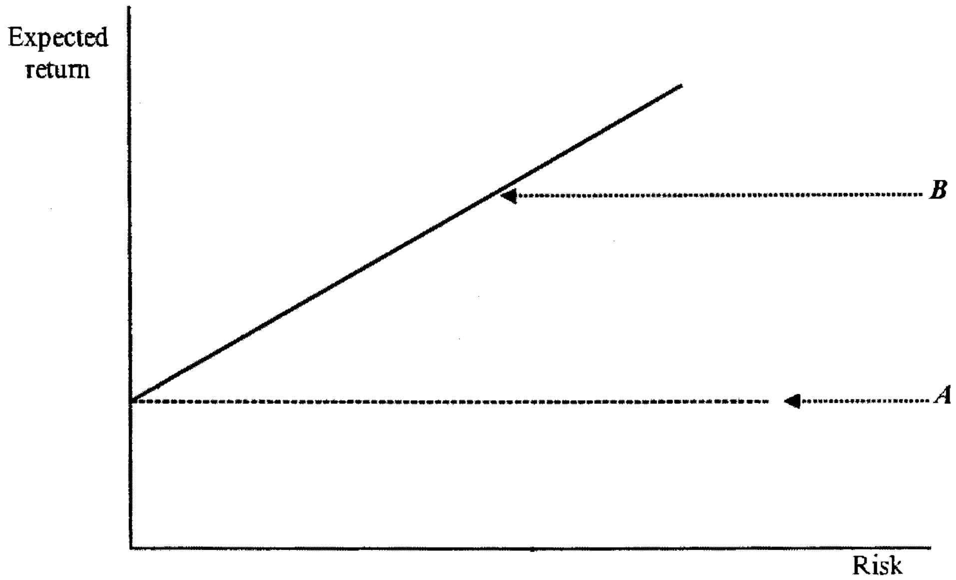
E(R)	=	Expected return
n	=	Number of possible outcomes
R_i	=	Return associated with the *i*th outcome
P_i	=	Probability of the occurrence of the *i*th outcome

Source: Clark *et al.* (1979:119), Harrington (1987:20) and Weston and Copeland (1992:363).

3.2.2 The relationship between risk and return

The risk/return relationship is illustrated in figure 3.2:

Figure 3.2 The relationship between risk and return



where:

A = Risk-free rate of return

B = As the risk of an investment increases, the greater the return expected by the investor

Source: Broadbent (1992:8) and Drury (1992:357).

The relationship between risk and return is a major topic in finance theory and the nature of this relationship is that the higher the risk associated with an investment, the greater the return expected by the investor to compensate for the level of risk involved (Broadbent 1992:8; Drury 1992:357).

Now that the risk/return relationship has been established, it is important to consider how investment decisions are influenced by risk, return and uncertainty.

3.2.3 The effect of risk, uncertainty and return on investment decisions

The decision to invest depends largely on whether the investment involved would render an adequate return to compensate for the risk involved. Any rational investor would expect a greater return on an investment which bears a higher degree of risk than an alternative investment opportunity (Broadbent 1992:8).

O'Brien and Srivastava (1995:5,9) states that the following factors and problems affect investment decision-making:

- The investor's current level of wealth.
- Estimating the expected return on an investment and determining whether the expected return is sufficient to compensate for the level of risk involved.
- Identifying the sources of risk and measuring the level of risk involved.
- Making the investment decision based on the risk and return involved, the prevailing interest rates and the various other investment opportunities available.

An important aspect in investment decision-making is estimating the value of an investment, and this value, apart from the underlying intrinsic value, is based to a large extent on the size and timing of the expected returns combined with the risk involved in obtaining the returns. Of these elements, risk is the most difficult to determine and the hardest part of decision-making is deciding on how much return is required to compensate for the measurable risk involved (Harrington 1987:1). Three investor attributes towards risk have been identified (Drury 1992:326; Weston & Copeland 1992:358) and these attributes can be described as:

- **Risk aversion**: The investor seeks to avoid risk and, when faced with a choice between alternative investments with the same expected return, would opt for the investment with the lowest degree of risk.

- **Risk seeking**: The investor is indifferent to the level of risk involved (gambler) and, when faced with different investment opportunities with different expected returns, selects investments which yield the highest expected return.
- **Risk indifference**: When choosing between investment alternatives that render the same expected return, the investor does not distinguish between different risk levels when making an investment decision.

Undoubtedly some investors are either risk seekers or risk indifferent, but empirical evidence, as shown by the study of Friend and Blume (1975), suggests that investors avoid risk where possible and will only opt for investments with a higher degree of risk when the related increase in the expected return exceeds the increase in the risk involved (Drury 1992:326,357).

The principle of choosing the less risky investment when faced with the choice between investments rendering the same expected return can also be described using the basic premises of utility theory (Weston & Copeland 1992:358).

3.2.4 Utility theory and the relationship between risk and return

Under conditions of uncertainty, both expected return and risk need to be considered when investment alternatives are evaluated. Under conditions of uncertainty, the outcomes of investment alternatives are only known in a probabilistic form and modern utility theory (based on the work of Von Neumann and Morgenstern (1947)) was developed to deal with decision-making under conditions of uncertainty. Utility theory attempts to provide a basis for rational decision-making. Utility values are attached to the various alternatives available, which include all aspects relevant to the decision. When utility theory is applied to investment decision-making, in particular in its application to the trade-off between risk and return, the investor must consider the following factors within his framework of personal preferences (Clark *et al.* 1979:122; Dobbins *et al.* 1994:23):

- The opportunity set of all relevant available decision alternatives.
- The determination of a hierarchy of alternatives, together with a trade-off of alternatives within this hierarchy.
- The investor's perception of risk and the investor's preference with regards to the risk/return relationship.
- The investor's attitude towards the choice between current or future consumption of wealth.

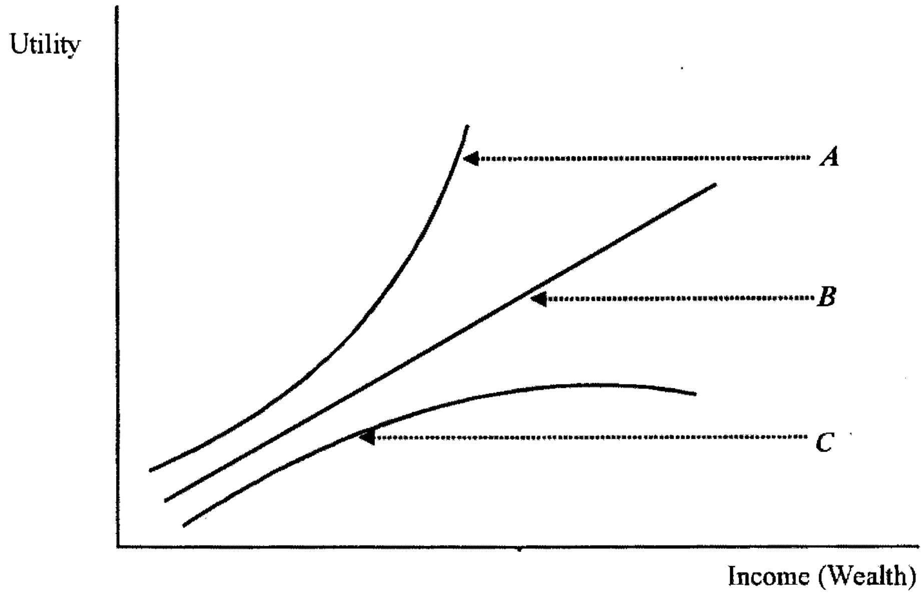
It is reasonable to assume that rational investors will act in such a manner as to maximise utility and therefore select those investment alternatives which will provide the greatest level of satisfaction. Fundamental to utility theory is the notion that investors have a diminishing marginal utility for wealth, and that this affects their attitude towards risk. Diminishing marginal utility for wealth leads to an investment attitude of risk aversion.

The principle of diminishing marginal utility for wealth can best be described using the following examples:

- An investor with diminishing marginal utility for wealth will, when faced with a choice between the two alternatives, prefer not to lose a Rand rather than gain a Rand.
- An investor with diminishing marginal utility for wealth gains less satisfaction from the second R1 000 of wealth earned than from the first R1 000 and this loss of satisfaction increases with each additional R1 000 of wealth earned (Weston & Copeland 1992:358-361).

The relationship between wealth and its utility depends on the investor's attitude towards risk and is illustrated in figure 3.3.

Figure 3.3 ***The relationship between income (wealth) and utility***



where:

A	=	Investor is a risk taker; the investor has an increasing marginal utility of wealth
B	=	Investor is indifferent to risk; the investor's marginal utility of wealth is constant
C	=	Investor is risk averse; the investor has a diminishing marginal utility of wealth

Source: Clark *et al.* (1979:124) and Weston and Copeland (1992:359).

In conclusion, the manner in which the various capital market theories describe the investment decision-making process, is considered.

3.2.5 Capital market theories and investment decision-making

As discussed in the preceding sections, obtaining an adequate return to compensate for the risk involved is the primary motivation of investors. Some investors may actually have a secondary goal of outperforming the capital market, that is, earning excessive returns, if they perceive capital markets to be inefficient. In practice, it can be assumed that most investors are not motivated solely by either one of these goals, but rather a mixture of the two. The problem for investors is that these are two conflicting goals and the more the investor diversifies his portfolio of investments in order to reduce the level of risk, the less likely he will be able to beat the market (Keane 1983:99).

Two capital market theories deal specifically with these two investment goals, namely Portfolio Theory and the EMH. Portfolio Theory is concerned with the relationship between risk and return and the effect of diversification on this relationship. Portfolio Theory proposes that it is necessary for investors to hold diversified portfolios, in line with their risk preferences, which render the maximum rate of return for a specific level of risk (Hendriksen & Van Breda 1992:168).

The EMH proposes that capital markets efficiently and correctly price securities and therefore it is difficult, if at all possible, to beat the market on any consistent basis. The efficiency aspect of capital markets is also of particular interest to accounting researchers since observations of market reactions to the release of accounting information provide both a means of testing the validity of the EMH as well as the usefulness of accounting practices and standards (Hendriksen & Van Breda 1992:168).

The next two sections of this chapter are concerned with a discussion of, firstly, Portfolio Theory and thereafter the EMH.

3.3 THE DEVELOPMENT OF PORTFOLIO THEORY

A combination of securities or investments held by an investor is known as a portfolio and Portfolio Theory is concerned with the selection of efficient combinations of securities or investments (optimal portfolios) depending on the investor's desired level of risk (Linley 1992:3; Drury 1992:333).

Optimal portfolios are those that provide the highest return for a given level of risk, or the lowest level of risk for a given rate of return (Weston & Copeland 1992:366).

Portfolio Theory is concerned with the principle that a portfolio of securities will always be a better investment strategy than holding a single security, and the concept behind Portfolio Theory is that any rational investor will always opt for the portfolio of securities which renders the highest possible return for a specified level of risk (Viljoen 1989 :20; Correia *et al.* 1993:113).

Markowitz (1952,1959) pioneered the development of modern Portfolio Theory, in particular with regards to risk in a portfolio sense. According to Markowitz rational investors will select portfolios which render the highest possible return for a specified level of risk, or will select portfolios with the minimum level of risk for a specified rate of return (Dobbins *et al.* 1994:12).

Diversification, as suggested by Markowitz, improves on naive diversification in the sense that investment in individual securities in a portfolio need not be equally weighted. Before Markowitz, naive diversification stipulated that investment in individual securities in a portfolio should be equally weighted. Markowitz provided the principle that risk in a portfolio can be reduced if the portfolio weights are not equal, provided that the weights are properly managed. Through his contributions, Markowitz provided a formal theory for portfolio selection (O'Brien & Srivastava 1995:48).

3.3.1 The concept and nature of Portfolio Theory

Portfolio Theory is based on a number of assumptions with regard to the way capital markets behave and investors function in conditions of uncertainty. Furthermore, Portfolio Theory has significant implications for investment decision-making and selection.

3.3.1.1 Assumptions of Portfolio Theory

Linley (1992:3,4), Hendriksen and Van Breda (1992:179) and O'Brien and Srivastava (1995:7,8) summarise the assumptions underlying modern Portfolio Theory as follows:

- Investors view the return on an investment as an adequate description of the outcome of the investment and that investment returns are normally distributed.

- Investors view the risk on a portfolio as being proportional to the variability of the expected return for the portfolio.
- All investors have fixed single period investment horizons and base their investment-decisions purely on the parameters of perceived risk and expected return.
- Investors are rational and risk-averse, that is, investors prefer less risk for a given expected return and more expected return for a given level of risk.
- All investors have full and equal access to the available information, there are no transaction costs or taxes, capital markets are perfectly competitive and securities are completely divisible.
- Investors are considered small in relation to the market and hence their individual actions will have no significant influence on market prices.
- Proceeds from investments occur at the end of the period and, when these are of equal amounts, investors are indifferent to the choice between income and capital gains.

Under these assumptions, portfolios are deemed to be efficient when no other portfolio renders a higher expected return for a given level of risk or no portfolio has a lower level of risk for a specified expected return (Linley 1992:4).

3.3.1.2 Stages in portfolio selection

Markowitz (1991:3) describes a good portfolio in the following manner:

> A good portfolio is more than a long list of good stocks and bonds. It is a balanced whole, providing the investor with protections and opportunities with respect to a wide range of contingencies. The investor should build towards an integrated portfolio which best suits his needs.

Markowitz (1991:6) also identifies two objectives of portfolio selection which are common to most investors:

- They want return to be high; they prefer more of it to less of it.
- They want this return to be dependable, stable and not subject to uncertainty; that is, they are not speculators.

Three stages in portfolio selection have been identified:

a. Investment analysis

Assessing the expected return and risk of potential investments, and also the correlation between the various expected returns (Viljoen 1989:19).

b. Portfolio analysis

Using the information obtained from investment analysis, different sets of investment opportunities that meet the investor's objectives can be identified (Viljoen 1989:20; Markowitz 1991:3).

c. Investment strategy

The final step involves the selection of a suitable strategy for the selection of investments rendering an acceptable return at an acceptable level of risk together with the identification of the method of financing the investments (Viljoen 1989:20).

3.3.1.3 Implications of Portfolio Theory

The most important implication of Portfolio Theory is that investors can reduce the level of risk through diversification and, therefore, earn the same expected return but at a lower level of risk. This implies that it is not the return and risk of individual securities that are important, but rather the contribution of an investment to the overall return and risk of the portfolio (Hendriksen & Van Breda 1992:179,180; Drury 1992:336).

Following on the above the effect of diversification on portfolio return and risk can be considered.

3.3.2 Portfolio Theory and the concepts of risk, return and uncertainty

Due to the fact that the effect of economic conditions cannot be predicted without doubt, uncertainty forms a permanent part of investment in securities. This uncertainty requires that the potential and weaknesses of all investments in the portfolio need to be carefully analysed. A further permanent aspect of investment in securities is that returns on securities are correlated, that is, returns on securities tend to move together, either up or down. As this correlation is not perfect, especially for securities across various industries and market segments, risk can be reduced through investment in a well diversified portfolio (Markowitz 1991:4,5).

3.3.2.1 Portfolio Theory and the concept of risk

The total risk involved in investment in securities consists of two parts:

a. Specific risk

This element of risk can be reduced or even eliminated through efficient diversification. This risk is specific to the individual security, and results fromeconomic, political and other factors which are unique to the corporation involved. Specific risk is also known as unsystematic risk, non-market risk, avoidable risk, unique risk or diversifiable risk.

b. Market risk

This element of risk cannot be diversified away. This risk affects all securities in the market to a greater or lesser degree through changes in factors such as interest rates, inflation, foreign exchange rates, taxation, oil prices, world recessions, government spending and changes in the money supply. Market risk is also known as systematic risk, non-specific risk, unavoidable risk or non-diversifiable risk (Linley 1992:8; Broadbent 1992:8; Correia *et al.* 1993:129; Dobbins *et al.* 1994:8,9).

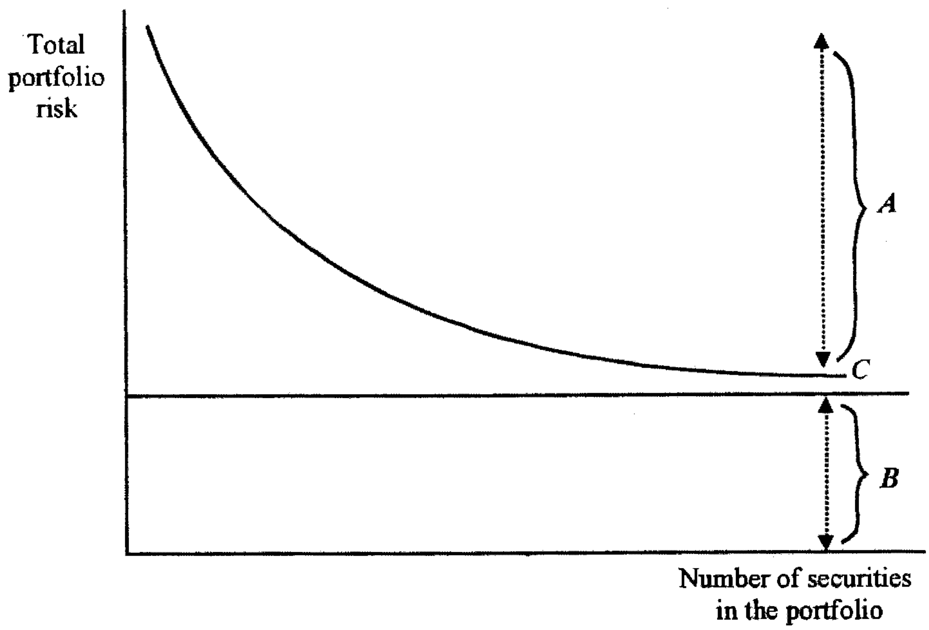
3.3.2.2 Risk reduction through diversification

Portfolio Theory argues that the risk involved in investment in securities can be reduced through diversification. The market will not compensate the investor for the specific risk associated with a poorly diversified portfolio, but a well -diversified portfolio should only suffer the risk known as market risk. Various studies have shown that when more and more randomly selected securities are added to a portfolio, the closer the level of risk resembles the level of market risk, and that 15 to 20 randomly selected securities are sufficient to remove most of the specific risk of a portfolio (Sharpe 1985:172; Broadbent 1992:8; Van Horne 1992:69).

This principle of reduction of portfolio risk through diversification is illustrated in figure 3.4, and the following can be seen from figure 3.4:

- The risk of a portfolio is rapidly reduced by increasing the number of securities in the portfolio until a stage is reached where the addition of more securities achieves little or no risk reduction.
- There is always a degree of risk involved, even at the point where the portfolio reflects the composition of the market as a whole (Correia *et al.* 1993:129).

Figure 3.4 Risk reduction through diversification



where:

A	=	Specific risk
B	=	Market risk
C	=	Diversified portfolio

Source: Van Horne (1992:70), Correia *et al.* (1993:128) and Dobbins *et al.* (1994: 7).

Figure 3.4 illustrates two very important aspects of Portfolio Theory, namely:

- Investors should not expect to be compensated (receive additional return) for taking avoidable risk.
- The expected return on a portfolio is directly related to the level of market risk associated with that portfolio (Dobbins *et al.* 1994:8,9).

3.3.2.3 Portfolio risk

Fundamental to Portfolio Theory is the principle that the risk of a portfolio is not simply the weighted average of the risk of the individual investments in the portfolio. The risk of a portfolio does not only depend on the riskiness of the investments in the portfolio, but also depends on the relationship between the returns of the various investments (Sharpe 1985:127; Van Horne 1992:53; Correia *et al.* 1993:115).

The risk of a portfolio will be at its highest when the returns on the investments are perfectly correlated. The purpose of diversification is to include investments in the portfolio which correlate as imperfectly as possible and thereby reduce the level of risk as far as possible (Hendriksen & Van Breda 1992:180). The correlation coefficient is used as a measure to show the degree to which the returns of the individual investments move together (correlate), and in general, returns tend to be positively correlated but are unlikely to be either perfectly positively nor perfectly negatively correlated (Correia *et al.* 1993:115).

According to Clark *et al.* (1979:150), Drury (1992:334) and Correia *et al.* (1993:115) the correlation between returns can be classified as follows:

a. Perfect positive correlation (+1)

This occurs when the returns of different investments exceed or fall below their expected values by the same margin. Risk cannot be reduced when perfectly positive investments are combined.

b. Perfect negative correlation (-1)

This occurs when the returns of some investments exceed their expected values, while the returns on other investments fall below their expected values by the same margin. When perfectly negative investments are combined, risk is reduced significantly to the market risk level.

c. Zero correlation (0)

This occurs when the movement in the returns on investments are independent of one another. If the returns of some investments exceed their expected values, then the returns on other investments are likely to either exceed of fall below their expected values by the same margin. A combination of zero correlated investments reduces the level of risk.

In practice the process of calculation of the correlation coefficients is complex, since the correlation coefficient of each new investment needs to be calculated in relation to all the existing investments in the portfolio (Drury 1992:335). The formula for the calculation of portfolio standard deviation (risk) can be expressed as follows:

Formula 3.4 Standard deviation of a portfolio

The standard deviation of a portfolio is a weighted sum of the standard deviations of the individual securities adjusted for the covariance among the securities.

$$\sigma_p = \sqrt{\sum_{i=1}^{n} x_i^2 \sigma_i^2 + 2\sum_{j=1}^{n-1} \sum_{i=j+1}^{n} x_i x_j \sigma_{ij}}$$

where:

σ_p	=	Standard deviation of the portfolio
x_i and x_j	=	The proportion of the portfolio invested in securities *i* and *j* respectively
σ_i	=	The standard deviation of security *i*
σ_{ij}	=	The covariance between the returns on securities *i* and *j*
n	=	The total number of securities in the portfolio

and the covariance can be calculated as:

$$\sigma_{ij} = p_{ij} \sigma_i \sigma_j$$

where:

σ_{ij}	=	Covariance between the returns on securities *i* and *j*
p_{ij}	=	Correlation coefficient between the returns on securities *i* and *j*
σ_i and σ_j	=	Standard deviations of securities *i* and *j*

Source: Van Horne (1992:55), Correia *et al.* (1993:126) and Dobbins *et al.* (1994 : 25).

3.3.2.4 Portfolio return

When different combinations of securities are evaluated, both the standard deviation (risk) and expected return of the various combinations need to be considered. The calculation of the expected return of a portfolio is simple, since it is purely the weighted average of the expected returns on the investments based on the proportional value of the portfolio (Clark *et al.* 1979:150; Sharpe 1985:127; Ross *et al.* 1990:257; Weston & Copeland 1992:366).

The formula for the calculation of the expected return on a portfolio can be expressed as:

Formula 3.5 Expected return on a portfolio

$$E(R_p) = \sum_{i=1}^{n} x_i E(R_i)$$

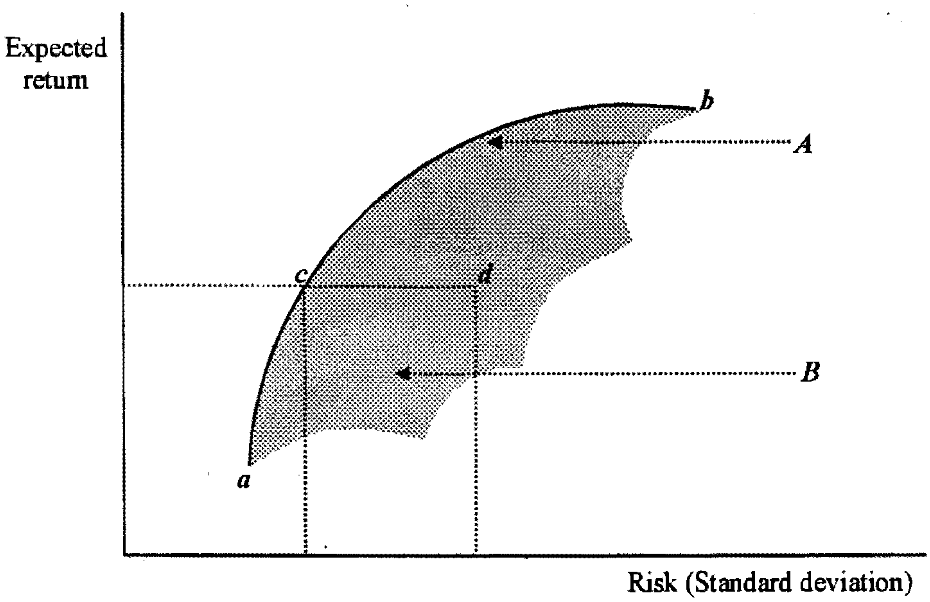
where:

$E(R_p)$	=	Expected return on the portfolio
x_i	=	Proportion of the portfolio invested in security i
$E(R_i)$	=	Expected return on security i
n	=	Number of securities in the portfolio

Source: Van Horne (1992:53), Correia *et al.* (1993:115) and Dobbins *et al.* (1994:24).

Rational investors will choose efficient portfolios and the available efficient portfolios, which depends on the investor's trade-off between risk and return, together form the efficient frontier (Harrington 1987:11). The opportunity set and efficient frontier is illustrated in figure 3.5.

Figure 3.5 The efficient frontier



where:

A = Efficient frontier; all efficient portfolios which dominate all portfolios to the right of it, as portfolio *c* dominates portfolio *d*.

B = Opportunity set; all attainable portfolios which can be achieved from the available securities.

a = Portfolio with the least possible risk

b = Portfolio with the highest possible rate of return

Source: Sharpe (1985:140), Hendriksen and Van Breda (1992:180,181)

3.3.3 The implications of Portfolio Theory for portfolio selection

O'Brien and Srivastava (1995:55) define the objective of portfolio selection in the following manner:

> The objective of the portfolio selection problem is to minimise portfolio risk, subject to:
> 1) attaining a target expected return, and
> 2) the sum of portfolio weights equalling one.

As a result, O'Brien and Srivastava (p.55) identify two constraints in the portfolio selection problem. Firstly, that for a certain expected return a portfolio is not dominated by any other portfolio with a lower level of risk. Secondly, if all portfolio weights are to be positive and the sum of these weights must equal one, short-selling is not allowed.

The rest of this section will only concentrate on the first constraint, since it is one of the underlying principles of the basic capital market theories and pricing models that short-selling is not allowed.

3.3.3.1 <u>The efficient frontier and portfolio selection</u>

Each investor has an opportunity set (a set of attainable portfolios) which depends on the investor's personal preferences regarding the trade-off between risk and return. Out of all these possible portfolios, only some can be considered to be efficient (undominated). To be considered efficient, a portfolio must satisfy the following criteria (Clark *et al.* 1979:158; Markowitz 1991:6; Rees 1995:163; O'Brien & Srivastava 1995:51,52):

- No other portfolio has a lower level of risk for a given expected return.
- No other portfolio has a higher expected return for a given level of risk.
- No other portfolio has a higher expected return combined with a lower level of risk.

3.3.3.2 Portfolio selection and global diversification

The return that an investor receives on investments in securities in the domestic capital market consists of:

- The capital growth of the investment over the period considered.
- The value of income (dividends) received during the period.

A third element must, however, be taken into consideration with return on investments in securities in international capital markets, namely:

- The change in the relationship between the investor's domestic currency and the foreign currency of the country of investment.

When there is a difference between the set of efficient portfolios attainable in the domestic and international markets, some international efficient portfolios will dominate domestic efficient portfolios. Therefore, global diversification should be beneficial in the sense that investors can decrease the level of risk for a given expected return or increase the expected return for a given level of risk (Dobbins *et al.* 1994:37,38).

3.3.3.3 Portfolio selection and capital budgeting

Portfolio selection for capital projects are more difficult than for investment in securities. This is due to the fact that most capital projects are indivisible and cannot be divided into homogenous units, unlike investment in securities which are divisible units with the same expected return and risk for each ordinary security of a specific corporation. Unlike investment in securities, it is most improbable that an investor can acquire a certain percentage of a capital project and thereby acquire a certain percentage of the return and the risk (Clark *et al.* 1979:161).

When considering a large number of indivisible capital projects, the efficient set of options involves a large number of combinations and integer programming is usually used to solve this problem. The lower confidence limit model assumes that the investor has a minimum acceptable return (the lower confidence limit) rather than a maximum level of risk for a specific level of return (Clark *et al.* 1979:161). The following equation is used to establish the lower confidence limit:

Formula 3.6 The lower confidence limit

$$L = E(R_p) - k\sigma_p$$

where:

L	=	Lower confidence limit
$E(R_p)$	=	Expected return on the portfolio
k	=	Constant which refers to the number of standard deviations in the normal distribution
σ_p	=	Standard deviation of the portfolio

Source: Clark *et al.* (1979:161).

By using this model, investors can establish a level beneath which the return on the project must not drop. Investors achieve this by putting a value on *k*, either 1, 1.5, 2 ..., and thereby establishing the minimum acceptable return together with the amount of acceptable downside risk. The higher the acceptable return (L), the fewer the number of efficient combinations available (Clark *et al.* 1979:161,162).

3.3.3.4 <u>The selection of porfolios</u>

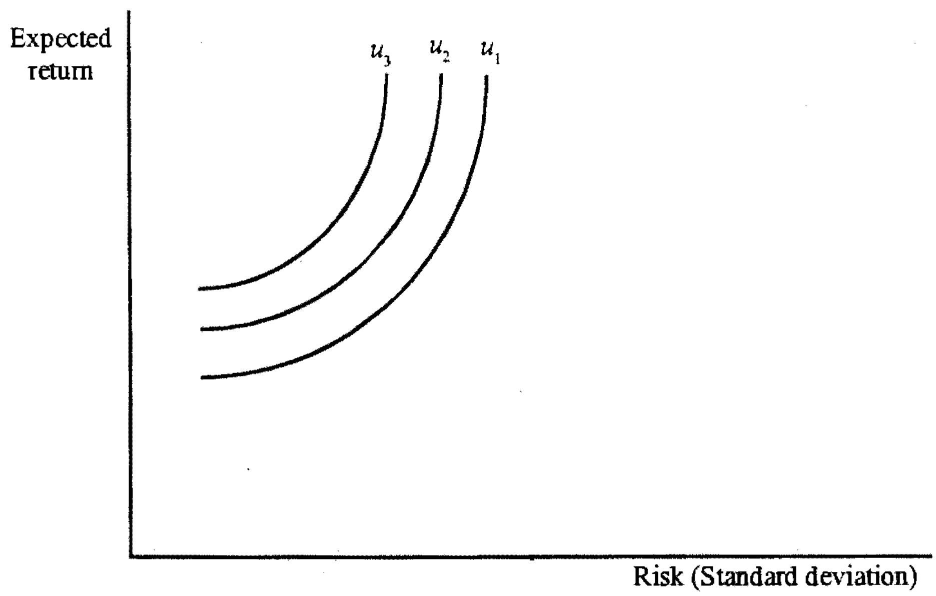
In the previous part of this section it has been established how to identify efficient portfolios, but not how to select a specific portfolio. This choice will depend on investors' attitudes towards risk. Thus, if investors are risk-takers, they will select portfolios with a higher risk level and with higher expected returns, or if investors are risk averse they will select portfolios with less risk and lower expected returns (Harrington 1987:11).

3.3.4 Optimal portfolios and utility theory

Portfolio Theory is concerned with the selection of optimal portfolios, that is, the allocation of investors' wealth among securities that will provide the highest return for a given level of risk or the lowest degree of risk for a specified return. Utility theory can be applied to select the optimal portfolio from the set of efficient portfolios, in other words, selecting that portfolio which best represents the risk and return preferences of the investor (Clark *et al.* 1979:159; Viljoen 1989:19; Dobbins *et al.* 1994:22). The process of selecting the optimal portfolio starts with specifying the objectives of the investor, which are expressed in terms of the investor's utility function. Following on this, the expected utility is then calculated to determine the investor's investment choices under conditions of risk and uncertainty (Van Horne 1992:60; Dobbins *et al.* 1994:22).

In general, rational investors are considered to have diminishing marginal utility of wealth, meaning they are risk-averse investors who associate risk with any variance from the value of expected return (Clark *et al.* 1979:159; Van Horne 1992:60,61; Dobbins *et al.* 1994:23). The utility indifference curves, which express the different combinations of risk and return of risk-averse investors, are depicted in figure 3.6.

Figure 3.6 Risk-averse investors' utility indifference curves



where:

u_1, u_2, u_3 = Indifference curves; the further the curves move to the left the greater the utility (more return for less risk)

Source: Clark *et al.* (1979:159) and Van Horne (1992:61).

Indifference curves represent a trade-off between risk and expected return where expected utility is constant and investors are indifferent to any combination of expected return and risk on a particular indifference curve. The more risk-averse the investor, the steeper the slope of the indifference curve (Van Horne1992:60; Dobbins *et al.* 1994:28). Rational investors want to maximise their expected utility of wealth and will select portfolios which satisfy this requirement. Expected utility of wealth is calculated as follows:

Formula 3.7 Maximum utility of wealth

$$E\left[u(w)\right] = \sum_i p_i u(w_i)$$

where:

$E\left[u(w)\right]$ = Expected utility of wealth

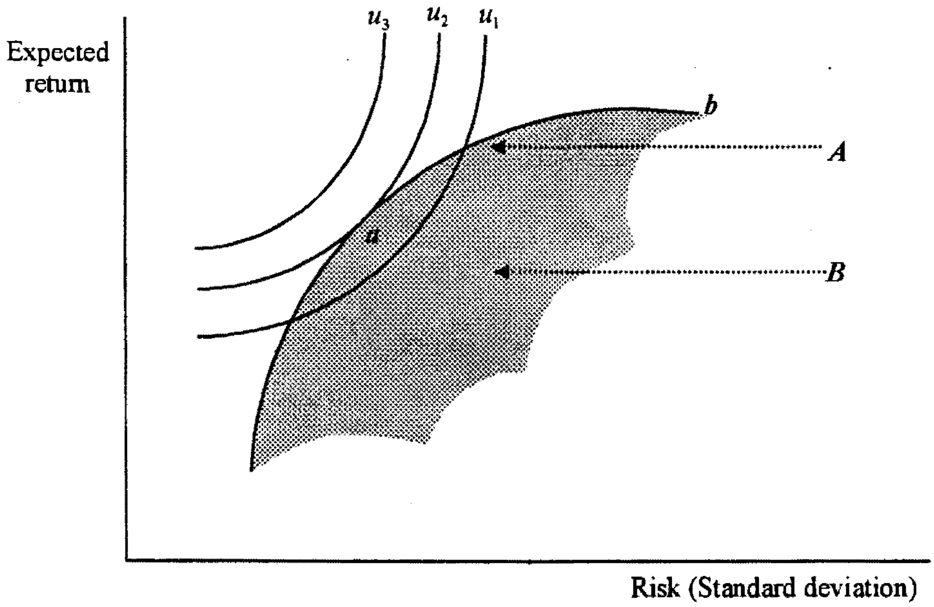
w_i = Wealth from outcome i

p_i = Probability that outcome i will occur

Source: Dobbins *et al.* (1994:44).

Investors want to select portfolios which are on the highest indifference curve, and optimal portfolios can be found where the highest indifference curve is at a tangent to the efficient frontier. The point of tangent represents the highest level of satisfaction investors can achieve and each investor has a unique point of tangency according to his preferred combination of securities (Van Horne 1992:61; Dobbins *et al.* 1991:29).The point of tangency that represents investors' optimal portfolios, is depicted in figure 3.7.

Figure 3.7 Selection of the optimal portfolio



where:

A = Efficient frontier

B = Opportunity set

u_1, u_2, u_3 = Utility curves

a = Optimal portfolio; the tangent between the efficient frontier and the utility curves.

Source: Clark *et al.* (1979:159) and Dobbins *et al.* (1994:29).

3.3.5 Research related to Portfolio Theory

Research related to Portfolio Theory has in the main focussed on the effectiveness of diversification and on the benefits of global diversification.

3.3.5.1 Studies on the effectiveness of diversification

Diversification has the effect of lowering the risk of a portfolio through the reduction of the variability of the portfolio returns. The results of research studies confirm this and has in general shown that a portfolio of securities need only consist of a relatively small number of securities to achieve significant benefits of risk reduction (Correia *et al.* 1993:128,129).

Evans and Archer (1968)

Due to the fact that risk can be quantified, it is possible to identify both the analytical and empirical properties of risk. Evans and Archer studied the impact of portfolio size on portfolio risk and concluded, from randomly selected equally weighted portfolios of varying size, that the benefits from diversification are significantly reduced when the share portfolio consists of more than 15 to 20 shares (O'Brien & Srivastava 1995:40).

Wagner and Lau (1971)

Diversification has the effect that the larger the number of shares the lower the risk of the portfolio, but the reduction of risk is relatively small after the first 10 shares. Further, there is also a level of risk (market risk) that cannot be diversified away. The data from the study of Wagner and Lau confirms that diversification reduces the level of risk, but even well-diversified portfolios have some level of risk that cannot be reduced through diversification (Weston & Copeland 1992:384,385).

Solnik (1974)

Most specific risk can be diversified away by randomly increasing the number of shares in a portfolio to about 30 and nearly only market risk remains when the portfolio is increased to resemble the composition of the market as a whole. Solnik's data, from both well-diversified portfolios in domestic and international markets, confirms that an increase in the number of shares causes the level of risk to become closer to the level of market risk (Sharpe 1985:172).

3.3.5.2 Studies on the effectiveness of global diversification

Diversification across different capital markets can further reduce risk levels due to exchange rate movements and due to the fact that different countries have different economic cycles. As a result, global diversification can lead to lower risk for the same return or more return for the same risk (Van Horne 1992:63,64).

Grubel (1968)

Grubel applied the principles of portfolio theory to internationally diversified portfolios, based on two additional assumptions. Firstly, that the only additional risk to consider is exchange rate movements and, secondly, that there is no increase in transaction costs. Grubel's study focussed on whether US investors can achieve any benefits by diversifying internationally. The results of the study confirmed that US investors can construct international portfolios that render higher returns or bear lower risk in comparison with domestic portfolios (Dobbins *et al.* 1994:38,39).

Levy and Sarnat (1970)

Levy and Sarnat also examined whether international diversification has any benefits for US investors. Their study, which ignored dividends and only used exchange rate movements and capital growth, showed that well-diversified international portfolios dominate well-diversified domestic portfolios. Further, the data showed that if international diversification is not limited only to Canada and Western Europe but also includes Japan, South Africa and developing countries, then the return achieved can be significantly improved for the same level of risk (Dobbins *et al.* 1994:39-41).

Dimson, Hodges and Marsh (1980)

The study of Dimson *et al.* on the advantages of international diversification for UK investors showed similar benefits from global diversification. Their data showed that the biggest risk reduction can be achieved when portfolios include investments from Japan and South Africa, and not only those of Europe and North America. Thus, portfolios which are diversified globally are likely to be superior to those which are only diversified across domestic capital markets (Dobbins *et al.* 1994:41).

3.3.6 Criticism of Portfolio Theory

The main objection to Portfolio Theory, as a model to select efficient portfolios, is the numerous and complex calculations involved. For a portfolio of 100 securities, in the order of about 5 000 correlation coefficients need to be calculated (Clark *et al.* 1979:166; Viljoen 1989:22; Linley 1992:3; Dobbins *et al.* 1994:36). A further objection is that the assumptions underlying Portfolio Theory, such as that there are no transaction costs or taxes, securities are completely divisible, investors have equal access to information, information is freely available and investors have the same time-horizons, are a major simplification. It allows investment decision-making to be examined under idealised conditions, but does not consider the practical complexities of investing in well-diversified portfolios (Linley 1992:3; O'Brien & Srivastava 1995:7,8).

Thirdly, Portfolio Theory states that higher return should be expected on riskier securities, but does not specify how this risk premium should be calculated. Portfolio Theory merely states that the risk of securities depends on the relationship between the various securities' returns (Linley 1992:3,4). A fourth objection to Portfolio Theory is that it is impractical for most investors to consider investing in proportion to all securities available on the market. Only investment in some unit trusts or pension funds might resemble an investment in the market portfolio (Correia *et al.* 1993:132).

The problems with estimating probabilities of cash flows in capital budgeting is a fifth objection to Portfolio Theory, insofar as these complicate the application of Portfolio Theory to capital budgeting (Clark *et al.* 1979:166).

3.4 THE DEVELOPMENT OF THE EFFICIENT MARKET HYPOTHESIS

Keane (1983:v) states that there are differing views on the efficiency of capital markets.

> The behaviour of the vast majority of market participants, professional and lay, informed and ill-informed, appears to be premised entirely on the assumption that market prices 'incorrectly' reflect underlying values with sufficient margin and frequency to justify a policy of actively striving to outperform the market.
>
> Side-by-side with this activity is an extensive body of research accumulated over a period of years which, for the main part, conflicts with the practitioner's basic premise and which suggests that the conventional investor in search of mispriced securities is largely a victim of self-deception.

The efficiency of capital markets refers to how successful capital markets are in correctly establishing security prices. Efficient pricing consist of two equally important parts; the speed of the adjustment of prices and the size and direction of the adjustments. If the markets are efficient, investors will not be able to systematically earn returns above the market average (Keane 1983:9).

The EMH suggests that security prices are the best estimate of their investment values since capital markets adjust prices immediately and fully to reflect new information that becomes available. This ensures that changes in security prices are unpredictable and that prices change in a random manner (Sharpe 1985:68).

To fully understand the implications of the EMH and the results of research done thereon, the concepts of "market efficiency" and "market inefficiency" together with the various forms, tests and anomalies of market efficiency need to be examined first.

3.4.1 The concepts "perfect markets", "efficient markets" and "inefficient markets"

3.4.1.1 The concept "perfect markets"

According to Keane (1993:26) and Rees (1995:176), capital markets need to display the following attributes to be considered as being perfect markets:

- All investors are rational and base their investment decisions on the principle of seeking higher returns for lower risk.
- All investors have full and immediate access to all relevant information and the information is available free of charge.
- There are many buyers and sellers of securities, there are no transaction costs and taxation has no effect on investment decisions.

Firth (1977:2,3) further states that the requirements for perfect markets are:

- Homogeneity of goods.
- Active trading in all securities.
- Freedom of entry to and exit from the market.
- An unlimited supply of securities.
- Availability of all information relevant to each security.
- Accurate pricing of all securities in accordance with the available information.

In practice, perfect capital markets should correctly price all securities so that each security's price correctly represents its investment value at all times. No existing capital market has the attributes nor meet the requirements to be described as a perfect capital market (Firth 1997:3; Sharpe 1985:67).

3.4.1.2 The concept "efficient markets"

Market efficiency implies that the market price of a security represents all the participants in the market's consensus value of that security (Van Horne 1992:51). To be considered efficient a capital market must instantaneously and unbiasedly incorporate all available information into the prices of securities. This implies that investors are unable to achieve abnormal returns on a consistent basis as the capital market does not under- or overprice securities (Firth 1977:105; Keane 1983:28; Henderson *et al.* 1992:292).

The efficiency of capital markets has been the subject of much research, based on the early work and findings of Fama (1970) who found that changes in security prices occurred randomly due to the correct adjustment to new information. This description of capital markets has become known as the EMH (Hendriksen & Van Breda 1992:169; Van Horne 1992:51; Henderson *et al.* 1992:291).

According to Harrington (1987:26-35) the following assumptions underlie the EMH:

- The objective of investors is to maximise their marginal utility of wealth.
- Investors base their investment decision on the risk/return relationship.
- All investors have the same expectations regarding risk and expected return.
- All investors have a specific (fixed) time-period of investment.
- All relevant information is available to all investors at the same time and at no cost to them.

The following conditions are deemed sufficient for capital markets to be considered efficient:

- There are no costs involved in the trading of securities.
- All relevant information is costless and equally available to all investors.
- All investors agree on the implications of the available information for security prices (Fama 1970:46; Bicksler 1977:1; Hendriksen & Van Breda 1992:169).

It can be concluded that if capital markets are efficient then security prices provide the best possible estimate of the underlying value of the securities (Rees 1995:176).

3.4.1.3 The concept "market inefficiency"

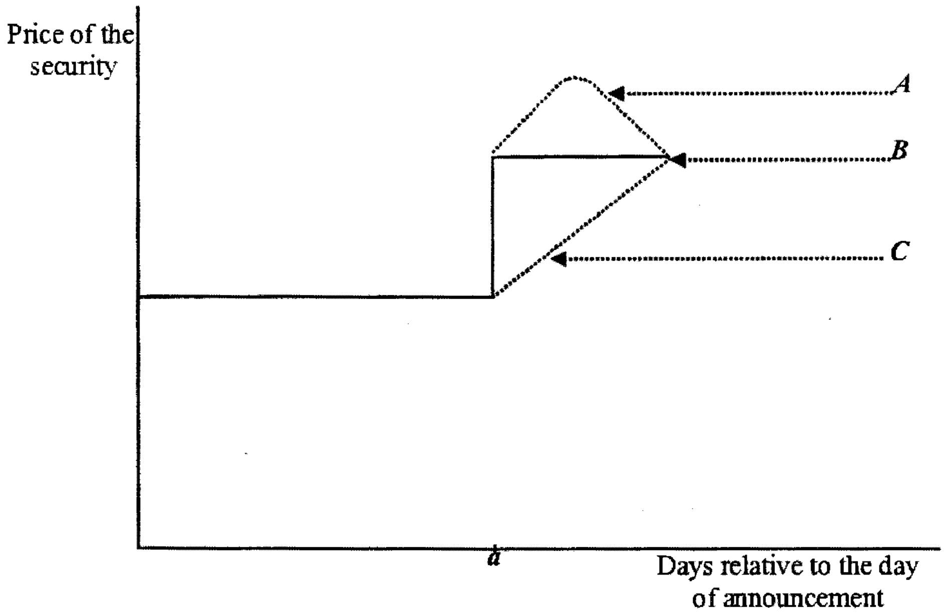
Opposite to the EMH is the possibility that capital markets are inefficient. Market inefficiency occurs when many investors do not have access to all information or if many investors incorrectly interpret new information. Further, if investors can predict security price movements and are able to consistently earn returns in excess of what is considered normal for the level of risk involved, then capital markets can be considered to be inefficient (Kam 1990:56; Henderson *et al.* 1992:292).

For capital markets to be considered inefficient, the inefficiencies must also be exploitable, that is, investors must be able to profit from them. Keane (1983:24) identifies the following criteria to be satisfied for an inefficiency to be exploitable:

- The inefficiency must be identifiable. Even if it can be shown that some investors or investment strategies can consistently earn abnormal returns, if the inefficiencies are not identified it will be of no use to the investor.
- Inefficiencies must be material enough to be able to profit from them, to such an extent that the costs and risks involved in exploiting them are exceeded.
- An inefficiency that has been identified in the past must be shown to continue in the future. If not, the market may have learned from the past and there may be no opportunity in future to profit from it.
- All inefficiencies must be shown to be authentic through proper statistical research.

Keane (1983:25,26) adds that if the market inefficiencies can only be perceived by investors with special insight, the rest of the investors will still consider the market to be efficient and act accordingly. If the investors with special insight make their knowledge publicly available, the capital market may act on this information and thus remove the inefficiency. This means that inefficiencies can only be exploited by the investors who perceive them and do not communicate their information, otherwise the capital market becomes efficient and removes the opportunity for achieving abnormal returns. The effect of the release of new information on security prices in efficient and inefficient capital markets is illustrated in figure 3.8.

Figure 3.8 Reactions of capital markets to new information



where:

a	=	The day of the release of the new information	
A	=	Inefficient market:	The market overreacts to the new information and it takes a number of days for the price to settle at the true price
B	=	Efficient market:	The market reacts instantaneously and correctly to the new information and there is no subsequent movement in the price
C	=	Inefficient market:	The market delays its reaction to the new information and it takes a number of days for the new information to be correctly reflected in the price

Source: Ross *et al.* (1990:340).

As can be seen from figure 3.8, investors with special insight have the opportunity to earn abnormal returns in inefficient capital markets, since security prices take a certain amount of time to reach their correct levels.

According to the EMH there are varying forms and degrees of capital market efficiency. These aspects of the EMH is the focus of the next section of this chapter.

3.4.2 Forms and degrees of market efficiency

According to Keane (1983:11) the research of Bachelier (1900) was the first reported tests of market efficiency. It was only in 1959 that Roberts first classified market efficiency according to three levels and these were formalised later by Fama (1970) into three forms of market efficiency.

Each form of market efficiency relates to a specific set of available information; firstly, information on past security price movements (weak form), secondly, all publicly available information (semi-strong form) and, thirdly, all known information, whether publicly available or not (strong form) (Keane 1983:10; Rees 1995:175).

3.4.2.1 <u>Weak form efficiency</u>

The weak form of the EMH states that current security prices reflect all the information contained in past security prices. Security prices follow a random walk and a study of past price movements are of little use in predicting future price movements. Therefore, only new information will cause security prices to change.

3.4.2.2 <u>Semi-strong form efficiency</u>

According to the semi-strong form of the EMH, security prices reflect all publicly available information. Security prices reflect new information instantaneously and in an unbiased manner. Therefore, analysis of all publicly available information will not provide the investor with the opportunity to earn abnormal returns.

3.4.2.3 Strong form efficiency

The strong form of the EMH contends that security prices reflect all information, both publicly available and privately held. Therefore, this suggests that even the use of insider information cannot be used to earn abnormal returns (Keane 1983:10; Ross *et al.* 1990:343; Weston & Copeland 1992:94,95; Correia *et al.* 1993:140; Rees 1995:78).

Keane (1983:10,11) states further that the three forms are interdependent of one another. For capital markets to be efficient in the strong form it must also be efficient in the other two forms. Likewise, for capital markets to be efficient in the semi-strong form it must also be efficient in the weak form. Most of the evidence for weak form efficiency seems conclusive, but due to some anomalies there is doubt about semi-strong efficiency. Strong form efficiency, however, is difficult to prove due to lack of opportunity in studying the effect of insider information. Further, it is quite implausible that security prices can fully reflect information which is not publicly available (Hendriksen & Van Breda 1992:173,176; Rees 1995:78).

Keane (1983:26) contends that when market efficiency is considered it is not only the form of efficiency that is important, but also the degree of efficiency.

3.4.2.4 Degrees of market efficiency

Market efficiency can be classified according to the following degrees of efficiency (Keane 1983:26,27):

- **Perfect efficiency**: Security prices are so close to their true values that no investors are able to achieve abnormal returns.

- **Near efficiency**: Security prices are close enough to their true values that only investment experts are able to earn abnormal returns. However, these excess returns are only sufficient to compensate them for the transaction costs incurred.

- **Inefficiency**: Securities are so mispriced that even non-expert investors can earn abnormal returns.

Capital markets can be considered to be perfectly efficient in the weak form, near efficient in the semi-strong forms and inefficient in the strong form. For most practical purposes capital markets need only be near efficient in the weak and semi-strong form (Keane 1983:27).

For market efficiency to hold it needs to be empirically verified. The tests used by researchers are classified according to the form of efficiency being tested (Correia *et al.* 1993:141).

3.4.3 Tests of market efficiency

As future information is not available it is impossible to test the efficiency of capital markets directly. Therefore, tests must be based on the available information and available statistical techniques (Dobbins *et al.* 1994:16,17).

Rees (1995:176) identifies two approaches to testing market efficiency:

- The first approach is examining the implications of a specific piece of information on a security's price. A trading rule is then established and the returns obtained from trading is then investigated for any abnormal returns.
- Secondly, the performance of a certain group of market participants is investigated for the possible achievement of abnormal returns.

According to Hendriksen and Van Breda (1992:170,171) there are also two parts to efficiency that need to be tested:

- Firstly, the speed with which the markets react to new information.
- Secondly, the correctness of the markets' response to the new information.

The results of research show that markets do react very quickly to new information, but it is not clear whether they react correctly. The problem with this is that it is very difficult to define what a proper response should be. Hendriksen and Van Breda (1992:171) also identifies two other problems with testing market efficiency.

- The first problem is that most of the tests of market efficiency requires the use of theoretical pricing models. Therefore, the tests jointly test the efficiency of capital markets and the efficiency of the pricing models.
- Secondly, a true price against which the market price of securities can be measured does not exist. Therefore, market efficiency is hard, if not impossible, to prove.

Firth (1977:118,119), further, identifies the following factors that need to be considered when the EMH is tested:

- The tests provide evidence for or against the hypothesis, but cannot be considered proof of market efficiency or inefficiency.
- The argument is not that the market is perfectly efficient and, therefore, a few in-efficiencies are expected. The problem is, however, how many inefficiencies are acceptable.
- The identification of inefficiencies in published research constitute publicly available information and may cause these inefficiencies to be removed from the market and prevent their recurrence in the future.
- The results of the tests are a reflection of the efficiency of the market at a certain point in time and the research needs to be ongoing to establish the overall validity of the EMH.

3.4.3.1 Weak form tests

Weak form tests of the EMH are concerned with whether past security price movements can be used to predict future security price movements. Most evidence from studies is consistent with weak form efficiency, in that no abnormal returns can be earned through the use of the historic series of prices (Bicksler 1977:1,2; Keane 1983:33-35; Ross *et* *al.* 1990:347; Dobbins *et al.* 1994:17). Of the tests that are used are:

- **Serial correlation tests**: Using correlation coefficients, the relationship between successive price changes are investigated for possible trends. If the market is weak form efficient the correlation coefficients would be approximately zero, meaning there is no consistent correlation between successive price changes.

- **Mechanical investment strategies**: Strategies such as filter rules and buying and selling of securities when their prices move beyond their moving average are used to establish whether higher returns can be earned than from a buy-and-hold strategy (Correia *et al.* 1993:141,142).

3.4.3.2 Semi-strong form tests

These tests are concerned with whether security prices react correctly and swiftly to new publicly available information. Most of the results of the tests suggest that capital markets are semi-strong efficient, but some anomalies still cause controversy (Bicksler 1977:2; Firth 1977:118; Keane 1983: 36,37; Weston & Copeland 1992:95; Dobbins *et al.* 1994:17).

Some information categories that have been tested are news about mergers, capitalization issues, dividend announcements, changes in accounting policies that effect reported earnings and earnings announcements. The tests attempt to establish whether the price movements can be attributed to the release of the information (Ross *et al.* 1990:350; Correia *et al.* 1993:142).

3.4.3.3 Strong form tests

Tests of the strong form attempt to establish whether investors with access to inside information can earn abnormal returns and whether certain investors have superior knowledge which consistently enable them to earn excess returns. Although there is the difficulty of obtaining the information about the results of the trading on inside information, most evidence suggests that the strong form of the EMH does not hold (Bicksler

1977:2; Firth 1977:118; Ross *et al.* 1990:354; Weston & Copeland 1992:96; Dobbins *et al.* 1994:17).

Most evidence from tests done on the efficiency of capital markets indicate that inside information is not impounded in security prices, but that security prices do provide a quick and correct reflection of publicly available information. This suggests that capital markets are efficient at the semi-strong level, although anomalies that have been identified still cast doubt on this conclusion (Bicksler 1977:2; Kam 1990:58; Van Horne 1992:51,52).

3.4.4 Efficient market anomalies

During the 1980s an increasing number of anomalies have been reported and these anomalies cast some doubt on market efficiency as defined by the EMH (Dobbins *et al.* 1994:110; Rees 1995:79,178).

Some of the anomalies that have been recorded include:

- **The small firm effect**: It appears that in many markets the shares of small firms outperform those of larger firms. When the relative risk involved is taken into account, the expected returns of small firms are much higher than that for large firms. There also seem to be some link between this size effect and certain calendar effects (Sharpe 1985:402; Dobbins *et al.* 1994:110; Rees 1995:179).

- **The P/E effect**: Firms with low P/E ratios tend to render abnormal returns when compared with firms with high P/E ratios. These returns seem excessive when compared with market prices and when the returns are linked to accounting earnings. Evidence suggests that much of the P/E effect may be explained by the small firm effect (Dobbins *et al.* 1994:110; Rees 1995:180).

- **The weekend effect**: Capital markets show a general tendency to fall over weekends and to a greater degree than any other day of the week, except Wednesdays (Sharpe 1985:408; Rees 1995:179).

- **The January effect**: This anomaly is linked to the small firm effect since the shares of small firms tend to significantly and consistently outperform those of larger firms during January (Sharpe 1985:405,407).

- **Stock market crashes**: The crash of October 1987 occurred when no significant news was released during the preceding days. This significant drop of between 20% and 25% seems irrational and not consistent with the concept of market efficiency. Since the reason for the crash of 1929 is still unknown it does not seem that these crashes can be explained other than by the theory of the bubble effect of speculative markets. Share prices must fall back to their true values after a period of speculation (Ross *et al.* 1990:353; Dobbins *et al.* 1994:121).

Although the evidence suggests that there are persistent irregularities which cannot be explained by the EMH, inefficiencies are expected to be exploitable until they are arbitraged away, and this does not seem to be the case. Rees (1995:181) identifies possible reasons for this:

- The returns from pursuing these irregularities may not be sufficient to compensate for the costs involved.
- Unexplained returns may be due, firstly, to the fact that what may be considered as normal returns is difficult to establish and, secondly, to some shortcomings in asset pricing models.

Correia *et al.* (1993:140,141) state that for capital markets to be efficient some investors need to believe that it is inefficient. Their activities of attempting to exploit inefficiencies will ensure that capital markets become more efficient. Following on this, it is now necessary to consider the implications of market efficiency as defined by the EMH.

3.4.5 Implications of the EMH

If capital markets are efficient it holds certain implications for investors and investment advisors. These implications can be summarised in the following manner:

a. Market efficiency implies that abnormal profits can only be achieved by chance and the best policy for investors is to hold well-diversified portfolios and to minimise transaction costs. This will reduce the risk of their investments underperforming (Keane 1983:116).

b. It would be a waste of time for investors to attempt to identify mispriced securities since the market price of the securities represents the best estimate of the securities' worth (Rees 1995:40).

c. When capital markets are efficient with respect to a specific set of information it is not worthwhile to attempt to earn abnormal returns by trading on data from that set of information (Hendriksen & Van Breda 1992:170). This implication can, further, be sub-divided into three separate implications according to the three forms of market efficiency.

- Weak form efficient. Past price patterns are already incorporated in current market prices and this implies that any form of technical analysis used to predict future prices will be of no value (Keane 1983:10; Ross *et al.* 1990:342; Van Horne 1992:51).

- Semi-strong form efficient. All publicly available information is already impounded into security prices and, thus, all forms of fundamental analysis used for trading decisions will not result in the investor being able to earn abnormal returns (Keane 1983:10;Ross *et al.* 1990:343;174; Van Horne 1992:51,52).

- Strong form efficient. Security prices reflect all public and private information and no-one is able to consistently achieve superior investment results (Keane 1983:10; Ross *et al.* 1990:343; Correia *et al.* 1993:141).

d. Due to the concept of market efficiency, the role of investment advisors is to assist their clients in achieving optimum investment performance from their available resources, and not to attempt to beat the market (Keane 1983:116).

In addition, the concept of market efficiency also holds some implications for accounting:

e. Through its effect on share prices the value of any item of accounting information can be evaluated.

f. The value of alternative accounting disclosure policies and methods can be ascertained through their impact on share prices.

g. The accounting disclosure policies and methods to be chosen are those which cause the least long-term variability in share prices (Firth 1977:140,141).

h. Since capital markets are not fooled by accounting gimmicks or tricks, capital markets are able to decipher information regardless of its form and only incorporates information that affect the expectations regarding the share's risk and return (Hendriksen & Van Breda 1992:175,176).

It is clear that in efficient markets "by chance" and "through luck", not ingenuity, are the only ways to earn excessive profits on capital markets. Therefore, to prove market inefficiency it is not sufficient to show that excessive profits have been earned, but that it has been earned through skill and on a consistent rather than one-off basis (Keane 1983:14,15).

From this, the misconceptions about the EMH need to be considered, as this is an aspect which is closely related to the implications of the EMH.

3.4.6 Misconceptions regarding market efficiency

Keane (1983:28) states that:

> The basic error is the belief that an efficient market is one that should be able to predict the future. Investors are subject to an illusion of inefficiency as a result of a common misconception of how an efficient market should behave.

Some of the misconceptions about market efficiency that have been identified are listed below:

a. Frequent changes in security prices are not an indication of market inefficiency, but rather efficiency as prices are rapidly adjusted to new information becoming available. A lack of price movements on the other hand might suggest an inefficiency (Keane 1983:28; Ross *et al.* 1990:346).

b. Secondly, differences between actual returns and expected returns on securities do not signify market inefficiencies. Expected return represents a probability distribution of what is likely to occur, but if subsequent events turn out to be more favourable or unfavourable than specified by the weighted average of probabilities, actual returns will differ from those expected.

c. Thirdly, since most investors do not hold portfolios of investments which represent the market as a whole, their investments may outperform the market return. This does not necessarily imply superior knowledge by the investor, but rather that economic events do not influence all securities equally and non-representative portfolios will be affected differently. This is also consistent with market efficiency (Keane 1983:28,29).

d. A fourth misconception is that capital markets are clairvoyant. Market prices are only a reflection of the knowledge available. With hindsight prices can be shown to have been incorrect, but that does not imply inefficiency as the EMH simply states that market prices are set at the correct level according to the information available.

e. Another misconception is that capital markets would be inefficient if no financial statements and other accounting information were available. Again, the semi-strong form of the EMH only asserts that all publicly available information is impounded in security prices. Without financial statements and accounting information the variability and levels of prices may be different, but this too does not imply inefficiency (Hendriksen & Van Breda 1992:176,177).

As it is through empirical testing only that the validity of the EMH can be established, it is now important to consider the results of some of the research which had been undertaken.

3.4.7 Research related to market efficiency

The tests of market efficiency can be divided into three categories (Fama 1976:136; Firth 1977:106), namely:

- Determining whether security prices fully reflect all the information contained in past prices and price patterns. Also, whether future security prices can be predicted by using the historic price information.
- Establishing whether security prices react fully and correctly to new publicly available information. The market's reaction, both in speed and correctness, to specific items of information is measured.
- Examining whether certain investors have superior knowledge, or access to information, which allow them to consistently earn above-average returns.

From this, results of some of the international research (on the US market, except where otherwise indicated) conducted until the mid-1980s are reviewed, according to their area of investigation.

3.4.7.1 Tests of the weak form of market efficiency

Weak form tests of market efficiency are concerned with whether historic prices and price movements can be used to predict future security prices.

a. Early random walk studies

The earliest research study was that of **Bachelier (1900)** in France, who concluded that commodity prices follow a random walk and that current prices are the best estimate of future prices. **Working (1934)** and **Cowles and Jones (1937)** confirmed the finding that commodity prices and security prices follow a random walk. **Kendall (1952)**, in the UK, suggested that security and commodity prices follow a random walk since he failed to find cycles in these prices, but found that price changes are independent of previous price changes. Both **Roberts (1959)** and **Osborne (1959)** also concluded that security prices appear to follow a random walk. **Cootner (1962)** agreed that security prices follow a random walk, but argued that it is not valid for all investors since some professional investors are able to earn abnormal returns. Finally, **Samuelson (1965)** confirmed that security prices change in a random manner and that capital markets are at least weak form efficient (Firth 1977:120,121; Dobbins *et al.* 1994:70-73).

b. Serial correlation analysis

The correlation between a security's current return and its future return has been the subject of a large body of research.

Moore (1964)

Moore examined the serial correlation between successive price changes of individual shares and found an average serial correlation coefficient which is not statistically different from zero. Moore concluded that there is little or no dependence between successive price changes and that any returns obtained from such dependence would be insufficient to compensate for the trading costs involved. Therefore, historic price changes cannot be exploited to achieve above-normal returns (Firth 1977:123; Anderson 1978:19; Dobbins *et al.* 1994:73).

Granger and Morgenstern (1963) and Godfrey, Granger and Morgenstern (1964)
Spectral analysis, a complex serial correlation technique, was used in an attempt to find cycles in share prices. No significant relationship between successive price changes was found since the serial correlation was found to be close to zero (Fama 1970:54; Firth 1977:125; Dobbins *et al.* 1994:72).

Fama (1965)
In a major study, Fama found an average serial correlation coefficient of 0.03. This is statistically not different from zero and confirmed that share price changes follow a random walk and that information on the history of the prices cannot be used to earn abnormal returns (Firth 1977:124; Dobbins *et al.* 1994:74).

Brearly (1970)
In a study in the UK, Brearly found some degree of serial dependence in share returns. The regularity found, however, is not sufficient to be exploited after transaction costs are taken into account and as such does not provide evidence against the random walk hypothesis and weak form market efficiency (Rees 1995:177).

Solnik (1973)
Solnik tested seven European stock markets and found greater serial dependence than that found in the US market. This dependence too proves to be insufficient to provide abnormal returns when transaction costs are taken into account (Keane 1983:48; Ross *et al.* 1990:347; Rees 1995:176,177).

Hagerman and Richmond (1973)

Hagerman and Richmond conducted a similar serial correlation analysis, but concentrated on smaller and thus less well analysed shares. They also found little serial correlation and concluded that capital markets are weak form efficient for even the small type firms (Firth 1977:124).

Various studies

Various other studies obtained similar findings in that share prices largely follow a random walk and that little or no correlation can be found between past prices and future prices of shares. Some of the evidence, though, suggest that infrequently traded shares' prices do not follow a random walk. Some of these studies are those of **Praetz (1972)** in Australia, **Niarchos (1972)** in Greece, **Dryden (1970)**, **Cunningham (1973)** and **Guy (1975)** in the UK, **Conrad and Juttner (1973)** in Germany, **Jennergrean and Korsvold (1975)** in Norway and Sweden, **Ang and Pohlman (1978)** who found the Japanese market to be highly efficient in the weak form, **Errunza (1979)** in Brazil and **D'Ambrosio (1980)** in Singapore (Frith 1977:124; Gay 1982:189; Keane 1983:43).

According to Keane (1983:48) smaller capital markets, such as Nigeria, Singapore and South Africa, have shown significant levels of weak form inefficiency. This arises from the size of these markets, the thinness of trading and weaknesses in disclosure of information. However, no evidence has as yet been presented that these inefficiencies are exploitable and thus the evidence presented regarding smaller markets is inconclusive.

Keane (1983:49) concludes that it is doubtful that the inefficiencies in smaller markets would present investors with abnormal profit opportunities. The major markets (US, Europe and Japan) are substantially efficient and, through the flow of capital across international borders, exploitable inefficiencies would be eliminated.

c. <u>Mechanical investment strategies</u>

Another area of research regarding weak form efficiency has been whether mechanical investment strategies, which provide signals for buying and selling of securities, enable investors to achieve abnormal returns.

Alexander (1961)

Alexander studied a filter rule which provides buy and sell signals when share prices move a certain percentage from a previous low and high point. He established that there are trends in share price movements, but also found that any abnormal returns disappear when transaction costs are taken into account (Firth 1977:126; Keane 1983:35; Dobbins *et al.* 1994:72).

Fama and Blume (1966)

Fama and Blume found similar evidence in that small abnormal returns can be earned with frequent trading. These excess returns are not sufficient to cover transaction costs and, in fact, a simple buy-and-hold strategy at the same level of risk can outperform trading based on the filter technique (Firth 1977:126; Weston & Copeland 1992:95).

Cootner (1962), Van Horne and Parker (1967) and James (1968)

All three studies investigated whether it is possible to earn abnormal returns when shares are bought or sold when their prices moved away from their moving average. The evidence showed that this is not a profitable investment rule when transaction costs are taken into account (Firth 1977:126,127).

Latané and Young (1969) and Evans (1970)

Both studies investigated the investment strategy of adjusting portfolios at the end of specific investment periods so that the portfolio weights are the same as at the beginning of the period, that is, the same proportion of the portfolio is invested in the same shares. The results of the studies showed that this investment strategy does not outperform a simple buy-and-hold strategy (Firth 1977:127; Keane 1983:35).

Levy (1967) and Jensen and Bennington (1970)

These researchers studied the strategy of ranking shares in terms of their price performance over a specific investment period. Shares from a certain percentage at the bottom of the ranking are sold and the rest are retained. Despite claims to the contrary, the results of the studies showed that this does not outperform a simple passive strategy (Firth 1977:127; Keane 1983:35).

Black and Scholes (1972)

In an investigation of the options market, Black and Scholes concluded that options are significantly mispriced. They also found that this cannot be profitably exploited by a trading rule due to the high transaction costs that would be incurred (Firth 1977:124).

Various studies

Studies by **Praetz (1969)** in Australia and **Dryden (1970)** in the UK also found that no abnormal returns can be earned by using filter techniques (Firth 1977:126).

Firth (1977:127,128) adds that many other mechanical investment strategies have been tested of which none can consistently outperform the market. Yet it can be accepted that investors who have profitable trading rules would keep it a secret and, hence, it is only those strategies which have been published that can be examined through empirical testing.

It can be reasonably concluded from the results of research done that:

- Security prices follow a random walk.
- The future prices of securities cannot be predicted by using information about the past prices and price changes of the securities.
- Mechanical investment strategies do not provide returns that exceed those of a passive buy-and-hold strategy.
- Therefore, capital markets are for all intents and purposes efficient in the weak form.

3.4.7.2 <u>Tests of the semi-strong form of market efficiency</u>

Tests of semi-strong efficiency are concerned with the reaction of capital markets to new information. These tests attempt to establish whether security prices react quickly and correctly to the new information and, if they do, it implies that investors would not have the opportunity to earn abnormal returns through trading on the basis of the information. Most of the research studied the impact of specific economic events and specific types of information on security prices to establish whether capital markets are semi-strong efficient.

a. <u>Annual earnings announcements</u>

Ball and Brown (1968)

Ball and Brown studied the impact of annual earnings announcements on share prices. They found that the prices move gradually during the year and that by the time of the announcements, approximately 90% of the content of announcements are already incorporated in the prices. This provides support for the semi-strong form of the EMH since the market anticipates the information contained in annual reports and it is not possible for investors to use annual earnings announcements for profitable trading (Fama 1970:70; Keane 1983:37,39; Weston & Copeland 1992:95,96; Henderson *et al.* 1992:296,298; Dobbins *et al.* 1994:74,75).

Beaver, Clarke and Wright (1979)

In this study on annual earnings announcements, Beaver *et al.* not only studied whether the changes in share prices are in the right direction, but also whether it is of the correct magnitude. It was found that the market continuously adjust prices and that the market is quite sensitive to the magnitude of changes in earnings (Keane 1983:39,40).

Beaver, Lambert and Morse (1980)

The Beaver *et al.* study confirmed that capital markets are able to anticipate earnings announcements and that its effect is to a large degree already incorporated in share prices (Keane 1983:40).

Various studies

In an Australian study, **Brown (1970)** found similar evidence to those of US studies. Later Australian studies by **Brown and Hancock (1977)** and **Brown, Finn and Hancock (1977)**, and a New Zealand study by **Emanuel (1984)** confirmed the results obtained in previous studies (Henderson *et al.* 1992:298).

b. Earnings announcements by similar type firms

Firth (1977)

In this UK study, Firth (1977:133) examined the impact on share prices when similar type firms release their earnings results. He found that price reactions are in the direction expected, but was unable to conclude whether the magnitude of changes are correct. This evidence supports the semi-strong form of market efficiency since capital markets use all relevant publicly available information to establish share prices.

Foster (1981)

Foster investigated the behaviour of share prices when firms of similar type make announcements about earnings. He found that the share prices move more than normal when firms in the same industry announce their earnings (Henderson *et al.* 1992:303).

c. Dividend announcements

Pettit (1972)

Pettit examined the market's reaction to dividend announcements. The results showed that the market reacts quickly and that the price adjustments are over immediately after the announcements. Pettit concluded that this confirmed the hypothesis about strong-form market efficiency (Firth 1977:131; Dobbins *et al.* 1994:77).

Watts (1973)

Although Watts disagreed with Pettit (1972) about the importance of dividend changes, his results confirmed those obtained by Pettit (1972) (Firth 1977:131).

d. Share splits

Fama, Fisher, Jensen and Roll (1969)

Fama *et al.* found results consistent with semi-strong market efficiency when they investigated the response of share prices to share splits. Share splits constitute an increase in the number of shares per shareholders and as such has no new information content. However, it was found that share splits are usually followed by an increase in dividends and that the capital market reacts to the splits in anticipation of this increased dividends. They found that share prices rise before the announcement of splits, but no abnormal returns could have been earned at the time of the announcement since the prices show almost no movement after the announcement, meaning that the price adjustments are over at that time (Fama 1970:67,69,70; Anderson 1978:25,26; Keane 1983:40,41; Ross *et al.* 1990:350; Dobbins *et al.* 1994:75).

Various studies

The studies of **Hausman, West and Largay (1971)** and **Reilly and Drzycimski (1981)** provided further confirmation of semi-strong efficiency in the case of share splits. **Charest (1978)**, however, differed from the above conclusions as he found large positive abnormal returns during the period surrounding the announcement of share splits (Van Rhijn 1994:28).

e. Capitalisation issues

Firth (1973, 1974, 1977)

Firth examined the impact of capitalisation issues on share prices in the UK, and found that this has no impact on share prices. This confirmed that markets react rationally and supports semi-strong efficiency (Firth 1977:134).

Various studies

Studies by **Johnson (1966)** and in Canada by **Finn (1974)** also found that no abnormal returns can be earned based on the announcements of capitalisation issues. Their results showed that the market reacts quickly and accurately to the information regarding capitalisation issues (Firth 1977:131).

f. Large block trades

Scholes (1972)

Scholes investigated the impact of secondary offerings (large underwritten sales of existing shares) on share prices. The findings showed that these trades are associated with small declines in prices. He found that the declines do not depend on the size of the trade, but on the seller of the shares. The largest declines are associated with corporations and corporate officers and this implies that other investors suspect that insider information is involved. This supports semi-strong form market efficiency as the market is more concerned with the information content of the sale than with the amount of the sale (Fama 1970:71; Anderson 1978:27; Dobbins *et al.* 1994:76).

Kraus and Stoll (1972)

Kraus and Stoll also found an effect on share prices when they investigated the impact of all block trades. Share prices decline after the trade but recover quickly thereafter, and they concluded that it is not possible to earn abnormal returns by acting on publicly available information regarding block trades (Dobbins *et al.* 1994:76,77).

Dann, Mayers and Raab (1977)

This study examined the impact of large block trades on the assumption that the sellers or buyers have access to special information. They found that block trades have an impact on share prices, but investors must act within five minutes of the trade to earn returns sufficient to cover transaction costs (Keane 1983:41).

g. New share issues

Scholes (1969)

In a study similar to those on share splits, Scholes found evidence that supported the semi-strong form of the EMH. As with share splits, new issues suggest favourable economic conditions for firms and prices tend to rise in the period preceding the new issue. Prices behave in a random manner after the issue which suggests that the market incorporates all the information into the prices (Fama 1970:71).

h. Exchange listings

Furst (1970)

The study of Furst examined whether listing has any effect on share prices. In general no impact was found, suggesting that listing is not deemed by investors as representing a change in the value of the firm. As a result no abnormal returns can be earned by investing at the time of the listing (Van Rhijn 1994:29).

Van Horne (1970)

Van Horne also studied new exchange listings in order to establish whether it is possible to profit from them. His results showed that prices move significantly upwards for a period before the listing, but, when transaction costs are taken into account, no abnormal returns can be earned after listing (Van Rhijn 1994:30).

Ying, Lewellen, Schlarbaum and Lease (1977)

Contrary evidence arose from the study of Ying *et al.* who found that abnormal returns can be earned during the month preceding the listing as well as the month thereafter. The abnormal returns persist after providing for reasonable transaction costs and represent evidence against semi-strong form market efficiency (Van Rhijn 1994:30).

McConnell and Sanger (1981)

The results of a subsequent study by McConnell and Sanger confirmed the findings of Ying *et al.* (1977).

From the foregoing, it is evident that the results of studies regarding new listings and the semi-strong form of market efficiency are mixed, since the more recent research provide little support for the semi-strong hypothesis (Van Rhijn 1994:31).

i. Mergers and takeovers

Mandelker (1974)

Mandelker found that capital markets generally anticipate mergers and that prices begin to adjust approximately eight months before the actual event (Dobbins *et al.* 1994:77).

Various studies

The UK study of **Firth (1977:133)** found that capital markets react quickly and correctly to the announcement of takeovers. **Hong, Kaplan and Mandelker (1978)** found similar results which support the EMH in the semi-strong form (Keane 1983:41).

j. Accounting for depreciation

Archibald (1972)

The study of Archibald examined the behaviour of share prices when firms change their methods of providing for depreciation. These changes are for accounting purposes only and have no tax effect and, therefore, no effect on cash flows. The results of the study showed that the changes have no effect on share prices, which is consistent with semi-strong market efficiency (Wolk *et al.* 1989:208; Hendriksen & Van Breda 1992:170; Van Rhijn 1994:33,34).

Kaplan and Roll (1972)

Kaplan and Roll also investigated changes in accounting for depreciation with no tax effect. Their results showed that the market is not fooled by the resulting increase in accounting earnings and these charges have no significant effect on prices (Dobbins *et al.* 1994:76).

Beaver and Dukes (1973)

Beaver and Dukes investigated whether using different methods for the provision for depreciation have any effect on prices. They adjusted the earnings for different firms to the same depreciation basis and found that these adjustments have no significant effect on the price/earnings relationship between the various firms (Wolk *et al.* 1989:207,208).

Cassidy (1976)

Cassidy also studied changes in depreciation with no tax effect. The results were consistent with semi-strong market efficiency as Cassidy found no effect on prices and no abnormal share returns were observed (Henderson *et al.* 1992:313).

k. <u>LIFO inventory valuation</u>

Sunder (1973, 1975)

Sunder studied whether a change to LIFO inventory valuation, with the resulting cash flow and tax effects, has any effect on share prices. Consistent with semi-strong market efficiency, prices increase in anticipation of the change, while no abnormal returns can be earned after the change (Dobbins *et al.* 1994:77).

Various studies

Findings similar to those of Sunder (1973,1975) were found by **Ball (1972)** and **Biddle and Lindahl (1982)**. The **Abdel-Khalik and McKeown (1978)** and **Brown (1980)** studies contradicted these findings since they found either no response or a negative response to the LIFO change. This suggests that previous studies had not correctly isolated the effect of the LIFO change (Wolk *et al.* 1989:208,209).

l. <u>Changes in the Federel Reserve discount rate</u>

Waud (1970)

The study of Waud provides additional support for the EMH in the semi-strong form. Waud found significant price changes on the day of the announcement and that the market even anticipates the announcement by a few days. The price changes, however, do not to persist after the day of announcement (Anderson 1978:28).

m. The effect of extraordinary items on earnings

Eskew and Wright (1976) and Gonedes (1978)

Eskew and Wright investigated whether changes in share prices are associated with the announcement of unexpected extraordinary items. The results showed such an association and support semi-strong form market efficiency. Gonedes, though, found no significant association (Henderson *et al.* 1992:302).

n. The announcement of large investment holdings

Firth (1975)

Firth's UK study examined the impact on share prices of the announcement of large investment holdings being built up in firms. The behaviour of prices after the announcement supports semi-strong efficiency, but insider trading was suspected as prices reacted irrationally in the lead up to the announcement (Firth 1977:132,133).

o. Significant world events

Reilly and Drzycimski (1973)

Reilly and Drzycimski examined the announcement of seven unexpected world events in an attempt to find market inefficiency. The results support semi-strong market efficiency as the market reacts swiftly and appropriately to the announcements. It was also found that investors are not able to earn abnormal returns on the trading day following such an announcement (Van Rhijn 1994:31,32).

p. Tipsters

Firth (1972)

In this UK study, Firth found that share prices adjust swiftly to new information contained in the press comments of tipsters. This response is quick enough to prevent profits for any investors who act on the advice, although the tipsters themselves may be able to profit before announcing their advice (Keane 1983:43).

Most of the event and information studies have shown that the capital market can in general be considered to be semi-strong efficient. Although mixed results were obtained in some areas, it can be concluded that in general capital markets:

- React swiftly to new information.
- Adjust security prices correctly.
- Respond to new publicly available information in such a manner that investors are not able to consistently outperform the market average.

3.4.7.3 Tests of the strong form of market efficiency

Tests of the strong form version of the EMH are designed to examine two issues:

- Whether certain investors have superior knowledge and, hence, have superior success in trading on capital markets.
- Whether access to privileged or inside information can be used by investors to obtain abnormal returns.

a. Mutual funds and unit trusts

Friend, Brown, Herman and Vickers (1962)

In the pioneering study on the performance of mutual funds, Friend *et al.* found that mutual funds on average do not outperform a passive buy-and-hold strategy. This implies that mutual fund managers in general do not have superior knowledge and they concluded that this evidence supports the EMH in the strong form (Anderson 1978:30; Dobbins *et al.* 1994:78).

Sharpe (1966)

The study of Sharpe also provides support for the efficiency of capital markets and found that mutual fund managers on average cannot outperform the market. Sharpe concluded that the fund managers should rather concentrate on evaluating risk and on efficient diversification (Anderson 1978:30; Dobbins *et al.* 1994:78).

Jensen (1968)

Jensen found no evidence of mutual funds having superior performance and when management expenses are taken into account they actually perform worse than randomly selected portfolios. Further, successful performance in the past should not be taken as an indicator of future success (Fama 1970:75,76; Anderson 1978:30; Keane 1983:43; Ross *et al.* 1990:351,352; Dobbins *et al.* 1994:78,79).

Friend, Blume and Crockett (1970)

Further confirmation that fund managers are unable to outperform unweighted random portfolios were provided by Friend *et al.* (Anderson 1978:31; Dobbins *et al.* 1994:79).

Firth (1977)

Firth studied the performance of unit trusts in the UK. His findings support those of US research, in that many unit trusts actually have significantly inferior performance and, therefore, that the managers of unit trust do not have superior knowledge or access to non-publicly available information (Firth 1977:137; Dobbins *et al.* 1994:79,80).

Various studies

Studies by **Treynor (1965)** and **Williamson (1972)** and UK studies by **Ward and Saunders (1976)** and **Cranshaw (1977)** provide further evidence in support of market efficiency. They concluded that these funds do not perform consistently and in general perform worse than the market average (Keane 1983:43; Van Rhijn 1994:50,51).

b. Forecasting ability

Fitzgerald (1974)

In this UK study, Fitzgerald found that portfolios constructed on the advice from certain advisers render returns that vary abnormally above and below the market average. He concluded that the UK market seems less efficient than the US market, but added that further research was required to confirm his findings (Firth 1977:134,135).

Ambachtsheer (1974)

Ambachtsheer apparently also found evidence that some investors have a special forecasting ability. He did qualify his findings, by adding that forecasting ability is hard to find since these investors may have had a lucky run, meaning that it may be due to chance and not forecasting ability (Dobbins *et al.* 1994:81).

Dimson and Marsh (1984)

The UK study of Dimson and Marsh supported Ambachtsheer's 1974 findings, in that they found that some analysts have a special forecasting ability. They showed that these analysts' forecasts can be used to earn abnormal returns, although the investors who receive their recommendations have to act quickly to profit. Dimson and Marsh qualified their findings by adding that this is not conclusive evidence against market efficiency since the analysts may have access to inside information (Dobbins *et al.* 1994:68; Rees 1995:79,178).

Penman (1980)

Penman investigated the association between earnings forecasts by management and share returns. The results of the study indicate a strong effect on the day before the announcement and that abnormal returns are noticeable on the day of the announcement (Henderson *et al.* 1992:302).

Imhoff and Lobo (1984)

The Imhoff and Lobo study found that abnormal returns are associated with analysts' forecasts, especially when management's own forecasts are not publicly available (Henderson *et al.* 1992:302).

Sinclair, Fatseas and Trotman (1986)

The Australian study of Sinclair *et al.* on forecasts by chairmen of companies found similar results to those of Penman (1980). It was found that abnormal returns are associated with announcements of both good and bad news (Henderson *et al.* 1992:302).

Various studies

Several studies examined the performance of individual investment advisers. The studies of **Craig and Malkiel (1968)**, **Elton and Gruber (1972)** and **Firth (1972),** in the UK, found that few advisers can claim abnormal performance with their forecasts (Firth 1977:137).

c. <u>Inside information</u>

Niederhoffer and Osborne (1966)

The study of Niederhoffer and Osborne found that stock exchange specialists can earn abnormal profits when they use their access to information about buying and selling orders which at that point in time have not yet been filled (Firth 1977:135; Van Rhijn 1994:49, Dobbins *et al.* 1994:80).

Reilly and Drzycimski (1975)

The Reilly and Drzycimski study found that stock exchange specialists can trade profitably on selling and buying directories received after the announcement of significant unexpected world events (Van Rhijn 1994:49).

Various studies

Various studies on the use of insider information found that this information can be used to earn significant abnormal returns. Although it is difficult to obtain information about insider trading, studies by **De Vere (1968)**, **Jaffe (1974)**, **Collins (1975)**, **Finnerty (1976)** and **Seyhun (1986)** found sufficient evidence to conclude that the strong form of market efficiency should be rejected. Share prices do not reflect non-publicly available information and, hence, such information can be used to trade profitably (Firth 1977:135,136; Keane 1983:36; Ross *et al.* 1990:354).

From the available evidence, the following conclusions can be drawn regarding the strong-form of the EMH:

- Mutual fund and unit trust managers do not have special knowledge or access to special information and therefore cannot earn superior returns.
- Although the evidence regarding forecasting ability is mixed, it still casts doubt on the efficiency of capital markets.
- Corporate insiders and stock exchange specialists do have access to information that can be used to earn above-average returns.
- Capital markets are therefore not efficient in the strong form, but the evidence about mutual funds and unit trusts supports semi-strong form efficiency.

3.4.7.4 Tests on efficient market anomalies

A number of anomalies have appeared that cast some doubt on the efficiency of capital markets. The tests on these anomalies have attempted to determine whether they persist or are one-off in nature and, whether the anomalies are exploitable.

a. Quarterly earnings announcements

Jones and Litzenberger (1970)

The Jones and Litzenberger study showed that when a mechanical investment strategy is used on quarterly earnings announcements, the market can be outperformed and, hence, excess returns can be earned (Firth 1977:132).

Jones (1970)

Jones extended his 1970 study with Litzenberger by using filter rules and again found that abnormal returns can be earned. The implication is that capital markets do not correctly adjust prices to the information contained in quarterly earnings announcements (Firth 1977:132).

Brown and Kennelly (1972)

The study of Brown and Kennelly examined the association between share price movements and quarterly earnings reports. The results of their study showed that abnormal returns can be earned by using the information contained in such reports (Henderson *et al.* 1992:298,299).

Joy, Litzenberger and McKnally (1977)

The Joy *et al.* study showed that favourable information contained in quarterly earnings announcements is not instantaneously reflected in share prices. They concluded that price changes after the announcements are influenced by the size of the unexpected announcements (Van Rhijn 1994:35,36).

Foster (1977), Brown and Hancock (1977) and Brown, Finn and Hancock (1977)

Foster's study showed significant movements in prices on the day before the announcements as well as on the day of the announcement. Similar results to those of Foster (1977) were obtained in the 1977 Australian studies by Brown and Hancock, and Brown, Finn and Hancock (Henderson *et al.* 1992:299).

Ball (1978)

The results of Ball's study indicate that abnormal returns can be earned through trading based on quarterly earnings reports, but he concluded that this is due to problems with the asset pricing model rather than an indication of market inefficiency (Van Rhijn 1994:36,37).

Watts (1978)

Watts reviewed Ball's 1978 study and stated that the abnormal returns were in fact due to market inefficiency and not misspecification of the asset pricing model (Van Rhijn 1994:37). The study of Watts covered the period 1962 to 1968 and he found that abnormal returns could only have been earned in the 1962 to 1965 period. Thereafter no significant abnormalities were observed, which suggests that the market had adjusted to the inefficiency and that it is reasonable to assume that it will not recur after 1965. Further, the abnormal returns during the 1962 to 1965 period were insufficient to cover transaction costs and, thus, Watts concluded that it is not reasonable for investors to expect to earn abnormal returns based on quarterly earnings announcements (Keane 1983:54,55).

b. The firms size effect

Banz (1981) and Reinganum (1981)

Both studies showed that small firms consistently provide investors with larger returns than do large firms. Neither study attempted to provide a reason for this phenomenon, although both contended that it is not due to market inefficiency, but rather due to misspecification of the CAPM. Reinganum also contended that the size effect provides an explanation for the price/earnings effect (Dobbins *et al.* 1994:111,113; Van Rhijn 1994:38,39).

Dimson (1979) and Roll (1981)

Dimson and Roll also noted the small firm effect, but both contended that this phenomenon is due to the incorrect measuring of small firms' risk. Standard risk measures do not take into account the infrequent trading of small firms' shares, leading to the understatement of their risk (Keane 1983:55,56; Van Rhijn 1994:39).

Reinganum (1982)

This study by Reinganum supports the results of the Dimson (1979) and Roll (1981) studies, but he found that the underestimation of risk does not completely explain the small firm effect (Keane 1983:56; Van Rhijn 1994:40).

Various studies

Several studies also found evidence supporting the size effect, whereby shares of small firms outperform those of large firms. These studies include those of **Ibbotson and Sinquefield (1982), Blume and Stambaugh (1983),** and **Braun, Kleiden and Marsh (1983)** in Australian markets, **Berges, McConnell and Schlarbaum (1984)** in Canadian markets and in Japan by **Nakamura and Terada (1984)** (Sharpe 1985:403,404; Dobbins *et al.* 1994:111,112).

c. The price/earnings (P/E) effect

Basu (1977)

The results of Basu's study showed that firms with low P/E ratios tend to yield higher returns than expected. This would imply that there is a relationship between the historical P/E ratio and future market performance. Obviously, this is in conflict with market efficiency since this provides investors with the opportunity to earn abnormal returns (Dobbins *et al.* 1994:113; Van Rhijn 1994:37,38).

Various studies

The studies of **Nicholson (1968)** and **Oppenheimer and Schlarbaum (1981)** confirm the P/E effect. **Reinganum (1981)** clearly showed that the P/E and size effects are closely related and that it is difficult to separate the impact of these two effects (Keane 1983:55; Dobbins *et al.* 1994:113).

d. The weekend effect

Cross (1973)

An early study that showed that returns on capital markets are not random was that of Cross, who found significant lower returns for the period between the close of the market on Fridays to the close of the market on Mondays (Rees 1995:179).

French (1980)

The study of French also found evidence of the weekend effect and the results showed that returns on shares are abnormally high on Fridays and, opposed to this, returns are negative on Mondays (Ross *et al.* 1990:353).

Rogalski (1984)

Rogalski's study showed that markets on average fall over the weekend. He found that the weekend effect is too small too exploit by selling shares just before the close of the market on Friday and then buying them at a lower price on Monday. Rogalski did, however, find that it would be wise not to buy shares on Friday afternoons or to sell shares early on Monday mornings (Sharpe 1985:408).

e. <u>The January effect</u>

Rozeff and Kinney (1976)

The research of Rozeff and Kinney showed that share prices tend to fall towards the end of the year and start to rise in January (Dobbins *et al.* 1994:114).

Keim (1983)

Keim found a significant relationship between the size effect and the January effect. The study found that small firms show abnormally high returns in January, especially during the first five days of January. Further, it was shown that approximately 50% of the size effect occurs during January (Ross *et al.* 1990:353; Dobbins *et al.* 1994:114).

Roll (1983)

Roll's study confirmed the existence of a January effect. In addition to this, the results showed that firm size has an additional effect in January (Van Rhijn 1994:45).

Grossman and Sharpe (1984)

Grossman and Sharpe found a significant effect for small firms during January. The results seem to indicate that the entire small firm effect occurs during January, in particular on the last day of December and the first four days of January (Sharpe 1985:405).

DeBondt and Thaler (1985)

The study of DeBondt and Thaler confirmed the existence of the January effect and, in addition, identified another aspect, other than the size effect, that occurs in conjunction with the January effect. They found that portfolios consisting entirely of shares that had performed poorly during the preceding year show excess returns during January, while portfolios of shares that had performed well earn less than the market average during January (Dobbins *et al.* 1994:116).

f. Other calendar effects

Various studies

Other calendar anomalies that have been identified are small and cannot be profitably exploited by investors due to the transaction costs involved. However, they still provide evidence against market efficiency and include irregularities related to the time of day, the study of **Harris (1986)**, and the day of the week, the studies of **Gibbons and Hess (1981)**, **Lakonishok and Levi (1982)**, **Keim and Stambaugh (1984)** and **Jaffe and Westerfield (1985)** (Dobbins *et al.* 1994:115,116).

g. Price to book value/Book value to market value (BV/MV) ratio

Rosenberg, Reid and Lanstein (1985)

Rosenberg *et al.* identified another irregularity which is closely related to the small firm and price/earnings effects. They found that investors can earn abnormal returns if they invest in firms which have a low share price to book value of shares ratio (Dobbins *et al.* 1994:113).

h. Market volatility

Various studies

Schiller (1981) investigated the reaction of the market to changes in dividends. In efficient markets, share prices should change with the release of new information, but Schiller found that the market does not act correctly and that this leads to excess volatility in share prices (Keane 1983:64; Ross *et al.* 1990:352,353; Dobbins *et al.* 1994:126). **Le Roy and Porter (1981)** found evidence that supported Schiller's conclusions regarding excess volatility. Studies by **Flavin (1983)**, **Marsh and Merton (1986)** and **Kleidon (1986)**, however, criticised the results obtained by Schiller (1981) as being a result of limitations in the model applied (Dobbins *et al.* 1994:126).

French and Roll (1986)

The study of French and Roll examined market volatility on the New York Stock Exchange (NYSE) during a period in 1968 when the market was closed on Wednesdays. They found lower volatility on Wednesdays when the market was closed, which suggests that market volatility is due to trading rather than to the release of new information. This finding is not consistent with market efficiency (Dobbins *et al.* 1994:116).

Although some of the anomalies identified cannot be profitably exploited by investors, the existence of anomalies is puzzling and casts doubt on market efficiency, especially on the semi-strong version of the EMH.

Dobbins *et al.* (1994:121) conclude that the stock market crash of October 1987 suggests that capital markets are irrational and cannot be considered to be consistently efficient. Markets around the world fell by nearly one-third, although no major release of new information (bad news) took place during the days preceding the crash.

A limited number of South African studies have also addressed the issue of the efficiency of the JSE, that is, the JSE Securities Exchange SA [previously known as the Johannesburg Stock Exchange (JSE)], and to date no definite conclusions can be reached from these studies as regards the level of efficiency of the South African market. The following is a summary of the results of some of the studies.

Affleck-Graves and Money (1975)

These researchers studied industrial shares and concluded that, even though the price changes are not totally independent, the JSE is at least weak form efficient (Van Rhijn 1994:7).

Gilbertson and Le Roux (1977)

Gilbertson and Le Roux studied both the performance of trading rules and mutual funds. They found that the trading rules do not outperform a buy-and-sell strategy, nor can the mutual funds consistently outperform the market. They concluded that the evidence from their study support the efficiency of the JSE at both the weak and semi-strong levels (Linley 1992:14; Van Rhijn 1994:22).

Gilbert and Vermaak (1982)

The Gilbert and Vermaak study also investigated the performance of mutual funds and found that the JSE is not efficient in the strong form (Linley 1992:14).

Knight and Affleck-Graves (1983; 1985)

The 1983 study on market efficiency and the change to LIFO found the JSE to be inefficient at the semi-strong level since the market did not react correctly to the change in accounting earnings. In their 1985 study, however, Knight and Affleck-Graves found evidence supporting market efficiency and they concluded that the JSE is approaching efficiency at the semi-strong level (Linley 1992:14; Correia *et al.* 1993:143; Van Rhijn 1994:7,32,33).

De Villiers, Lowings, Pettit and Affleck-Graves (1986)

The De Villiers *et al.* study supported the findings on the size effect anomaly and concluded that the size effect also occurs on the JSE (Van Rhijn 1994:41).

3.5 SUMMARY

This chapter examined the main capital market theories - Portfolio Theory and the Efficient Market Hypothesis - and their impact on investment decision-making.

In the first section of this chapter investment on capital markets, the effect of risk, return and uncertainty, and the impact of utility theory on investment decision-making were examined. Through this it was established that risk is the major factor to consider when investing in capital markets and that it can be concluded that most investors prefer less risk to more and have diminishing marginal utility for wealth.

Portfolio Theory and the effect of diversification on investment risk and return were examined in the second part of the chapter. The results showed that diversification can reduce the level of risk of a portfolio and that the application of utility theory enables investors to construct optimal portfolios. Through the review of the research related to Portfolio Theory it was established that diversification does have definite investment value, even more so when done on an international scale.

The final section of this chapter examined the EMH and the implications of market efficiency for investment decision-making. The various degrees and forms of market efficiency, its implications and misconceptions together with certain anomalies were examined. In the last section, the extensive body of research related to market efficiency was reviewed. The results of the tests and research done showed that, for the most part, capital markets are efficient at a weak and semi-strong level but not at a strong level. Certain anomalies identified still require further investigation.

The next chapter focuses on the main pricing models that can be used to quantify the risk and other factors related to specific investments. These models are used to derive expected returns on investments and hence to provide a decision framework for investment decisions.

CHAPTER 4

THE DEVELOPMENT OF PRICING MODELS

4.1 INTRODUCTION

Sharpe (1985:xix) notes that, although the field of investments continues to be revolutionised, before the 1950s there was a lack of a theory of the formulation of prices and capital markets.

Since then, development of Portfolio Theory and the Efficient Market Hypothesis, as examined in Chapter 3, have contributed to our understanding of the risk/return relationship, how capital markets behave and how prices on capital markets are established. Three other important aspects which have contributed to our understanding of investment on capital markets and the formulation of prices will be examined in this chapter. These are the Capital Asset Pricing Model (CAPM), the Arbitrage Pricing Theory (APT) and options theory, with its related Black-Scholes (B-S) Option Pricing Model.

The first section of this chapter is concerned with the CAPM which, according to Harrington (1993:1), has made a fundamental contribution to financial theory and, together with Portfolio Theory, changed the way investors, analysts, fund managers and academics thought about investment management.

The CAPM attempts to explain the trade-off between risk and return in efficient markets and provides a model of the equilibrium risk/return relationship (Sharpe 1985:xix; Harrington 1993:1). It uses beta as a measure of risk and as a basis for establishing expected returns. The CAPM has been the subject of a tremendous amount of empirical research and it was through empirical difficulties experienced and empirical anomalies identified that an alternative theory of asset pricing was developed (Blume 1993:6,8).

The second section deals with this alternative asset pricing theory, the APT, which suggests that returns are a function of various macro-economic risk factors and not only one, beta, as suggested by the CAPM (Arnott 1993:16).

No clarity currently exists about which model is superior, the CAPM or the APT, but as Sharpe (1985:xx) notes, it is not necessary to choose one above the other, they may both hold at the same time. Both have strengths and weaknesses and only time and empirical work will determine whether either, or both of them are validated or discarded.

Hodges (1988:4) identifies another aspect of the continuing revolution in the field of investments and that is the development of markets for options. The third section, therefore, concentrates on options markets and the option pricing model developed by Black and Scholes. Their model, the B-S model, was the breakthrough that was required to improve understanding of share-options as investment alternatives and as a hedge against risk.

An important element of this chapter's examination and review will be the role of empirical research in the development of these theories and models. Both Sharpe (1985:xx) and Hodges (1988:4) note that research facilitated much of the recent developments and that research is a key element of investment management.

4.2 THE DEVELOPMENT OF THE CAPITAL ASSET PRICING MODEL

The CAPM has been developed to measure the relevant risk of securities and to describe the relationship between the risk and expected return associated with investments. Although the CAPM has a number of simplifying assumptions, the importance of the model does not lie in the realism of its assumptions, but rather in how well it predicts and describes reality. If empirical evidence confirm that the CAPM is successful in explaining the returns on risky assets, then it can be concluded that the model is useful and the realism of its assumptions is thus of less importance (Jones 1998:226).

Two important relationships are associated with the CAPM, namely the capital market line (CML) and the security market line (SML). The CML depicts the relationship between total risk and expected return, while the SML depicts the relationship between systematic risk and expected return. Both the CML and SML apply to individual shares as well as portfolios. The SML is the graphical depiction of the parameters of the CAPM and can be used to identify under- and overvalued securities (Jones 1998:230,247).

The CAPMs main conclusions are that there exists a positive relationship between risk and return and that the relevant risk for a share can be measured by its effect on portfolio risk. To assess the validity of these conclusions, and of the theory as a whole, requires that empirical testing be performed and there exists an extensive literature as regards to testing of the CAPM (Jones 1998:241).

In the following sections on the development of the CAPM all of these aspects are examined, that is, the nature and assumptions of the CAPM, how the CAPM assesses risk, the parameters of the CAPM, the CML and SML, the tests and validity of the CAPM, how the CAPM can be employed in investment decision-making, and the evidence from empirical research done on the CAPM.

4.2.1 The nature of the CAPM

The development of the CAPM is generally ascribed to the work of Sharpe (1964), although Treynor (1961), Lintner (1965) and Mossin (1966) made important, though independent, contributions. Using the implications of Markowitz's (1952) work in the development of a theory of portfolio selection, they established an equilibrium model for the pricing of assets and this model, the CAPM, is mostly used to price the shares traded on capital markets (Casabona 1979:7; Bradfield *et al.* 1988:11).

The CAPM provides a simple, but powerful, description of the relationship between risk and return in efficient markets. It is based on several simplifying assumptions and with its focus being on the relationship between risk and return, it assumes firstly that all investors view the risk and expected return characteristics of individual shares in the same manner. Other assumptions include that transaction costs can be ignored; investors have homogeneous beliefs; investors have access to the same information and analyse it in the same way; shares are divisible and liquid; investors can borrow and lend at the risk-free rate of interest; taxes have no real effect on investment in shares; and investors are only concerned about two aspects of investments, namely risk and return (Sharpe 1985:148; Blume 1993:6).

According to the CAPM the best portfolio is one that is fully diversified and in which each share is held in proportion to its value in the market. The expected risk premium (the expected return on the market minus the risk-free interest rate) on each share is proportional to the expected risk premium on the market and the constant of proportionality (beta) is related to the covariance of the returns of the individual shares with the returns on the market portfolio (Blume 1993:6).

If the CAPM is an accurate description of capital markets it is easy to establish the relationship between risk and return for efficient investment strategies. This relationship can be demonstrated graphically and is known as the capital market line (CML). The CML provides a relationship between expected return and risk, as measured by the standard deviation of returns, for efficient portfolios and the slope of the CML can be seen as representing the reward for every unit of risk borne (Sharpe 1985:152,153).

Since the CAPM considers beta as the accurate measure of risk, every share and portfolio are expected to plot on an upward-sloping straight line and this relationship between risk and return is known as the security market line (SML). The SML is a key implication of the CAPM and represents an equilibrium theory of the expected returns on shares (Sharpe 1985:160-162).

Since the CAPM is an expectational theory (it makes assertions about the expected returns on shares and the future value of risk (beta)), it is difficult if not impossible to test whether it describes reality. Historical data are usually used as surrogates for future expectations in testing the CAPM. Only if the expected returns and the value of beta remain constant over a long period of time, and if actual returns conform to these predictions, can the historical data be used with success in establishing the validity of an equilibrium theory such as the CAPM (Sharpe 1985:393).

Such tests are joint tests of the CAPM and the assumptions about the stability of the predictions, together with the conformance of the actual results with the predictions. Sharpe (1985:394) concludes that:

> If such a test fails, it may indicate that the equilibrium theory is in error. Alternatively, one or more of the other assumptions may be inappropriate. As a practical matter, such procedures cannot reject an equilibrium theory. They can, however, provide suggestive evidence.

The original CAPM makes strong assumptions and has significant implications for investment decision-making. Since its development, various extended CAPMs have been proposed and these extensions posit that expected returns are not only related to beta, but also to additional risk factors (Sharpe 1985:173,199).

A theoretical examination of these extended models, and the research done thereon, largely falls outside the scope of this study. This is not a study of the CAPM itself, but rather of the various capital market theories and pricing models and how research thereon has contributed to the development of accounting theory.

Broadbent (1992:10) concludes that empirical research suggests that the CAPM is a useful tool for investment decision-making, as long as investors hold well-diversified portfolios. However, before the research on the CAPM can be reviewed and conclusions drawn from it, it is necessary to examine all aspects of the CAPM and their implications. The discussion commences with a review of the assumptions underlying the model.

4.2.2 Assumptions of the CAPM

The CAPM relies on a number of simplifying assumptions, some of which are unique to the CAPM, while others also underlie the EMH and Portfolio Theory. In order to derive the CAPM, the following assumptions are required:

- All investors are rational, risk-averse and have the objective of maximising the expected utility of their wealth at the end of their investment period. This assumption is required in order to describe investor behaviour. Investors' utility of wealth depends on their specific risk and return preferences (Harrington 1987:26-28; Seneque 1987:29).

- Investors base their investment decisions purely on the criteria of expected return and risk. This assumption is necessary in order to describe how investors select investments so as to maximise their utility of wealth. Thus, investors are assumed to make their portfolio choices on the basis of the expected values of returns and standard deviations (or beta) of the returns (Harrington 1987:26,28; Elton & Gruber 1995:295).

- All investors have identical expectations with respect to risk and expected return. Without the assumption that investors agree on the market price of risk, a condition of capital market equilibrium, whereby all investments are efficiently priced with regard to the level of risk involved, will not exist (Harrington 1987:26,31; Elton & Gruber 1995:295; Jones 1998:227).

- Investors have a common single-period time horizon for decisions about investments and are assumed to have the exact same definition of this time-period. This facilitates comparisons over a common interval, since a single-period model like the CAPM requires that investors construct their investment portfolios at the same point in time and sell them at the same unidentified future point in time (Anderson 1978:69; Harrington 1987:26,33; Elton & Gruber 1995:295).

- Information relevant to the investment decision is costless and simultaneously available to all investors. Without the assumption that capital markets are efficient and that most investors are in agreement about the future prospects of shares, the CAPM cannot be applied effectively (Harrington 1987:26,36; Laing 1988:8; Viljoen 1989:23).

- A risk-free asset exists and investors can borrow or lend unlimited amounts at the risk-free rate of interest. This is a fundamental, and perhaps the most crucial, assumption underlying to the CAPM. This implies that investors are not concerned about the risk characteristics of individual shares, but rather how the risk of the portfolio is affected when a portion of the risk-free asset is added to the portfolio, or funds to invest in the portfolio are borrowed at the risk-free rate (Harrington 1987:26,36; Keogh 1994:17).

- There are no market imperfections, that is, no transaction costs, no rules placing restrictions on short sales and dividend income and capital gains are not subject to different rates of taxation (Harrington 1987:26,42; Seneque 1987:29). According to Keogh (1994:17) this allows investors to be treated equally as no-one would be able to take advantage of these imperfections. Elton and Gruber (1995:295) state that transaction costs are probably not important and will only make the model more complex, and that the major results of the model will hold if taxes on income and capital gains are not the same.

- There are a fixed amount of shares, meaning that new issues of shares can probably be ignored (Harrington 1987:25,45). Secondly, shares are infinitely divisible and thus investors can construct any portfolio, regardless of their wealth (Elton & Gruber 1995:295). Thirdly, the shares are marketable, that is, they are liquid and can be bought and sold at the ruling price (Oosthuizen 1992:11).

- There are many investors and no single investor is able to affect prices through individual buying or selling decisions. Also, since investors are price-takers, they act as if prices are not affected by their own buying or selling decisions (Elton & Gruber 1995:295; Jones 1998:227).

Both Elton and Gruber (1995:295) and Pike and Neale (1996:89) state that several, if not most, of these assumptions are unrealistic and do not hold in the real world. It should, however, be noted that the CAPM is an expectational model and should not be judged on the realism of its assumptions, but rather on how well it explains reality and predicts expected behaviour (Harrington 1987:27; Seneque 1987:29). Pike and Neale (1996:279) add, further, that the CAPM has stood up well to the relaxation of many of these assumptions and that the apparently unrealistic assumptions have no significant negative effect on its implications. Elton and Gruber (1995:295) conclude that it is not how realistic the assumptions of the CAPM are, but rather how well it describes capital markets and the performance thereof.

Before any significant conclusions regarding the CAPM can be reached, it is first necessary to examine its parameters and how it measures risk. These will be examined in the following two sections of this chapter, whereafter its implications, namely the capital market line and the security market line, will be discussed. This leads to the final and most important sections of this examination of the CAPM, namely, its implications, tests of the model, its validity and the research related to the model.

4.2.3 Risk and the CAPM

The CAPM defines risk as the extent to which the share's return covary with the return on the market, that is, beta (as the designated risk measure) measures the volatility of the share's return relative to the return on the market portfolio (O'Brien & Srivastava 1995:15).

From Portfolio Theory and the effect of diversification, it is known that the systematic risk is the only element of risk that is priced and rewarded, and beta is a measure of the systematic risk that cannot be diversified away. Beta, therefore, is a relative measure of risk - it is an estimate of the risk of a share relative to the risk of the market portfolio. That is, beta is a measure of a share's volatility (fluctuations in price) and estimates how the share or portfolio's expected return will move relative to the market portfolio's return (O'Brien & Srivastava 1995:16; Jones 1998:234).

Portfolio beta, as with expected return, is simply the weighted average of the betas of the individual shares contained in the portfolio. The market portfolio has a beta of 1, while more risky investments have betas higher than 1 and less risky investments have betas lower than 1. Thus, for shares or portfolios with more or less risk than the market portfolio, the returns would be proportionally higher or lower than the market return (Harrington 1987:17; Jones 1998:235).

It can be concluded from Jones (1998:236) that the CAPM provides an elegant, yet simple, risk/return relationship. This relationship between beta and return states that investors expect the return on shares to be equal to the risk-free return plus a risk premium, and the greater the risk the greater will be the risk premium. The next section examines these individual components (parameters) of the CAPM.

4.2.4 Parameters of the CAPM

Implementation of the CAPM requires estimates of the following variables:

- The risk-free rate of return.
- The expected return on the market.
- The beta coefficients for individual shares.

4.2.4.1 <u>The risk-free rate of return</u>

The risk-free rate of return should have no variance and no covariance with the return on the market, that is, it should be the return on an asset with no risk. Such assets are difficult to find and there is some doubt that such assets actually exist, meaning that various proxies are used. These proxies, for example, government bonds and treasury bills, have been found to be empirically inadequate and theoretically suspect since they are subject to uncertainty and inflation, and as such do have a degree of variance and covariance with the market. These proxies have a further problem, namely, the historical period to use as the period that would be most representative of the future (Firer 1993:27, Rees 1995:170).

4.2.4.2 <u>Return on the market</u>

The market return should be the return on a market portfolio that includes all risky assets and, again, there is doubt that such a market portfolio is ever likely to exist. Usually a market index is used as a proxy for the market portfolio, but the problem still remains - which index and historical period to use as proxy for the future (Firer 1993:31).

Rees (1995:170,171) identifies two approaches that are used to estimate market returns. The first, and most widely used, approach is to select some market index as a proxy for the market portfolio and then to use long periods of historical data to eliminate any short-term movements. This approach provides estimates of the market proxy's return that are generally stable and reliable. The second approach is more expectational and uses forecasts from market analysts of individual share returns to estimate market returns. This approach requires a considerable investment in data collection as input for a model to forecast the market return, and is for this reason rarely used.

4.2.4.3 Beta

The third parameter, beta, is crucial to the CAPM and it brings together investors' expectations of returns and those of the market (Jones 1998:238). There are a number of factors to take into account when estimating the betas for individual shares.

- A stock market is usually used as a proxy for the market as a whole when estimating beta and this may not fully reflect the market portfolio as required by the CAPM (Harrington 1987:103; Jones 1998:240).

- The use of a stock market index as a proxy for the whole market, which in turn is a proxy for the whole market portfolio of all risky assets, is a major compromise of the specifications of the CAPM (Harrington 1987:103; Jones 1998:240).

- A third aspect relates to the stability of beta over time. Historical betas are used to make estimates of future betas, and whether historical betas are good estimates to use in an expectational model, remains a mute point. Empirical studies have generally shown that portfolio betas derived from historical data are useful estimates of future betas (Harrington 1987:99; Firer 1993:25; Rees 1995:169).

  According to Sharpe (1985:170) using a share's historical beta without change, as an estimation of its future beta, is an extreme assumption. Historical betas are therefore, in practice, adjusted or used in conjunction with other information when estimates of future betas are made.

- Estimates of beta using historical data vary substantially, depending on the number of observations used in the calculation, the length of the time periods used and the presence of outliers. There is no correct time period or number of observations and estimates can vary from weekly to monthly rates of return over 30 years to periods that are five years and even less. Using a large number of observations result in less variation in betas, but there is also the likelihood that betas will not remain constant over long periods of time (Rees 1995:167; Jones 1998:240).

- The estimates of future betas are only estimates and may not be equal or close to the actual true betas (Jones 1998:240).

- Beta will not remain perfectly stable over time. Beta will change as the fundamental variables such as cash flows and earnings of companies change, and thus beta will always have a degree of instability (Jones 1998:240).

- The procedure in obtaining reliable estimates of beta is statistically taxing and investors are well advised to make use of professional beta services. Such services are available both in South Africa and internationally and are preferable to ad hoc estimates of beta (Firer 1993:25).

Firer (1993:25) notes that, due to the estimation problems, it is not possible to apply the CAPM in its pure form and provides the following summary of the estimation problems.

> In order to obtain an estimate for beta, the stock's returns should theoretically be regressed against an index representing all risky assets in the world. No such index exists and so a "true" beta cannot feasiblely be obtained. Even the existence of a truly riskless asset is questionable. Thus surrogates must be sought for the CAPM parameters - a segment of the "world index" for which an index can be found, and a financial instrument closest to the risk-free ideal.

Before the tests of, and research on the parameters of the CAPM can be reviewed, it is necessary to consider how the CAPM defines the risk/return relationship. In the next two sections the concepts "capital market line" and "security market line", which graphically describe this relationship, will be examined.

4.2.5 The concept "capital market line"

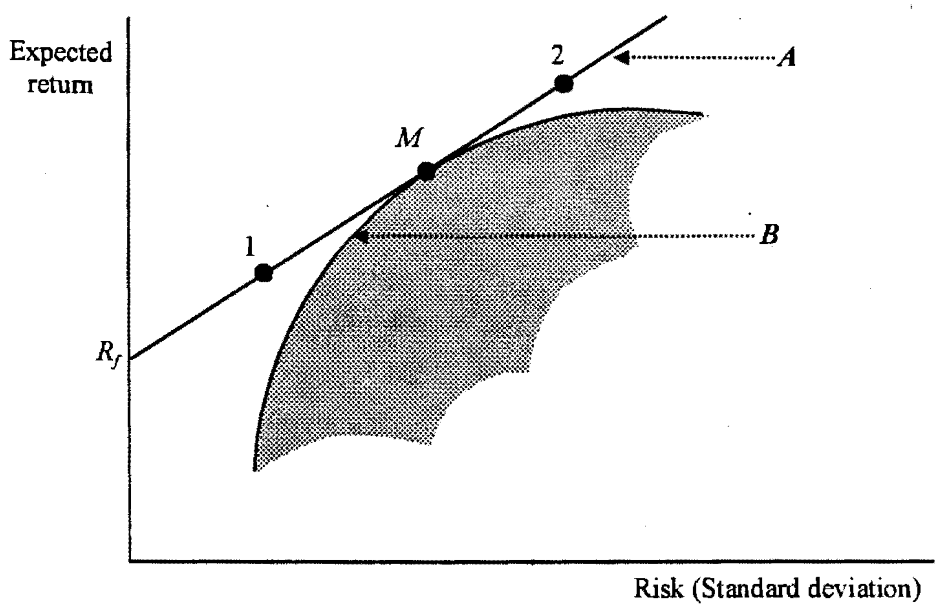
When the assumption regarding the existence of a riskless asset is added to the efficient frontier, as defined by Portfolio Theory, the number of investment opportunities available to investors are increased and a new and more efficient frontier is created. By being able to borrow or lend at the riskless rate, and combining these with investment in the market portfolio, investors are able to implement investment strategies that provide more return for the same level of risk, or less risk for the same level of return, than with the Portfolio Theory efficient frontier (Firth 1977:89; Harrington 1987:14).

Firth (1977:89,90) notes that the capital market line (CML) provides investors with the following investment strategies:

- The investor can lend (invest) all his funds available for investment at the riskless rate.
- The investor can lend (invest) a part of the funds in the riskless asset and invest the balance in the market portfolio.
- The investor can invest all his funds in the market portfolio.
- The investor can borrow funds at the riskless rate and use these funds, in conjunction with his own funds, to invest in the market portfolio.

The capital market line (CML) and its resultant investment strategies are illustrated in figure 4.1.

Figure 4.1 ***The capital market line***



where:

A = Capital market line (CML)

B = Efficient frontier

M = Market portfolio

R_f = Risk-free rate

Source: Viscione and Roberts (1987:195) and Ross *et al.* (1990:276).

The CML shows the risk/return relationship from combining lending or borrowing at the risk-free rate with investing in the market portfolio. The returns that can be achieved by combining investing in the market portfolio and investing in the risk-free asset or borrowing at the risk-free rate, represent the most efficient portfolios and describes the risk/ return relationship for all shares traded in the market (Drury 1992:400).

The investment strategy an investor will select depends on his risk/return preferences. An investor who is risk averse will combine investment in the risk-free asset with investment in the market portfolio - as indicated by point 1 on the CML. Against that, an investor who is prepared to accept more risk will combine investing in the market portfolio with borrowing at the risk-free rate - as indicated by point 2 on the CML. Point 2 renders a higher expected return, but is subject to a higher level of risk (Firth 1977:90).

Jones (1998:230-232) gives an extensive analysis of the CML and the main aspects to note are the following:

- The slope of the CML indicates the additional amount of return the market demands for each percentage increase in the risk of a portfolio and as such represents the equilibrium price of risk in the market.

- Only efficient portfolios that consist of both the risk-free asset and the market portfolio lie on the CML, that is, all the combinations of the risk-free asset and the market portfolio that lie on the CML are efficient portfolios.

- Since the CML describes conditions under equilibrium, it must always be upward sloping, because the greater the risk the greater the return, that is, the market price of risk is always positive.

- However, on an *ex post* (after the fact) basis the CML can for a period be downward sloping where the return on the risk-free asset is greater than the return on the market portfolio. This does not make the CML invalid, but merely shows that actual returns differ from those expected. Thus, although the *ex ante* (before the fact) CML must always be upward-sloping, expectations are not always realized and it can sometimes be downward sloping on an *ex post* basis.

- The CML shows the expected return for each level of risk and can as such be used to measure the optimal expected return for various portfolio risk levels.

According to Firth (1977:91,92) the CML holds for efficient portfolios, but does not describe the relationship between expected returns on individual shares or inefficient portfolios and their risk, as measured by beta. The relationship between beta and expected return is called the security market line (SML) and will be considered in section 4.2.6.

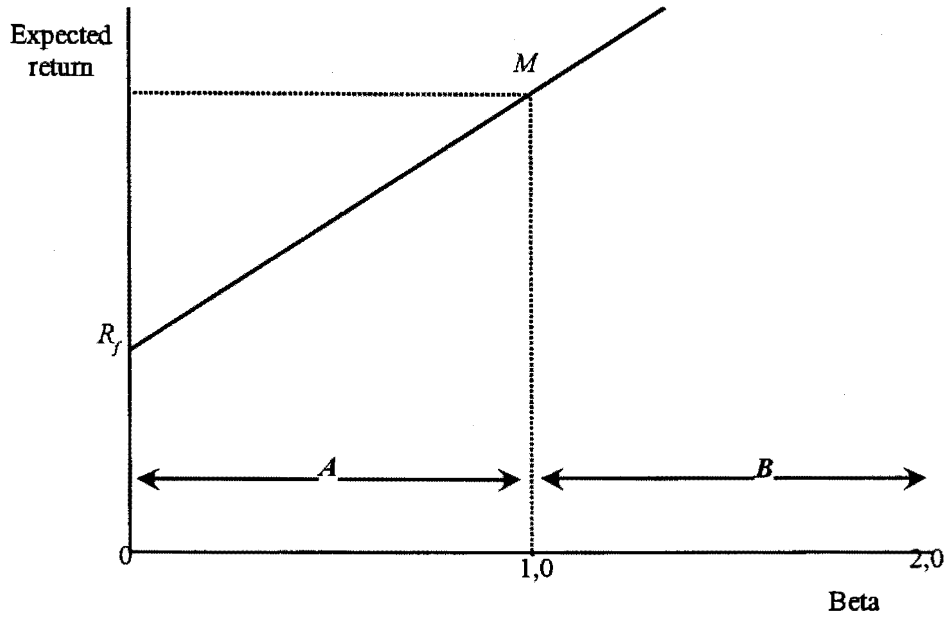
4.2.6 The concept "security market line"

The security market line (SML) differs from the CML in the following ways:

- The CML depicts the risk/return trade-off for efficient portfolios only.
- The SML depicts the risk/return trade-off for all assets, including individual shares, efficient portfolios and inefficient portfolios.
- Standard deviation appears on the horizontal axis of the CML, while it is beta that appears on the horizontal axis of the SML.
- The SML provides an unique relationship between systematic risk (as measured by beta) and expected return on investments (Ross *et al.* 1990:287; Weston & Copeland 1992:403; Jones 1998:232,233).

According to Pike and Neale (1996:274) the CAPM postulates that all shares are correctly priced and that the SML gives the relationship between risk and return under these conditions of market equilibrium. This relationship between beta and expected return is depicted in figure 4.2.

Figure 4.2 *The security market line*



where:

A = Shares/portfolios that are less risky than the market portfolio (beta < 1,0)

B = Shares/portfolios that are more risky than the market portfolio (beta > 1,0)

M = Market portfolio

R_f = Risk-free rate

Source: Sharpe (1985:161) and Jones (1998:234).

4.2.6.1 Characteristics of the SML

Ross *et al.* (1990:285,286) and Keogh (1994:27,28) identify the following characteristics that can be associated with the SML:

- The expected return on a share with a beta of 0 is equal to the risk-free rate.
- The expected return on a share with a beta of 1 is equal to the return on the market portfolio. The beta of the market portfolio is 1 since the market portfolio represents the average beta of all shares, weighted according to the proportion of each share's market value to the value of the total market portfolio.

- The SML is an upward sloping straight line depicting a linear relationship between beta and expected return. Beta is the appropriate measure of risk and high-beta shares will have a greater expected return than low-beta shares.
- Shares not lying on the SML are mispriced. Shares above the line are underpriced and those under the line are overpriced, and under conditions of equilibrium it is expected that these prices will adjust so that the SML becomes straight, that is, depicting a linear relationship between risk and return.
- The SML is a graphical depiction of the CAPM. The equation for the CAPM is represented by formula 4.1.
- The SML, and thus the Capital Asset Pricing Model, holds for both portfolios and individual shares.

The CAPM is a model of equilibrium prices for shares and portfolios in efficient markets, and the expected return on these shares and portfolios is equal to the return on the riskless asset, plus the beta of the security or portfolio times the market risk premium (Hendriksen & Van Breda 1992:183).

Formula 4.1 ***The capital asset pricing model***

$$R = R_f + \beta\left(R_m - R_f\right)$$

where:

R = Expected return on the share/portfolio

R_f = Risk-free rate

β = Beta (volatility of the share/portfolio relative to the market portfolio)

R_m = Expected return on the market portfolio

$R_m - R_f$ = Market risk premium

Source: Harrington (1987:17), Ross *et al.* (1990:286) and Jones (1998:235,236).

Gay (1982:14) summarises the major implications of the CAPM as being:

- The risk/return relationship is positive and linear.
- That systematic risk, as measured by beta, is the only relevant risk that affects a share or portfolio's return.

4.2.6.2 Alpha (under- and overvalued shares)

In equilibrium all shares are correctly priced and under conditions of equilibrium prices of shares or portfolios should lie on the SML. If a share or portfolio does not lie on the SML, a situation of disequilibrium exists, it means that the share or portfolio is mispriced and the extent to which the share or portfolio is mispriced, is measured by its alpha value (Sharpe 1985:163).

A share or portfolio's alpha value represents the difference between its expected return and the appropriate (equilibrium) expected return. A positive alpha value indicates that the share or portfolio is underpriced, that is, its expected return is greater than the appropriate expected return for investments with similar attributes. Against that, a negative alpha value indicates that the share or portfolio is overpriced, while an alpha value of zero indicates that the share or portfolio is correctly priced (Sharpe 1985: 163,164).

The equation for the calculation of alpha is shown by formula 4.2.

Formula 4.2 ***Alpha***

$$\alpha = E - E^{e}$$

where:

α	=	Alpha value
E	=	Expected return on the share/portfolio
E^{e}	=	Appropriate (equilibrium) expected return on the share/portfolio

Source: Sharpe (1985:164).

Alpha implies that investors and investment managers who try to outperform the market hope to construct portfolios with positive alpha values, that is, construct portfolios that are underpriced. Those who do not attempt to outperform the market will try to construct portfolios with alpha values of zero, while those who make incorrect judgements construct portfolios with negative alphas, that is, construct portfolios that are overpriced (Sharpe 1985:165).

The previous sections of this chapter examined the theory behind the CAPM. In the next section its validity will be investigated, including tests and areas to be tested to establish its validity, that is, whether it is realistic and whether it provides a good description of the behaviour of capital markets.

4.2.7 Tests and validity of the CAPM

Several criticisms have been directed at the CAPM. One area of criticism is noted by Keogh (1994:36), namely, that the assumptions underlying the CAPM are unrealistic and, hence, that it cannot predict capital markets in a practical (real world) manner. Harrington (1987:52) and Rees (1995:173) identify two other areas of criticism. Firstly, the CAPM may be misspecified, that is, the model is wrong and the actual risk/return relationship is not linear. Secondly, the CAPM is inadequate, that is, the model does not include all the factors relevant to the pricing of assets.

4.2.7.1 Validity of the assumptions of the CAPM

According to Harrington (1987:35,47) the assumptions underlying the CAPM are clearly unrealistic and most, if not all, are violated in the real world. Without examining each assumption individually it can be stated, according to Anderson (1978:80), that if the assumptions were to be relaxed, the theoretical market equilibrium conditions cannot be reached and as a consequence there will not be a true CML and efficient frontier for all investors.

Asset prices will only adjust to a level where proportional returns approximate the total risk associated with the asset, resulting in investors having many alternative combinations of efficient portfolios. The result of this is that there will be a number of tangencies between the CML and the efficient opportunity set (Anderson 1978:80).

Milton Friedman (1953), however, warned against judging a theory purely on the basis of the realism of its assumptions, unless the theory aims to provide an accurate description and explanation of behaviour. But, if the theory aims to provide predictions which can be tested against reality, the realism of the underlying assumptions is less important, especially in circumstances where the predictions can be shown to accord reasonably closely with reality (Pike & Neale 1996:285, 286).

It is therefore inappropriate to judge the CAPM on the basis of the realism of its assumptions. A more appropriate approach is to conduct empirical studies on the criteria of a good model, that is, does it have explanatory power and/or predictive ability? If it has either or both, then the model is useful and can be applied to improve decision-making (Firth 1977:96; Harrington 1987:35).

Before examining the tests of the CAPM, it is necessary to first look at difficulties in testing the model in order to establish the limitations of the tests and, hence, the limitations of the conclusions that can be drawn from the tests.

4.2.7.2 Problems with testing the CAPM

Three inherent problems with the tests, apart from the difficulties experienced with faulty or insensitive methodology, are generally emphasised:

- The CAPM is an expectational model, but most tests use realized (*ex post*) returns, since expected (*ex ante*) returns are not readily observable. This creates difficulties in that the model may actually hold for expected returns, although actual returns may cast some doubt on it (Viscione & Roberts 1987:204). Rees (1995:173) deems attempts to model investor's expectations using historical information (mostly as regards to estimating beta), or testing expectations against realizations, not to be direct tests of the CAPM.

- The CAPM relies on the existence of a risk-free asset and there is doubt that such an asset actually exists. The tests, therefore, depend on the specification of some measure to be used as a proxy for the risk-free rate of return (Viscione & Roberts 1987:204; Pike & Neale 1996:287).

- The CAPM requires that share returns be analysed against the market portfolio. Because such a portfolio does not exist, a proxy must be used and this could result in different SMLs, depending on the proxy used. Further, the index used as a proxy may be inefficient and thus distort the results of the tests. Hence, any ex-post test of the CAPM is as much a test of the validity of the proxy as it is a test of the model (Viscione & Roberts 1987:204; Rees 1995:173; Pike & Neale 1996:287).

The role of each of these aspects in testing the CAPM is now examined in more detail.

a. <u>Estimating beta</u>

The stability of beta over time has become an important issue in the tests of the CAPM. Historical betas are used as predictors of future betas and if beta remains relatively stable (unchanged) over time, these historical betas will be useful in estimating future betas. If, however, the historical betas are unstable and change substantially over time, then they will have little predictive value. Instability of beta may have a further effect, in that it can cause difficulty in interpreting the results of the tests and may even cause the results to be invalid (Firth 1977:98,100; Harrington 1987:118).

The problem of stability of beta can be divided into three elements, namely the choice of historical measurement period, the choice of length of interval within the chosen measurement period and the choice of market proxy to be used as the benchmark (Harrington 1987:109-115).

- **The measurement period.** The measurement period must be long enough to achieve a statistically significant result, but must not be too long so as to capture data that will not be relevant to forecasting the future. Unfortunately the CAPM provides no guidelines for choosing the measurement period, but studies have shown that the length of the period is important and that, in general, the longer the period the better the estimation of beta (Harrington 1987:109,110).

- **The choice of interval.** The length of the intervals within the chosen measurement period can also affect the estimates of beta. Again, the CAPM provides no guidelines and researchers have a choice between daily, weekly, monthly and quarterly intervals, among others. Studies have shown the interval period is important in order to obtain an adequate set of data, without including irrelevant data which may bias the beta estimates (Harrington 1987:110,114).

- **The choice of market proxy.** If the market index used as a proxy is not fully diversified and, hence, not a good reflection of the market portfolio, an incomplete distinction will be made between systematic and unsystematic risk. Due to the misspecification of systematic risk, this can result in incorrect and even useless estimations of beta values (Harrington 1987:114,115).

b. <u>Estimating the risk-free rate</u>

The risk-free rate is of equal importance to the other two parameters of the CAPM and is used twice in the model. Firstly, as the minimum expected return and, secondly, as one of the two components of the market risk premium. The choice of proxy should be carefully considered, since error in the estimation of the risk-free rate can cause a significant error in the estimation of the expected return on a share or portfolio (Harrington 1987:149).

c. <u>Estimating the return on the market</u>

Harrington (1987:167) identifies four problems with estimating the return on the market proxy, namely which index to use as the proxy; how the return should be calculated;

whether the index should be value or equally weighted; and the period over which the return should be calculated.

- **The choice of index as market proxy.** All share indexes are only fragments of the total market and usually consist of different kinds of shares. Hence, it is difficult, and probably impossible, to establish whether a particular index is an adequate proxy for the market portfolio (Harrington 1987:174,175).

- **Calculating the return.** Two methods are generally used to calculate returns, namely, the simple (arithmetic) average method and the compound (geometric) average method. Again, it is not known which method is best to use when looking at past performance to forecast a future return (Harrington 1987:167).

- **Value or equal weighting of the index.** There exists a choice between weighing each return in the index according to the market value of the share, or by simply averaging the returns in the index in order to calculate the return on the market. Again, there is some disagreement and it is not known which method is the more correct (Harrington 1987:168,170).

- **The time period.** Another dilemma is the choice of time period to use as a proxy for the future return on the market. Returns vary substantially between periods of bull markets and periods of bear markets. This also creates the problem of choosing the beginning and ending periods of the estimation period. Results can vary substantially when the period starts with a bear market low and ends with a bull market high, in comparison with starting high and ending low. It is therefore important to select a time period that, according to the investor or researcher's judgement, will best resemble the period expected to realize over the investment horizon. The time period chosen should, in general, exclude periods of high volatility and should be long enough to construct meaningful frequency distributions (Harrington 1987:170-173).

Despite these difficulties the CAPM has been the subject of a considerable amount of empirical testing (Rees 1995:173), and the following aspects have been the focus of the testing in order to establish whether the model has possible problems with mis-specification or inadequacy.

4.2.7.3 Tests of possible misspecification

Harrington (1987:56-77), Seneque (1987:30) and Linley (1992:15) describe five conditions which indicate whether the CAPM is valid, that is, not misspecified. These conditions are reviewed below.

There are two basic tests which can be performed to determine whether the CAPM is reliable:

- *Ex post* data is examined to establish whether the relationships are the same as those predicted by the model.
- Historical data is used to forecast the values of beta, the risk-free rate and the market return and these forecasts are then tested against more recent history to establish how well the CAPM predicts future behaviour (Harrington 1987:55; Linley 1992:15).

The results, constrained by the difficulties of testing the model, of the numerous tests conducted into the five conditions are summarised below.

a. Condition 1 - Does the CAPM describe reality?

Many studies have examined the stability of beta and compared historical data with data generated from simulated portfolios. Although the results from the tests on the stability of beta are not conclusive, it has been found that portfolios have more stable betas than individual shares. Tests using *ex post* data have also indicated that the risk/return relationship is not the same as that predicted by the CAPM (Harrington 1987:56,62; Seneque 1987:30,31; Linley 1992:16).

b. <u>Condition 2 - Is the relationship between risk and return positive and linear?</u>

Although the results of research have shown some nonlinearity, in general most of the evidence support a positive linear relationship between beta and returns for portfolios of shares. Where the tests of portfolios cover a long period of time (in excess of 10 years) the evidence tends to support the requirement of the CAPM that the beta/return relationship be positive and linear (Harrington 1987:62: Seneque 1987:31; Linley 1992:17).

c. <u>Condition 3 - Does beta measure risk?</u>

The beta coefficient should be equal to the excess return on the market and if the results of the tests do not accord with this requirement of the CAPM, beta may be an incorrect or insufficient measure of risk. Since it had been found that excess portfolio returns are less than predicted, the results of these studies generally cast doubt on this requirement (Seneque 1987:31; Linley 1992:17). According to Harrington (1987:64,65), if investors act as if though diversification removes all unsystematic risk and beta measures systematic risk, the CAPM may be ratified.

d. <u>Condition 4 - Is alpha zero or at least close to zero?</u>

The results of studies on this condition cast some doubt on the validity of the CAPM. Low-beta shares have been found to earn significantly higher returns than predicted, while high-beta shares earn significantly less than predicted (Seneque 1987:31,32; Linley 1992:18).

e. <u>Condition 5 - What does the choice of market proxy show?</u>

The use of an index that is not a suitable proxy of the market can provide incorrect information. If the market indexes do not correlate highly with the true market portfolio, betas will be affected and the slope and position of the SML will be different than specified. Although this means that all tests of the CAPM should be treated with caution, it does also cast doubt on the usability of the model in evaluating portfolio performance (Harrington 1987:77; Seneque 1987:32; Linley 1992:18).

4.2.7.4 Tests of possible inadequacy

An aspect that has received considerable attention is whether the CAPM is inadequate in its depiction of the pricing of assets, that is, whether there are other important factors that the model omits (Harrington 1987:79).

The CAPM is tested for inadequacy by adding other factors deemed relevant to the model in order to establish whether these additional factors provide better explanatory power, more stable parameters, or better diversification with fewer assets (Harrington 1987:79).

Listed below are some of the additional factors that have been added to the CAPM as a means of testing its adequacy.

a. The effect of dividends and taxes

The effect of dividends has always been considered as a factor that affect share prices, due to possible tax differentials between dividends and capital gains. Although some evidence of a dividend yield effect have been uncovered, it has been shown that this effect cannot be attributed to taxes, but rather to some other factors such as firm size (Harrington 1987:79; Bradfield *et al.* 1988:12,13). Hence, Harrington (1987:79,81) concludes that the effect of both dividends and taxes are as yet not clear and require further information.

b. The effect of firm size

The size effect is another factor that has received considerable attention and it has been shown that there is a significant relationship between the market value of shares and the returns on shares, that is, that small firms show long and persistent abnormal returns. However, it is not yet clear whether firm size is responsible for the effect, or whether it is only a proxy for some other factor affecting returns (Harrington 1987:83; Bradfield *et al.* 1988:13).

c. The effect of liquidity

The liquidity effect is related to the size effect, in that it can be expected that the shares of smaller firms will be less liquid than those of large firms. Although little evidence regarding the liquidity effect exists, it can be assumed that investors should require a higher expected return for less liquid shares as compensation for its limited marketability and higher cost of trading (Bradfield *et al.* 1988:13).

d. The effect of price/earnings (P/E) ratios

Studies on the effect of P/E ratios have shown that low P/E portfolios outperform and earn higher returns than high P/E portfolios (Linley 1992:16).

4.2.7.5 Summary

The basic results of the tests performed on the CAPM and their implications concerning the model's validity are summarised below.

- Beta appears to be related to past returns, has better explanatory power than the standard deviation of returns and the risk/return relationship appears to be linear and positive (Gay 1982:179; Linley 1992:19; Rees 1995:172).

- Low-beta shares tend to earn more than that predicted by the CAPM and high-beta shares tend to earn less (Gay 1982:178,179).

- The risk-free rate of return appears to be higher than expected, although this could be as a result of incorrect estimation rather than error with the CAPM, and the slope of the risk/return relationship is insufficiently steep (Rees 1995:172).

- Although systematic risk is found to be significant in explaining returns, other factors have also been found to have explanatory power and their inclusion in the model may improve its fit (Rees 1995:172).

It can, in general, be concluded that the CAPM is not misspecified and that it is therefore valid from this point of view, but investors should be cautious when applying it to evaluate investment performance. From a validity point of view, it appears as if the CAPM may be inadequate and that other factors and/or pricing models may provide a better description of the risk/return relationship (Seneque 1987:32; Linley 1992:18,19).

Following from this, the next section briefly examines how the CAPM can be applied in investment decision-making.

4.2.8 Application of the CAPM in investment decision-making

As noted in section 4.2.7, serious criticisms can be levelled at the CAPM. According to Harrington (1987:209) the following three criticisms severely restrict the practical application of the model in investment analysis.

- The assumptions underlying the model are unrealistic and, thus, the basic CAPM is flawed.
- Tests of the CAPM have shown that the model does not provide an accurate description of reality, and is as such flawed.
- Forecasts of the risk-free rate, the market return and beta are hampered by serious uncertainties and this may cause the CAPM to be of limited use in practice.

Despite these criticisms and practical problems associated with the tests of the CAPM, the model does have practical applications. Although application of the CAPM should be performed with care, corporate management, regulation of public utilities, portfolio management and share selection have been found to be areas where the CAPM can be applied with real practical use (Harrington 1987:210).

4.2.8.1 Corporate management

Harrington (1987:210) identifies three interrelated fields where the CAPM has, and continues to be, used by corporate management.

- Determining the hurdle rate for corporate investment.
- Estimating the required rates of return for divisions, business units and lines of business.
- Evaluating the performance of divisions, business units and lines of business.

a. Hurdle rates - Cost of capital

Management often uses the weighted average cost of capital (WACC) as the yardstick against which the expected returns of capital investment proposals are evaluated. The cost of equity is an element of the WACC and the CAPM is often used to calculate the firm's required return on equity (Harrington 1987:210).

b. Estimating the required rate of return

The CAPM can also play an important strategic planning role in assisting corporate managers in the implementation of a consistent and systematic method of risk analysis. The distinction between systematic and unsystematic risk, and the measurement of systematic risk using beta, are quite useful to corporate managers when applying risk analysis in corporate strategic planning (Harrington 1987:211).

c. Performance evaluation

The CAPM is also used to evaluate past performance and to establish whether divisions, business units and lines of business have created value and, at least, earned the cost of equity (Harrington 1987:211).

4.2.8.2 Regulation of public utilities

The CAPM can also been used to establish the cost of equity of public utilities. Utility rates are set so as to recover all costs, including the cost of equity, and thus the CAPM is a useful tool for managers and regulators of public utilities (Harrington 1987:213).

4.2.8.3 <u>Portfolio management and share selection</u>

Investment managers have also been able to apply the CAPM with some success in the fields of share selection, portfolio construction and portfolio performance evaluation.

a. <u>Share selection</u>

Many practitioners attempt to forecast returns and beta in order to identify undervalued shares, that is, shares with positive alpha values. The CAPM can be used to forecast share returns and practitioners have used this process to identify underpriced shares in order to earn abnormal returns (Harrington 1987:214-216).

b. <u>Portfolio construction</u>

The CAPM can also be used to control the level of portfolio risk. Beta is used, as a risk-level constraint in linear programming, to manage the level of portfolio risk (Harrington 1987:216-218).

c. <u>Evaluating portfolio performance</u>

Using historical returns and beta, the performance of portfolios can be evaluated against the SML. In this manner, portfolios that have underperformed, that is, having negative alpha values, and portfolios that have achieved abnormal risk-adjusted returns, that is, having positive alpha values, can be identified (Harrington 1987:218).

As it is only through empirical testing that the validity, application and descriptive ability of the CAPM can be established, it is now important to review the results of some of the research conducted on the CAPM.

4.2.9 Research related to the CAPM

Although the CAPM suggests that shares with high forecasted beta values should render high expected returns, it does not imply that these shares will necessarily render high actual returns. If there is a substantial increase in the market (the market has gone up), one would expect the actual returns of high-beta shares to be higher than that of low-beta shares. If, however, the market shows a substantial decrease (the market has gone down), one would expect the actual returns of high-beta shares to go down more than those of low-beta shares. These are, however, only expectations and over time actual returns may bear little resemblance to expected returns and, hence, to estimated beta values (Sharpe 1985:395).

This clearly illustrates why many writers have observed that the CAPM is basically untestable. It is based on investor's expectations about future returns and expectations are difficult, if not impossible, to measure. Thus, researchers have generally had no choice but to test the CAPM using past data as proxies for future expected returns (Pike & Neale 1996:286).

Sharpe (1985:395) identifies a further problem, namely, the measurement of beta. The CAPM requires that beta should measure a share's sensitivity to a market portfolio consisting of all risky assets. However, such a market portfolio has as yet not been identified and researchers are forced to use some stock market portfolio or index as a proxy for the market portfolio. This causes the problem that the same share can have different beta values, depending on whether the sensitivity of its returns have been measured against a stock market index, a country's full stock market portfolio or even an international stock market portfolio.

Despite these problems, the CAPM has been the subject of extensive research. These studies have examined the CAPM in many ways, but the essence and basic procedure of these studies are (Levy & Sarnat 1994:336,338; Pike & Neale 1996:286):

- The application of time-series analysis to a large sample of historical (*ex post*) data of shares in order to estimate beta and expected returns.
- Using regression analysis to apply the estimates of beta and expected return to form a SML in order to establish whether the projected SML corresponds with the slope of the SML suggested by the CAPM.

From this, the results of some of the international research (on the US market, unless otherwise indicated) conducted until the mid-1980s are reviewed, according to the area of investigation.

4.2.9.1 Research on beta as a measure of risk

Sharpe (1966) and Friend, Blume and Crocker (1970)

These studies represent evidence in support of the CAPM. The performance of mutual funds was examined and it was found that higher returns are associated with increased systematic risk (Firth 1977:98).

Arditti (1967,1971)

Arditti investigated the importance of a number of factors, including skewness, and found that the return on shares is directly related to variance, but inversely related to skewness. He showed that, although increases in return are correlated to variance, the increases in return are less than proportional to the increases in risk and concluded that skewness is an important factor in explaining returns (Harrington 1987:72).

Arditti also found evidence in support of investors' preference for positive skewness (Elton & Guber 1995:247). He found that actual returns on the market and those for the sample of mutual funds investigated, showed positive skewness. The mutual funds exhibit a greater amount of skewness than the market and it was concluded that this represents evidence that managers are willing to sacrifice some expected return, or accept more variability in returns, for the chance of earning large returns (Firth 1977:96).

Jensen (1968)

Jensen also examined mutual fund performance and found evidence consistent with the implications of the CAPM. He found a linear relationship between systematic risk (beta) and returns and also found that portfolio betas are quite stable over time. This implies that estimates of beta based on historical data are useful in making predictions of future portfolio betas (Van Rhijn 1994:103).

Douglas (1969)

The study of Douglas covered 616 shares for the years 1926 to 1960. The covariance of each share's returns was calculated against an index consisting of the 616 shares examined. Douglas found evidence in conflict with the CAPM, in that a much stronger relationship was found between variance and returns than between beta and returns. This implies that, for the vast majority of the years studied, total risk explained returns better than systematic risk (beta) could (Firth 1977:96; Van Rhijn 1994:104,105; Reilly & Brown 1997:312).

Douglas further found that the minimal rate of return (the intercept) is not equal to the actual risk-free rate, that is, the intercept is higher (Harrington 1987:57; Reilly & Brown 1997:312).

Lintner (1969)

Lintner found results similar to those of Douglas(1969) (Firth 1977:96; Harrington 1987:57; Van Rhijn 1994:106). Harrington (1987:57) concludes that the results of the Douglas (1969) and Lintner (1969) studies could either be because of faulty test procedures or because the CAPM is wrong.

Francis and Archer (1971) and Jacob (1971)

Jacob used individual shares to study the CAPM, while Francis and Archer used portfolios, but they found similar results. Again the evidence was similar to that of the 1969 studies of Douglas and Lintner, and in conflict with the CAPM (Anderson 1978:83-85).

Black, Jensen and Scholes (1972)

These researchers examined a sample of all the shares traded on the NYSE over the period 1926 to 1966 (Van Rhijn 1994:114). They used 10 different portfolios to investigate the relationship between portfolio returns and betas over the 40 year period of their study (O'Brien & Srivastava 1995:117). The major conclusions drawn from their study were that:

- Over time, there exists a close relationship between beta and return, and this relationship is positive and linear (Casabona 1979:12; Seneque 1987:31; Pike & Neale 1996:287).
- The intercept is significantly greater than the risk-free rate, and that the slope of the SML is flatter than predicted by the CAPM (Casabona 1979:12; Harrington 1987:59; Pike & Neale 1996:287).
- The value of alpha is not equal to zero, since high-beta shares earn returns that are lower than expected and low-beta shares earn higher returns than expected. This implies that there are additional factors which explain returns (Firth 1977:97; Gay 1982:181; Seneque 1987:32).
- Returns are better explained by a two-factor model, which they developed and called the zero-beta model. Risk-free borrowing is not used as an assumption in this model (Firth 1977:97; Gay 1982:181; Harrington 1987:61).

Miller and Scholes (1972)

Miller and Scholes found results similar to those of Black *et al.* (1972) in their investigation of a sample of 631 shares for the period 1954 to 1963 (Firth 1977:97; Van Rhijn 1994:107). They proposed that the combined effects of skewness of returns and beta measurement errors could have caused the pre-1972 results, and concluded that the results of these studies are inconclusive as they concentrated on variance/standard deviation and did not properly divide total risk into its systematic and unsystematic parts (Firth 1977:96; Anderson 1978:84,85; Van Rhijn 1994:108).

Sharpe and Cooper (1972)

Sharpe and Cooper examined the long-term risk/return relationship using monthly returns and each share's beta relative to an index of the returns on all shares listed on the NYSE for the period 1931 to1967. They found results for short-term (one year) and medium-term (up to five years) periods that are consistent with a positive relationship between beta values and returns. The results for the overall 37-year study period are less clear, but it shows an overall result of an apparent positive relationship between beta and long-term returns (Sharpe 1985:395-398).

Elton and Gruber (1995:344) conclude that the work of Sharpe and Cooper represents strong evidence in favour of the existence of a positive linear relationship between beta and return.

Friend and Blume (1970) and Blume and Friend (1973)

Friend and Blume investigated the risk/return relationship in order to establish whether beta is the only and complete measure of risk. They tested 200 randomly selected portfolios consisting of shares listed during the period January 1960 to June 1968 to determine whether a linear relationship exists between risk-adjusted returns and two measures of risk, namely beta and standard deviation. They found that neither beta nor standard deviation are complete measures of risk and that high-beta portfolios earn lower returns than do low-risk portfolios. These findings are contrary to the implications of the CAPM and they concluded that a less rigid expression of the risk/return relationship would be preferable (Harrington 1987:65,66; Van Rhijn 1994:108,109).

In a follow-up study in 1973, Blume and Friend again examined the risk/return relationship for shares listed in the period 1955 to1968. Although they found a linear relationship between realized returns and systematic risk, they concluded that their tests failed to find evidence in support of the CAPM as the estimated risk-free rate of return and the estimated risk premium on the market portfolio are significantly different from the average actual risk-free rate and the return on the market portfolio over the period of the study (Van Rhijn 1994:109,110).

Fama and MacBeth (1973)

The Fama and MacBeth study found evidence in support of the CAPM's positive linear relationship between portfolio beta and expected returns (Seneque 1987:31; Levy & Sarnat 1994:338). Fama and MacBeth tested 20 portfolios of NYSE listed shares over the period 1935 to 1968 and found overall evidence that is consistent with the basic CAPM. The main conclusions from their study were:

- The relationship between expected returns and risk is linear in efficient portfolios.
- Beta provides a relatively complete measure of risk and no other measure of risk provides a better explanation of expected returns of efficient portfolios.
- The risk/return relationship is positive since higher risk is associated with higher return (Firth 1977:97,98; Casabona 1979:13,14; Van Rhijn 1994:114).

Drzycimski and Yudelson (1969), Joyce and Vogel (1970), Klemkosky and Petty (1973) and Ben-Zion and Shalit (1975)

All these studies identified some problems with using historical beta to measure risk and recommended that more than one measure of risk should be used (Anderson 1978:96).

Levy (1974)

Levy also concluded that the evidence shows that it would be possible to find a greater correlation between historical risk and subsequent return if risk is measured by a variable other than beta (Anderson 1978:96).

McDonald (1974)

This study of mutual fund performance, over a 10-year period, found that higher returns are associated with increased systematic risk. Although evidence was found that high-beta portfolios earn higher returns than expected, this was not found to be statistically significant and the overall results of the study provide evidence in support of the CAPM (Firth 1977:97,98).

Cooley, Roenfeldt and Modani (1977)

The study of Cooley *et al.* also examined the completeness of beta as a measure of risk by comparing it with a number of the more traditional measures of risk. They showed that beta provides additional information to the traditional measures, but there are other measures with which it overlaps. As with the 1967 study of Arditti, it was found that skewness provides non-beta related and useful information, and that share returns which are not normally distributed, but skewed to the right, have less downside risk and more upside potential, resulting in less risk for the investor (Harrington 1987:71).

Firth (1977)

Firth's study of the performance of unit trusts in the UK also found evidence in support of the CAPM in that higher returns are associated with higher levels of systematic risk (Firth 1977:98).

Friend, Westerfield and Granito (1978) and Friend and Westerfield (1981)

Friend, Westerfield and Granito added unsystematic risk to the CAPM and found that this provides a better explanation of share returns. They concluded that systematic risk, as measured by beta, is not the sole variable explaining returns and that residual standard deviation is at least as important in explaining returns (Gay 1982:182; Van Rhijn 1994:131).

Gay (1982:182) notes, however, that it is unclear whether these findings are a true reflection of an *ex ante* phenomenon or whether it is only a statistical artifact. Gay further notes that the study is tainted due to a limited number of observations. Friend and Westerfield extended the initial study over a longer time-period and found results which confirm the initial findings.

Cheng and Grauer (1980)

This study examined the monthly share values for firms listed on the NYSE during the period 1926 to 1977. In order to ensure that their test results are compatible with the results of previous studies, they based their portfolio selection technique on that used by Fama and MacBeth in their 1973 study. Cheng and Grauer formulated five testable hypotheses according to which the CAPM could be judged and concluded from their results that these hypotheses cannot be accepted as they do not hold jointly and, as such, that their findings provide evidence against the CAPM (Van Rhijn 1994:131).

Lakonishok and Shapiro (1984)

Lakonishok and Shapiro examined portfolios of shares for a 22 year period and found that risk is rewarded, but that it is variance that is rewarded and not beta. Similarly to Black, Jensen and Scholes (1972), they found further evidence against the CAPM in that high-beta shares perform better in up markets and worse in down markets than low-beta shares, and in general, that high-beta shares earn less and low-beta shares more than predicted by the model (Harrington 1987:66,68; Seneque 1987:32).

Other researchers, in addition to the studies of Arditti (1967), Black *et al.* (1972) and Cooley *et al.* (1977) also investigated the relationship between beta and return, and the effect of skewness on expected returns. They found that when returns are normally distributed there exists a balance between positive and negative observations, that is, the distribution is symmetrical. Skewness, however, is a measure of the asymmetry of the distribution of returns and positive skewness refers to a situation where there is an abnormal number of large positive price changes. Investors should prefer positive skewness as there exists a strong probability of large payoffs and many researchers have considered skewness as the reason for the CAPM phenomenon that low-beta shares earn higher returns and high-beta shares lower returns than expected, that is, low-beta shares are underpriced and high-beta shares are overpriced (Elton & Gruber 1995:247; Reilly & Brown 1997:314).

McEnally (1974)

The results of the McEnally study confirmed these perceptions about skewness, but also found that high-beta shares have high positive skewness. A possible explanation for this finding is that investors prefer shares with high risk and high positive skewness as this provides the opportunity for very high returns (Reilly & Brown 1997:314).

Kraus and Litzenberger (1976)

Kraus and Litzenberger suggested that it is not skewness in itself, but rather the systematic and unsystematic skewness that is important and criticized Arditti (1967) for not differentiating between the diversifiable and non-diversifiable elements of skewness (Harrington 1987:72; Elton & Gruber 1995:247).

They added a skewness term to the CAPM and tested this new model on 20 portfolios over a 32-year period. They found that systematic skewness increases the explanatory power of the CAPM in that it corrects for the apparent mispricing of high-beta and low-beta shares. They concluded that expected return is a function of both systematic and unsystematic skewness (Firth 1977:97; Reilly & Brown 1997:314).

Friend and Westerfield (1980)

In a subsequent test of the Kraus and Litzenberger (1976) model, Friend and Westerfield found mixed results (Reilly & Brown 1997:314), and Gay (1982:182) concludes that while skewness was found to be a significant factor, it does not add much to the explanatory power of the CAPM.

Simkowitz and Beedles (1978)

This study examined the effect of diversification on portfolio skewness and found that skewness is reduced through diversification, since 92% of skewness is eliminated when portfolios reach five shares. All positive skewness was found to have disappeared after portfolios reach six shares and Simkowitz and Beedles concluded that investors who prefer skewness would not diversify (Harrington 1987:72,73).

Reinganum (1981)

In this examination of the risk/return relationship, Reinganum used at least 100 days of daily data to estimate betas and found that, for the period 1926 to1979, the higher the portfolio beta the higher the returns. These results are however not statistically significant. He also showed that portfolios ranked according to beta have significantly skewed results, even when the abnormal returns are excluded (Harrington 1987:62,72).

It can be concluded from the above studies that when historical data is used, the risk/return relationship is not quite as that predicted by the CAPM (Harrington 1987:62). Although the evidence is not strong enough to reject the CAPM, it does indicate that the basic CAPM is flawed. It has been shown that the CAPM provides incorrect descriptions of the past and that it does not describe expectations well. The intercept appears to be higher than predicted and the slope of the SML seems to be less steep than predicted (Harrington 1987:75,79).

4.2.9.2 <u>Research on the stability of beta</u>

Blume (1971,1975)

The 1971 study of Blume examined the stability of beta for both portfolios of shares and individual shares over consecutive seven-year periods (42 years in total). Two main conclusions were drawn from this study:

- Betas for individual shares are unstable, but those of portfolios tend to be fairly stable over time, and historical portfolio betas are fairly good predictors of future betas.
- Betas of firms tend, over the 42 years of the study, to move towards the beta of the market as a whole and when beta values depart from their average values, their next value tends to be such that it is brought back towards the average value (Firth 1977:99; Clark *et al.* 1979:183).

The evidence from the 1975 study confirmed the 1971 results, in that it was found that:

- Betas for individual shares are not good predictors of future betas, while betas of portfolios are stable and contains much information about future betas.
- Betas tend to regress towards the mean over time and the shares with extreme risk characteristics tend to be less extreme over time (Blume 1975:21,31; Jones 1998:240).

Fisher (1971) and Jacob (1971)

Fisher found only a slight difference between the beta values provided by various base time periods, while the study of Jacob suggested that beta values are relatively unstable (Firth 1977:98,99).

Levy (1971,1974)

Levy examined, similarly to Blume (1971,1975), the stability of beta over time and with similar results and conclusions. The 1971 study, the results of which were confirmed by the later study, involved an examination of over 500 shares listed on the NYSE over a 10-year period (Anderson 1978:92; Reilly & Brown 1997:310). Clark *et al.* (1979:183) provide the following summary of the conclusions that can be drawn from Levy's studies:

- Betas for large portfolios are quite stable, more so than for small portfolios and even more than those of individual shares.
- The longer the beta forecast period, the more reliable the forecast.
- Large portfolios with more than 25 shares and a forecast period of longer than 26 weeks provide historical betas that are good and stable predictors of future betas.

Levitz (1972)

The study of Levitz supports Levy's findings. Although he found poor correlation between individual share's historical and actual betas, he found significant correlation for portfolios of only 10 shares. (Clark *et al.* 1979:183).

Sharpe and Cooper (1972) and Sharpe and Sossin (1976)

Other than finding a positive relationship between risk and return, although not completely linear, both these studies also examined the stability of beta for individual shares and found a high level of stability, even for individual shares (Firth 1977:99).

Cunningham (1973)

In a study on UK shares, Cunningham examined 950 shares for two different three-year periods. He found beta to be relatively stable and historical betas to be relatively good predictors of future betas (Firth 1977:99).

Meyers (1973)

Meyers examined the hypothesis that beta's instability is caused by the fact that the amount of variance explained by the market varies from one period to the next. The periods 1952 to 1960 and 1961 to 1967 were investigated and the portfolio beta of 94 shares were found to be reasonably stable, while the variance was virtually unchanged during both periods. For individual shares, however, the degree of return behaviour explained by beta varied significantly from period to period (Harrington 1987:123).

Aber (1972), Brennan (1973) and LeRoy (1973)

Aber also found betas to be relatively unstable. Both Brennan and LeRoy developed theoretical models which imply that beta can and will not be stable over time (Firth 1977:99).

Various studies (1970-1976)

A number of studies have also confirmed the findings that

- betas for individual shares are relatively unstable,
- betas for portfolios consisting of a large number of shares are quite stable and have a high degree of predictive ability, and
- beta stability is directly related to the degree of diversification.

These studies include those of **Beaver, Kettler and Scholes (1970)**, **Rosenberg and McKibben (1973)**, **Schwartz and Altman (1973)**, **Vasicek (1973)**, **Schlarbaum and Racette (1974)** and **Rosenberg and Guy (1976)** (Anderson 1978:92,93).

The studies of **Baesel (1974)**, **Klemkosky and Martin (1975)** and **Porter and Ezzell (1975)** confirmed the earlier findings that the betas for portfolios are more stable than those of individual shares, while **Baesel (1974)** and the French study of **Altman, Jacquillat and Levasseur (1974)** found that the betas of individual shares become more stable with increases in the estimation period (Harrington 1987:125; Reilly & Brown 1997:311).

Fielitz (1974) and Porter and Ezzell (1975)

Fielitz found that a portfolio consisting of only eight shares has a beta with a considerable degree of stability, but to have a beta with a high degree of stability the size of the portfolio needs to be increased substantially. The findings of Porter and Ezzell's study contradict those of Fielitz, since they found no evidence that an increase in portfolio size improves the stability of beta (Seneque 1987:30; Reilly & Brown 1997:310).

Elton, Gruber and Urich (1978)

The study of Elton *et al.* showed that two elements of beta estimates contribute to its instability. These elements are the correlation between the share and the market and the volatility of the returns of the share. It seems that, in general, it can be concluded from this study that more accurate estimates of betas can be obtained if it is based on the average correlation for all the shares in the sample, rather than estimates of beta for specific shares (Rees 1995:169).

Roenfeldt, Griepentrag and Pflamm (1978)

The study of Roenfeldt *et al.* examined the relationship between the length of time of the base period and the test period in the estimation of beta. Betas derived from 48 months of data were compared with subsequent betas for 12, 24, 36 and 48 months. The findings of their study showed that beta estimates using 48 months of data are not good predictors for subsequent 12-month betas, but do predict 24-, 36- and 48-month betas well (Reilly & Brown 1997:311).

Alexander and Chervany (1980)

This study confirmed Meyers' 1973 conclusion that betas of well-diversified portfolios are relatively stable. They also found that the benefits of diversification on the stability of beta, to a large degree, disappear after the addition of the tenth share to the portfolio (Harrington 1987:124)

Carpenter and Upton (1981)

Carpenter and Upton examined the impact of trading volume on the stability of beta and found an effect related to the small-firm effect. They showed that beta estimates can be improved when volume-adjusted betas are used (Seneque 1987:30: Reilly & Brown 1997:311).

Theobald (1981)

The findings of Theobald explain the earlier findings of Baesel (1974) and partially explain those of Roenfeldt *et al.* (1978). Theobald showed that the stability of beta improves with an increase in the calendar period examined and concluded that the optimal period could be over 10 years if beta had not shifted during that period (Seneque 1987:30; Reilly & Brown 1997:311).

Tole (1981)

Tole agreed with Fielitz's 1974 findings and contradicted those of Porter and Ezzell in 1975. Tole concluded that 10 to 25 shares in the portfolio still improves the estimates of beta and that these benefits can be attained when the portfolio grows beyond 100 shares (Seneque 1987:30; Reilly & Brown 1997:310).

Bey (1983)

Using a sophisticated technique, Bey examined the stability of beta for public and utility shares for the period 1960 to 1979. He found betas of individual shares to change substantially from five-year period to five-year period and concluded that betas of individual shares are not stable (Harrington 1987:118).

Dimson and Marsh (1984)

In a study on the UK stock exchange, Dimson and Marsh confirmed the earlier findings of Blume (1971,1975) (Rees 1995:169).

Grossman and Sharpe (1984)

This study examined the beta values on the NYSE during the period 1928 to 1982 and found that beta values are positive when excess returns exceed the riskless rate and negative when the reverse occurs, that is, shares with historic high beta values are more volatile than those with low beta values. They concluded that this is a relationship that is statistically significant and that historic betas are useful indicators of future betas, especially when combined with the size effect (Sharpe 1985:399,400).

Kryzanowski and To (1984)

Kryzanowski and To argued that much of what was cited as the cause of the instability of beta do not in actual fact create real instability. Estimates of beta were generated using time-series analysis of historic data on past returns, whereas betas are expectational, that is, a function of expected returns. They concluded that

> betas estimated using *ex post* return data can be expected to exhibit non-stationarity, even when the underlying *ex ante* security returns are serially independent and obey a stationary distribution over time (Harrington 1987:130).

From these studies it can generally be concluded that betas of portfolios are relatively stable, while those of individual shares are much less stable (Firth 1977:99). Hence, the CAPM is more useful in structuring investment portfolios than in estimating returns on individual shares (Van Rhijn 1994:250). Two other conclusions that can be drawn from the studies into the stability of beta is that at least 36 months of data should be used for its estimation and that cognisance should be taken of the share's trading volume (Reilly & Brown 1997:311).

4.2.9.3 Research into the association between accounting measures of risk and beta

Ball and Brown (1967)

Ball and Brown found an association between beta, systematic risk and the covariance of individual firm's returns to an average level of corporate earnings (Firth 1977:100).

Beaver, Kettler and Scholes (1970)

This twofold study examined the relationship between beta and various accounting measures of risk, together with whether these accounting measures are good predictors of beta. The accounting measures investigated were dividend payout, growth, financial leverage, liquidity, size, variability of earnings and a measure of cyclacility (earnings beta). The investigation entailed the examination of the accounting data and beta of 307 firms for the period 1947 to 1965, with the first 10-year period used as a predictor of beta values for the remaining years. The results of the study showed that leverage and earnings beta have strong correlations, earnings variability and dividend payout have significant correlation, while the rest only have weak correlation (Beaver *et al.* 1970:287-289; Myers 1973:51-53; Firth 1977:101). The conclusions drawn from the study were that:

- Accounting data is incorporated in market prices and accounting measures of risk are good predictors of beta.
- Accounting data provides better predictions of beta than does naive estimates of beta (Beaver *et al.* 1970:287-289; Firth 1977:101).

Hamada (1972)

In this study, Hamada examined beta levels and found that a firm's beta is influenced by its leverage (Firth 1977:103).

Logue and Merville (1972)

Logue and Merville concluded from their research that there is a significant correlation between a firm's beta value and its liquidity ratios, leverage, dividend payout and profitability (Clark *et al.* 1979:183).

Pettit and Westerfield (1972)

This study, on the other hand, found that accounting measures of risk do no better than other financial factors in explaining beta values (Firth 1977:103).

Rosenberg and McKibben (1973)

In their study, Rosenberg and McKibben examined whether accounting data and the historical distribution of share returns can be used to predict the unsystematic risk and current levels of beta. They concluded that accounting measures of risk have a certain degree of explanatory power (Firth 1977:102).

Lev and Kunitzky (1974)

Lev and Kunitzky found that smoothing of accounting data, that is, reducing its variability, reduces the level of a firm's beta (Firth 1977:103).

Various studies

Various other researchers have examined the association between different accounting measures of risk and systematic risk. Most of these studies have found a fair, but variable degree of association and concluded that although the degree of predictive ability was not ascertained, accounting measures of risk have major explanatory power. Examples of such studies include those of **Breen and Lerner (1973)**, **Gonedes (1973,1975)**, **Beaver and Manegold (1975)** and **Bildersee (1975)** (Firth 1977:101).

The results of these studies have generally shown an association between market measures of systematic risk and accounting measures of risk. It is, however, unclear whether accounting data provides better forecasts of future betas than other financial data (Firth 1977:103).

4.2.9.4 Research on whether beta is the only factor that explains returns

King (1966)

The study of King was an investigation of whether industry-specific indices are a better reflection of the returns-generating process. King found that around 50% of the volatility of share returns are explained by the market index, while an additional 10% can be attributed to an industry classification and, thus, that industry-specific indices do add value. King's study has however been rejected by critics on the basis that his classification scheme is not acceptable and that any industry factor identified is unsystematic and, hence, a diversifiable risk (Harrington 1987:86,87).

Cohen and Pogue (1967)

Cohen and Pogue found some evidence in support of conclusions of King (1966), but the usefulness of their study is hampered by severe statistical problems (Harrington 1987:87).

Merton (1973,1980)

Merton postulated that share returns are determined by a risk measure based on stock market volatility and that investors' portfolios are a linear combination of three different portfolios, namely the market portfolio, the riskless portfolio and a portfolio with perfect negative correlation with the riskless asset (Bicksler 1973:84; Oosthuizen 1992:10). Merton developed an intertemporal CAPM that allows for changes in the investment opportunity set. He argued that this model provides a conceptual explanation of the observed phenomena that high (low) beta portfolios earn less (more) than expected (Bicksler 1973:84).

Farrell (1974,1975,1976)

Farrell postulated that the industry effect is not unsystematic and diversifiable and that there will be positive and negative correlation between various indices. Farrell developed a multi-index model which he showed to outperform a single-index model, in that portfolios created through the use of a multi-index model reduce risk faster or require less diversification to reach the same level of risk of portfolios created using the single-index CAPM (Harrington 1987:87).

Fouse (1976)

Fouse investigated whether liquidity has an effect on the pricing of shares. *Ex ante* data generated by investment analysts was used to project the returns for individual shares and liquidity was added to this risk/return relationship. Fouse showed that liquidity has a significant effect on expected returns and that a liquidity factor will have a significant effect on share selection (Harrington 1987:81).

Bassu (1977) and Nicholson (1968)

Both these studies examined the effect of P/E ratios and Bassu confirmed the views of Nicholson, that is, low P/E portfolios yield higher returns than do high P/E portfolios (Seneque 1987:31; Linley 1992:16).

Levy (1978) and Mayshar (1979)

Both Levy and Mayshar have contended that expected and realized returns are affected not only by beta, but also by variance. In conditions where diversification is constrained by, for example, the number of shares in the portfolio and/or transaction costs, both these types of risk need to be included in the model as return-generating factors (Harrington 1987:30).

Arnott (1980)

Arnott also examined whether more than one factor affects expected and realized returns and found that the market factor explains only about 30% of the variance of returns. He concluded that other factors, such as an industry effect, cannot be ignored when the risk characteristics of a portfolio are evaluated and that the CAPM ignores such an industry risk factor (Harrington 1987:88,89).

Banz (1981)

In an investigation of the relationship between the size effect and share returns, Banz added a firm size factor to the CAPM. Using data for the 1936 to1975 period, he found that shares of firms with large market values have, on average, lower returns than do those of small firms (Harrington 1987:85; Bradfield *et al.* 1988:13).

Reinganum (1981)

Using a different technique, Reinganum, like Banz (1981), also found that portfolios consisting of shares of small firms consistently earn higher risk-adjusted returns than do portfolios of shares of large firms (Harrington 1987:83,85; Bradfield *et al.* 1988:13). Reinganum concluded that the basic CAPM is misspecified, as it seems if the persistence of abnormal returns is caused by risk factors which are omitted from the CAPM (Seneque 1987:31).

Blume and Stambaugh (1983)

Blume and Stambaugh showed that the technique used by Reinganum in 1981 caused an upward bias in the estimates of the returns on the small firm portfolios. This upward bias was caused by a bid-ask spread bias which is inversely related to firm size, and the bias caused the premium of the size effect to be doubled (Bradfield *et al.* 1988:13).

Lakonishok and Shapiro (1984)

The beta coefficient should be equal to the excess return on the market, but Lakonishok and Shapiro found it to be much less than predicted by the CAPM. They also found that returns on individual shares do not appear to have a specific relationship with systematic risk (Seneque 1987:31; Linley 1992:17). They added the size effect to a regression analysis consisting of beta and variance and found that the size factor is the only significant variable (Harrington 1987:85).

Chi-Cheng, Reilly and Wong (1985)

The Chi-Cheng *et al.* study showed that the size effect is related to the liquidity effect. They suggested that, due to the close relation between liquidity and size, a liquidity factor can be one of a number of factors missing from the CAPM (Bradfield *et al.* 1988:13).

Amihud and Mendelson (1986)

In their study, conducted over the period 1961 to1980, Amihud and Mendelson showed that liquidity, as measured by the bid-ask spread, has a significant and positive relationship with return. It was found that illiquid (high bid-ask spread) shares earn higher returns than liquid (low bid-ask spread) shares (Bradfield *et al.* 1988:13,18).

From the evidence available it does seem as if beta does not provide a full description of risk and that other risk measures are also important in explaining share returns. These conclusions, together with the findings on the problem of skewness of returns, seem to indicate that the CAPM may possibly be misspecified (Harrington 1987:79).

4.2.9.5 <u>Research on the estimation of beta</u>

Breen and Lerner (1972)

Breen and Lerner examined the effect of having different choices of holding periods when estimating beta. They calculated the betas for a number of shares, using linear regression with monthly intervals, and found that, as the holding period lengthens, significant changes in individual beta values occur (Harrington 1987:109).

Phillips and Segal (1975) and Levhari and Levy (1977)

Both these studies showed that estimated beta values are different when different estimation intervals are chosen. Levhari and Levy calculated the betas for a number of shares, for the period 1948 to1968, using different monthly intervals and found that most beta values change significantly with a lengthening in the interval period (Harrington 1987:110).

Frankfurter (1976)

Frankfurter investigated the choice of index on beta values. Three different indices were used to estimate the betas for the same shares and it was found that some shares' beta values are quite similar while others are not (Harrington 1987:115).

Peseau (1977)

Peseau examined beta values for two overlapping periods, 1971 to 1974 and 1971 to 1975. Although no dramatic changes in beta values were expected, as only a year was added on in the latter period, it was shown that the betas had changed significantly between the periods (Harrington 1987:109).

Alexander and Chervany (1980)

Using data from 1950 to 1967, the aim of this study was to estimate the optimal interval period which should be used to calculate beta. They found that a six-year horizon provides the least absolute errors, although this is only insignificantly better than a four-year period (Harrington 1987:110).

Hawawini (1983)

Hawawini estimated betas on a daily, weekly, two-weekly, three-weekly and monthly interval over the period 1970 to 1973 and found the values to differ substantially. He speculated that this occurs because firms with large market values lead the market and their betas will increase as the interval shortened, while small firms lag the market and their betas will decline with a shortening of the interval (Harrington 1987:111).

Various studies have examined the problem of how to correctly estimate beta using historical data and the conclusion at this stage seems to be that it is not known how beta should be measured. The trial-and-error experimentation should thus continue (Harrington 1987:118).

4.2.9.6 Research on the estimation of the market return and the validity of the market proxy

Roll (1977,1980)

Roll (1977) provided a strong critique on the empirical testing of the CAPM, based on the argument that the CAPM is basically untestable. Keogh (1994:41-44) and Van Rhijn (1994:126-128) summarise the reasons for Roll's critique as the following:

- The CAPM is an expectational model and can only realistically be tested if the composition of the true mean-variance efficient market, containing all assets, is known and used in the tests.
- All other implications of the CAPM stem from the efficiency of the market portfolio and cannot be tested independently.
- The use of a proxy for the market portfolio creates two basic problems. Firstly, the proxy may be mean-variance efficient even though the true market portfolio may not be. Secondly, the various market proxies will be correlated with each other and with the market portfolio, whether they are mean-variance efficient or not.
- Misspecification of the market portfolio will create bias and non-stationarity in the risk/return relationship.

These factors imply that empirical tests of the CAPM have not been tests of expectations, but of what has actually occurred (Harrington 1987:75). All the tests have therefore been incorrect , their results should be treated with caution and it would seem that it is highly unlikely that a correct and unambiguous test of the theory will be accomplished in the near future (Dobbins *et al.* 1994:65; Van Rhijn 1994:126).

In a follow-up critique, Roll (1980) also criticised the use of the CAPM in the evaluation of the performance of portfolio managers. This procedure calls for a comparison of the performance of the managed portfolio with that of an unmanaged portfolio bearing the same level of risk, and Roll argued that the use of a proxy for the market portfolio as a benchmark invalidates the evaluation process. This is caused by the impossibility to establish whether the risk-adjusted returns are attributable to a manager's ability or to the inefficiency of the market proxy. Roll showed that when the performance of different managed portfolios are compared through the use of different market proxies, the rankings of the evaluation can be reversed (Dobbins *et al.* 1994:65).

Gay (1982:190) concludes that although Roll's critique is strictly correct, it is rather over-exaggerated. All that can really be concluded is that it is unlikely that it will ever be known whether the CAPM is true, as tests of it will almost certainly deliver imperfect information.

Solnik (1977)

Solnik extended Roll's critique of the CAPM to include international tests of the CAPM and concluded that, as in domestic tests, the problem with the market proxy persists and that the true mean-variance efficient market portfolio had not been used in these tests (Berges-Lobera 1982:73,74).

Friend, Westerfield and Granito (1978)

Friend *et al.* examined the choice of index as market proxy and found that the use of different indices renders different regression coefficients. They concluded that the choice of index will have a significant effect on the analysis (Harrington 1987:75-78).

Mayers and Rice (1978)

Mayers and Rice partially refuted Roll's 1977 and 1980 critique of the CAPM. They showed that the CAPM can provide meaningful conclusions with portfolio performance tests. As long as the chosen market index consists of a high proportion of the total market value of shares, it can be an acceptable benchmark for performance measurement and beta estimation (Dobbins *et al.* 1994:67).

Stambaugh (1982)

The market proxy issue was also examined by Stambaugh. Through the inclusion of bonds and real estate, he constructed broader market indices and found that the tests are not really sensitive to the choice of market proxy (Bradfield *et al.* 1988:12).

Carleton and Lakonishok (1985)

Carleton and Lakonishok investigated two aspects of estimating the market return, firstly whether simple or compound rates should be used and, secondly, whether the index used should be value or equally weighted. They examined market returns using different holding periods of between five to 25 years and found differences between geometric and arithmetic average share returns. They further found that the differences between the two methods do not remain constant. Carleton and Lakonishok also found that an equally weighted index provides higher returns over all the holding periods and suggested that these results are due to differences in risk, as smaller shares have a heavier weighting in an equally weighted index.

Carleton and Lakonishok reached two basic conclusions from their study. Firstly, they suggested that the geometric method should be used to measure changes in returns for a buy-and-hold strategy over more than one period, while the arithmetic approach would be preferable when measuring performance over a single historical period. Secondly, they concluded that the value-weighted index provides a better reflection of the market and of investors' experiences. Other researchers have, however, disagreed with this conclusion (Harrington 1987:167,168,170).

From Roll's criticisms it can basically be concluded that the use of indices as proxies for the market portfolio has serious implications for tests of the CAPM. Roll showed it is possible that the relationship between beta and returns can be shown to be linear when the market proxy is efficient. This is unfortunately not a true test of the CAPM as one is not working with the true SML, but only with an estimated SML. It would, therefore, seem unlikely that the CAPM could be truly tested in the foreseeable future (Reilly & Brown 1997:317,318).

It should be noted that the market proxy issue does not invalidate the CAPM, it is only an indication of the measurement problems associated with testing the model as well as with using the model to evaluate portfolio performance (Reilly & Brown 1997:321).

On the issue of estimating the market return, no definite conclusions can be reached at this stage. Various issues, such as the choice between arithmetic and geometric methods, the choice of an appropriate historical period and the choice of a suitable index remain unresolved (Harrington 1987:185).

4.2.9.7 Research on the estimation of the risk-free rate of return

Grey (1974)

According to Grey, among others, the rate of a long-term government bond or high quality industrial bond should be used as proxy for the risk-free rate. Although this proxy is only an approximation and not based on theory, its use is advocated because empirical studies have shown the intercept of the SML to be higher than Treasury bill rates and the activities of central banks preclude a free market rate (Firer 1993:27).

Ibbotson and Sinquefield (1979)

Ibbotson and Sinquefield examined the use of US Treasury bills as a proxy for the risk-free rate over a 54-year period, 1926 to 1979. They found significant negative covariance between share returns and the Treasury bill rate as well as strong serial correlation in the Treasury bill return series. This suggested a pattern to the returns over time and that the beta for Treasury bills will not be equal to zero, that is, it is not risk-free (Harrington 1987:151; Firer 1993:27).

Casabona and Vora (1982)

This study also examined the use of US Treasury bills and found that, even after converting the Treasury bill rate to a perpetuity, there is significant correlation with the market return (Harrington 1987:151).

Carleton and Lakonishok (1985)

Carleton and Lakonishok found that average returns on US Treasury bills are routinely used in the applications of the CAPM. They, however, advocated the use of long-term bonds as a proxy for the risk-free rate since estimates using Treasury bills are also used to analyse long-term investments, which could include investments in the Treasury bills (Firer 1993:26).

Although doubts have been expressed over the use of various instruments as proxies for the estimation of the risk-free rate, it can in general be concluded that beta is a valid and quite complete measure of risk (McLaney 1997:177).

4.2.9.8 Research on the assumption of no taxes and no dividends

Miller and Modigliani (1961) and Modigliani and Miller (1963)

These researchers showed that capital gains will have a greater after-tax value in conditions where dividends are taxed at a higher rate than capital gains. Where no tax differentials exist, given an investment policy, dividends and capital gains will have equal attraction (Harrington 1987:43).

Brennan (1970,1971)

Brennan also examined the effect of taxes and suggested that investors in different tax brackets are interested in different shares and this will cause multiple CMLs if taxes are important enough to affect share prices. Brennan also showed that, if dividends are certain, the risk/return relationship will still be linear even if dividends and capital gains are taxed at different rates (Harrington 1987:43).

Black and Scholes (1974)

Black and Scholes examined the effect of dividends on share returns by adding a dividend payout variable to the CAPM. They found this variable to be not significantly different from zero, over both the entire period and every subperiod of the study. They concluded that this implies that there is no significant difference between the expected returns on high and low dividend-yield shares and, therefore, there is no significant relationship between dividends and share returns, both before and after taxes (Harrington 1987:80; Bradfield *et al.* 1988:12).

Bar Yosef and Kolodny (1976)

The results of this study contradicted the findings of Black and Scholes (1974), as well as those of the 1982 study of Miller and Scholes (Harrington 1987:43).

Litzenberger and Ramaswamy (1979)

Litzenberger and Ramaswamy found that investors with different characteristics prefer different dividend yields and the higher the yield the lower the aversion for dividends. They concluded that the expected before-tax return on a share has a linear relationship with its dividend yield and systematic risk (Harrington 1987:80).

Miller and Scholes (1978,1982)

Miller and Scholes (1978) argued that investors are able to efficiently transform dividends into capital gains through efficient leverage, and if investors use tax shelters there may be no difference between the before-tax return on shares paying dividends and those that do not (Bradfield *et al.* 1988:12).

In 1982 they criticized the findings of the 1979 study of Litzenberger and Ramaswamy and suggested that their conclusions were based on a dividend announcement effect and not on a systematic tax effect. After correcting for the information effect of dividend announcements, they concluded that they could not find any significant relationship between share returns and dividend yields. They did not state that there was no such effect, only that it could not be found using short-term measures (Harrington 1987:80).

Vandell and Stevens (1982)

This study investigated the effect of taxes on share prices by examining the differences between the basic CAPM and a CAPM that includes a personal tax variable. Using analysts' forecasts, 90-day US Treasury bills and the market return, they examined the *ex post* CML and a plane derived from a combination of risk and yield. They found negative correlation between beta and yield, that is, high-yield shares tend to have low betas, and they concluded that this means that beta does not capture the effect of taxes (Harrington 1987:80).

Various studies

Several other studies have also examined the tax and dividend effect. Most have identified the existence of such effects, although the evidence is not unanimous. These studies include those of **Long (1978)**, **Rosenberg and Marathe (1979)**, **Stone and Bartter (1979)**, **Blume (1980)**, **Gordon and Bradford (1980)**, **Elton, Gruber and Rentzler (1983)** and **Keim (1985)** (Bradfield *et al.* 1988:13; Reilly & Brown 1997:309).

4.2.9.9 Research on the CAPM assumptions in general

Brennan (1969)

Brennan examined the assumption that investors can borrow and lend unlimited amounts at the risk-free rate and showed that differential borrowing and lending rates means that two different lines are going to the efficient frontier. This has the implication that investors can either borrow or lend, but borrowing portfolios (subject to higher interest rates) are less profitable than lending portfolios (Reilly & Brown 1997:306).

Mayo (1971) and Levy (1978)

Both these studies showed that the CAPM may still be usable, even if several of the assumptions are invalid. They showed that if markets are not perfect, meaning that there are taxes, transaction costs, less than perfect competition, information inefficiency and investors are unable to maximise their expected utility of terminal wealth, the CAPM can still be used (Harrington 1987:46).

Mayers (1972) and Merton (1973)

These studies have developed extensions of the CAPM under conditions where the assumptions were relaxed. In the case of Mayers, a model was constructed which incorporated the existence of a non-marketable asset such as human capital. Merton, on the other hand, derived a version of the CAPM under the assumption that trading took place continuously over time and, secondly, that returns on assets are lognormally distributed (Bradfield *et al.* 1988:12).

Black (1972), Gibbons (1982), Stambaugh (1982) and Shanken (1985)

Black developed a zero-beta CAPM that does not require the existence of a risk-free asset, and several studies have tested this model. Both the Gibbons and Shanken studies rejected the model, while Stambaugh found evidence in support of the model (Reilly & Brown 1997:307,308).

Both Levy and Sarnat (1994:336) and Reilly and Brown (1997:310) note that the CAPM should not be judged on the basis of its assumptions, and although many of the assumptions clearly do not hold, in reality it cannot be rejected on these grounds, but rather on how well it describes and explains the risk/return relationship that exists in the real world. It is on the basis of this proposition that no conclusions on the validity of the CAPM are provided in sections 4.2.9.8 and 4.2.9.9.

4.2.9.10 General research on major non-US markets

Modigliani, Pogue, Scholes and Solnik (1972)

In the first major non-US study, Modigliani *et al.* found, over the five-year period studied, that the CAPM does provide a good description for the French, UK and Italian markets, while the CAPM is not supported for the German market (Gay 1982:183).

Altman, Jacquillat and Levasseur (1974)

Altman *et al.* examined the French market over a seven-year period using 430 shares. They found that the CAPM explains the variability of share returns just as well in France as it does in the US. The fact that they did not report the estimated alpha coefficients, however, limits the conclusions that could be drawn from this study (Gay 1982:185).

Lau, Quay and Ramsey (1974)

The study of Lau *et al.* examined 585 shares listed on the Tokyo Stock Exchange for a five-year period and found strong support for the CAPM. The study also found no evidence that the CAPM misprices low and high-beta shares, but it should be noted that the study purposely omitted shares which were infrequently traded and made no conclusions regarding the explanatory power of the CAPM (Gay 1982:185,186).

Pogue and Solnik (1974) and Friend and Losq (1979)

In a study that expanded the earlier 1972 study of European markets by Modigliani *et al.*, Pogue and Solnik added the Swiss, Belgium and Netherlands markets to the original four markets studied. They concluded that their findings suggest that the CAPM is better suited for Western European markets than for the US markets. Friend and Losq examined the 1974 study of Pogue and Solnik and concluded that the study had some problems with sampling bias. The Pogue and Solnik comparison between European results and NYSE shares consisted of only a small random sample of NYSE shares, of which the largest companies were Western European (Gay 1982:183,185).

Palacios (1975)

Palacios performed the first study on a non-industrialised nation's capital market, namely Spain. The study examined 150 shares over a 13-year period. No evidence was found to support the CAPM and the risk/return relationship was found to be negative. In addition Palacios found that high-beta shares have negative alphas, while low-beta shares have positive alphas. Due to these extreme findings, Palacios divided the study into two subperiods, one of eight years (a pre-mutual fund period) and one of five years (a post-mutual fund period). By making this distinction, Palacios found some evidence in support of the CAPM in the post-mutual fund period. However, these findings are not sufficient to provide any strong support for the CAPM (Gay 1982:186).

Guy (1976,1977)

In the 1976 study, Guy examined 100 shares in two separate five-year periods on the UK market and found little support for the CAPM. The findings seem to indicate that the

CAPM is only really applicable to UK companies with large market capitalisation. It should be noted, however, that this study suffers from a number of problems, namely the small sample examined, the relatively short time period used and measurement errors. Guy re-examined the German market in 1977. The study covered a 10-year period and concluded that the earlier study of Modigliani *et al.* in 1972 suffers from a time period problem and that the CAPM does in fact suit the German market (Gay 1982:183,187).

Morrin (1976)

Morrin investigated the Toronto Stock Exchange in Canada and concluded that the CAPM seems to be only partially correct and that alpha is significantly different from zero (Gay 1982:185).

Errunza (1979)

This study of the Brazil market examined 64 shares over a period of approximately four years. Errunza found that only four shares had insignificant betas and concluded that the CAPM has good explanatory power. However, the conclusions that can be drawn from this study are hampered by the fact that the alpha coefficients were not reported and also by the short time period of the study (Gay 1982:187).

Levy (1980)

Levy examined the Israeli capital market using 104 shares over an 11-year period. Both quarterly and annual data on returns were examined and it was found that the CAPM holds for annual data and does not misprice shares, but it that it fails for quarterly data. Levy argued that the reason for the CAPM's failure with quarterly returns is because it does not take full account of investors' individual time horizons. However, Levy's findings are subject to potential errors in that the work was not adjusted for measurement errors and it is unclear whether any adjustments were made for any estimation bias caused by infrequently traded shares (Gay 1982:187,188).

Ritsonis (1980)

In a study of the Greek capital market, Ritsonis found that both systematic and unsystematic risk are significant for Greece (Gay 1982:188).

Ibbotson, Carr and Robinson (1982)

The study of Ibbotson *et al.* investigated equilibrium in international capital markets. The basic postulate underlying their study was that if there is complete integration in international capital markets, then the relationship between expected return and the relevant attributes of shares may be described by a type of International Capital Asset Pricing Model (ICAPM). It is expected that the return on each share will be proportional to its beta value relative to the world market portfolio. However, a different CAPM may hold for each country if capital markets are totally segmented. The relationship between beta and return may be different in each country and within each country the expected return on a share may be proportional to its beta value relative to the market portfolio of that country. It is, however, expected that there will be some relationship between expected return and the total risk of a market portfolio across countries (Sharpe 1985:719).

The study of Ibbotson *et al.* provided some evidence on the average return and standard deviation of return, in US dollars, for the share indices of 16 countries over the period 1960-1980. The countries involved were Australia, Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, the UK and the US. They measured, in US dollars, the beta value of the excess return on each index relative to the world share index, together with the *ex post* values of alpha for each country's index relative to the world index. It should be noted that all the indices used were only proxies for the various countries' market portfolios, since only shares were included (Sharpe 1985:719).

Ibbotson *et al.* found that the alpha values varied substantially, but none were statistically different from zero and concluded that this does not confirm complete international capital market integration. They also found the relationship between average return and standard deviation across countries to be nearly equally as strong as the relationship between beta and average return. They concluded that this confirmed that the international capital markets are not completely segmented (Sharpe 1985:719,720).

It can be concluded that the results from the various international studies have generally confirmed what is known about the CAPM from the US studies and, thus, no new or differing conclusions can be drawn from these studies. On the issue of equilibrium in international capital markets, the evidence is as yet not powerful enough to reject or accept the hypothesis, that is, that the market is completely integrated or totally segmented, or to suggest where it is lying between these two extremes (Sharpe 1985:720).

4.2.9.11 South African research

Booth (1979)

The objectives of Booth's study were to determine the strengths and weaknesses of the CAPM in the South African context and to establish whether it can be applied or not. He concluded that the CAPM cannot successfully separate systematic and unsystematic risk and that it only performs well when the systematic portion is high (Van Rhijn 1994:142,143).

Gilbertson (1979)

This study investigated the estimation of the risk-free rate in South Africa and proposed that short-term, rather than long-term, Government bond rates should be used. This will ensure that investors' short share-investment horizons are reflected (Firer 1993:28).

Boshoff (1986)

Boshoff, on the other hand, suggested the use of the prevailing trading rates of the shortest-term gilts as proxy for the risk-free rate. These rates will reflect the highest return available to investors without any risk being borne (Firer 1993:28).

Due to the limited number of studies which had been done on the CAPM in the South African context by the early 1980s, no definite conclusions can at this stage be reached on its applicability, validity and explanatory power under South African conditions.

4.2.10 Conclusion

Reilly and Brown (1997:322,323) provide the following summary of the status of the CAPM up to the mid-1980s:

> The tests of the CAPM indicated that the beta coefficient for individual shares were not stable, but the portfolio betas generally were stable assuming long enough sample periods and adequate trading volume. There was mixed support for a positive linear relationship between rates of return and systematic risk for portfolios of shares, with some recent evidence indicating the need to consider additional risk variables or a need for different risk proxies.
>
> In addition, several papers by Roll criticised the tests of the model and the usefulness of the model in portfolio evaluation because of its dependence on a market portfolio of risky assets that is not currently available.

Many studies seem to indicate that the basic CAPM is inaccurate. They have identified a factor or factors that appear to be omitted from the CAPM and these factor models, particularly the APT model, were developed in an attempt to capture all aspects influencing the behaviour of share returns. The APT requires only limited assumptions, but it is important to note at this time that the factors and their impact on share returns can change quite rapidly. Also, the factor models are descriptive by nature and may or may not be behavioural, that is, explain what should be (Harrington 1987:93).

In the next section of this chapter the APT, which is the predominant alternative to the CAPM, will be examined.

4.3 THE DEVELOPMENT OF THE ARBITRAGE PRICING THEORY

The most appealing aspect of the APT is that it has less restrictive assumptions and is more general than the CAPM. The APT is also concerned with the relationship between risk and return, but is based on the view that several sources of risk affect expected and realized returns. These APT risk factors are not company-specific by nature and represent broad economic forces (Jones 1998:242,245).

The APT has important implications for investment management, in that if investors are able to identify the main risk factors which affect most securities, they would then be able to improve the design and performance of their investment portfolios. This, however, is also the APT's biggest drawback, since it offers no clues as to the identity of the risk factors that affect share returns. It is only through empirical research that the identity and importance of the various risk factors can be established. Some researchers have identified and measured a number of risk factors and some have also concluded that the theory of the APT is superior to that of the CAPM (Jones 1998:245).

In the following sections on the development of the APT, all these aspects are examined, that is, the nature and assumptions of the APT, risk and the APT risk factors, tests and validity of the APT, the APT compared with the CAPM, how the APT can be employed in investment decision-making, and empirical research related to the APT.

4.3.1 The nature of the APT

It is clear from the preceding section of this chapter that, although the CAPM is a simple and enlightening model, it is beset by a number of problems. The main problems, identified by Rees (1995:172,173), are:

- It is dependent on a number of simplifying assumptions.
- The market is described as the only source of risk.
- Empirical evidence is mixed and the tests may not be genuine tests of the model.

- The model is unable to provide an explanation of some persistent anomalies in market returns.
- It is difficult to make reliable and stable estimates of its parameters.
- There exists doubt that returns are only dependent on systematic risk (beta).

From these and other criticisms, Ross (1976) developed an alternative pricing theory known as the APT in an attempt to provide a more meaningful and realistic model for measuring risk. The APT describes the relationship between risk and return in terms of several factors rather than the single market factor of the CAPM. Although the APT does not specify what the factors might be, it does provide a testable multi-factor model which is an interesting and appealing alternative to the CAPM (Harrington 1987:93; Linley 1992:19).

Linley (1992:19) notes that the APT should not be seen as a perfect model. It has failings, but it is an important alternative to the CAPM which may in time replace the CAPM as the predominant asset pricing model.

The logic of the APT is founded on the basic arbitrage principle, namely the law of one price, which states that two equivalent assets trading in the same competitive market cannot sell at different prices. Thus, two shares in the same company must sell at the same price as they are affected by the same factors and will have equal expected returns. If they did not sell at the same price, investors would simultaneously sell the higher priced share and buy the cheaper share and thus achieve arbitrage profits at no risk to them (Seneque 1987:32; Jones 1998:242).

Jones (1998:242) adds further that the APT states that market prices will adjust to eliminate arbitrage opportunities to achieve conditions of market equilibrium and when a situation of market disequilibrium did arise, it will only require the actions of relatively few investors to restore market equilibrium.

It is from these arbitrage arguments that the APT derives its share return relationships, namely an arbitrage portfolio requires no new wealth, has no risk and offers a return equal to the risk-free rate. If it did offer a return in excess of the risk-free rate, investors would borrow at the riskless rate to buy the portfolio and thus earn arbitrage profits without incurring any risk (O'Brien & Srivastava 1995:144; Pike & Neale 1996:288).

According to Harrington (1987:191,192) the principle of arbitrage seems intuitively logical and a reasonable description of investor behaviour. Investors are profit seekers and believe that opportunities to make profit exist, but in efficient markets the active share trading activities of these investors eliminate the arbitrage opportunities and over time no investor can, on average, find arbitrage profit opportunities. However appealing the APT might be, certain assumptions still apply to it. The theory has less restrictive assumptions than the CAPM and it assumes that share returns depend partly on macro-economic factors and partly on company-specific factors. The company-specific factors can be eliminated through diversification, leaving only the macro-economic risk variables as determinants of share prices (Pike & Neale 1996:288).

Both the APT and the CAPM expect the relationship between expected return and risk to be positive, but the APT relates expected return to the risk-free asset and a range of other common factors that systematically affect returns. It, therefore, has a more general view of risk than the CAPM, which views it purely on the basis of beta related to the market portfolio (Harrington 1987:189; Ross *et al.* 1990:286).

The APT states that different shares will be more sensitive to certain factors than others, but it does not postulate what these explanatory factors might be. It does, however, eliminate a serious problem associated with the CAPM, the need to identify the market portfolio. The two major areas of uncertainty associated with the APT, which are also the two areas wherein most of the research and empirical testing of the model have been conducted, are, firstly, the identity of the macro-economic variables that affect returns and, secondly, the risk premium for each variable and the measuring of the sensitivity of share returns to these factors (Pike & Neale 1996:288).

Before the research into and empirical testing of the APT can be reviewed and conclusions drawn from it, it is necessary to examine all aspects of the theory, its implications and compare it with those of the CAPM. The next section therefore reviews the assumptions of the APT.

4.3.2 Assumptions of the APT

The APT is a simpler theory than the CAPM and requires fewer and less rigorous assumptions (Seneque 1987:32). However, there are a number of assumptions that it shares with the CAPM:

- Investors require return as compensation for risk, they are risk averse and wish to maximise their terminal wealth (Harrington 1987:193; Laing 1988:17; Linley 1992:20). Harrington (1987:193) adds that it is important to note that no assumption is made about the distribution of returns, nor does it assume that investors base their decisions on information about mean returns and the variance of returns.

- Investors are able to both borrow and lend at the risk-free rate of interest (Harrington 1987:193; Linley 1992:20). Harrington (1987:193) states that this is a logical part of any pricing model but, as with the CAPM, nothing is said about the borrowing and lending rates.

- Capital markets are perfectly competitive and there are no market imperfections such as transaction costs, taxes and restrictions on short-selling and all relevant information is simultaneously and costlessly available to all investors (Harrington 1987:193; Laing 1988:17; Linley 1992:20). Harrington (1987:193) also notes that, as with the CAPM, these imperfections cause difficulties in pricing, and hence they are assumed away.

In addition to these assumptions, the APT also requires some unique assumptions of its own. These are:

- Investors are in agreement about the number and nature of the factors which are important in the systematic pricing of assets (Harrington 1987:193; Laing 1988:17; Linley 1992:20). This unique assumption of the theory suggests that returns are generated by a number of factors, not only the market, and that investors believe these to be all the factors which are important in the pricing of assets (Harrington 1987:194; Linley 1992:20,21).

- No arbitrage profit opportunities are available. This assumption describes investor behaviour. Investors are active in their pursuit of opportunities for riskless profits, and through their activities these opportunities are eliminated (Harrington 1987:193,194; Linley 1992:20,21).

Following from these assumptions, the next section examines a fundamental aspect in asset pricing, namely risk, and how the APT views risk and describes the risk/return relationship.

4.3.3 Risk and the APT

The underlying rationale behind the APT is that if a particular risk factor only affects a certain sub-set of shares, then this element of risk will be priced in those shares in order to ensure that share returns compensate for this additional risk factor. If markets are not efficient and this does not occur, then arbitrageurs will be able to take advantage of arbitrage opportunities and so eliminate risk in order to earn abnormal returns (Rees 1995:173).

While it is possible for investors to eliminate unsystematic risk through diversification, the APT asserts that investors cannot eliminate a share's exposure to various macro-economic factors. The beta coefficients will, however, vary from share to share, depending on the exposure of each share to each macro-economic variable (Dobbins *et al.* 1994:131).

As stated above, different shares will have different sensitivities to these systematic risk factors and it follows that investors' risk preferences will, to a degree, be influenced by and reflect these risk variables. Each investor will have a different attitude and will, thus, construct their portfolios based on the exposure of the shares to each of these risk factors. It follows that it will be possible, if the market price of these risk factors and the sensitivity of each share's returns to changes in the factors are known, to estimate the expected return for each share (Jones 1998:245).

The APT states that the risk premium for each share will depend on each factor's premium in combination with the sensitivity of each share to these factors. It relates the expected return of a share to the risk-free rate of return and to the various factors that systematically affect returns (Linley 1992:21; Jones 1998:243).

The factor formula for the APT can be formally stated as per formula 4.3

Formula 4.3 The arbitrage pricing theory factor-model

$$R_j = E\left(R_j\right) + b_{j1}f_1 + b_{j2}f_2 + \ldots + b_{jn}f_n + \in_j$$

for:

j = 1 to n

n = Number of assets

where:

R_j = The rate of return on asset j during a specified time period

$E\left(R_j\right)$	=	The expected rate of return on asset j
b_j	=	The sensitivity of asset j's returns to a factor
f	=	A common factor with zero mean that influences the returns on all assets under consideration
ϵ_j	=	A random error term, unique to asset j, that, by assumption, is completely diversifiable in large portfolios and has a mean of zero

Source: Weston and Copeland (1992:422), Reilly and Brown (1997:298,323) and Jones (1998:243,244).

Reilly and Brown (1997:298,323) provide some further elaboration on two elements of equation 4.3:

- The term *f* refers to the various systematic macro-economic factors that are expected to have an impact on share returns and according to the theory there are many such factors.
- The term *b* determines how each share reacts to the common systematic macro-economic factors.

The APT equation asserts that there is a linear relationship between expected returns and the various sensitivities to the major factors in share returns (Sharpe 1985:197). The equation states that the expected return of a share is related to its factor betas and these factors represent risk that cannot be diversified away. It follows that the higher a share's sensitivity to a specific factor, the higher its risk and the equation states that the expected return on a share is a combination of the risk-free rate plus compensation for each type of risk borne (Ross *et al.* 1990:310).

According to Jones (1998:243), a factor model like the APT is based on the principle that there are various risk factors that affect expected and realized returns. These factors are broad economic factors, are not company-specific and reflect unexpected changes of the factors from their expected values.

Reilly and Brown (1997:299,323), however, note that the APT does not identify these factors. The number and nature of these factors will be investigated when the empirical studies are reviewed. In the next section the nature and characteristics of the APT factors, and the principles of factor identification, will be examined.

4.3.4 Identification of the factors to be included in the APT

As previously stated, Ross (1976), in the development of the theory, made no statement about the identity of the factors that affect returns. He did, however, state that the whole theoretical and empirical structure should be explored in order to obtain a better understanding of the economic forces/factors that systematically affect actual returns (Van Rhijn 1994:153).

Harrington (1987:190) restates the problem associated with the identification of the factors that affect share returns, by pointing out that the APT makes no statement and provides no guidance about the nature of the factors, their magnitude or their signs. Nor does it provide any guidance on how these aspects should or could be determined.

According to Brevis (1998:88) a factor that is priced could be described as an uncertain economic variable that will affect the expected returns on shares or portfolios of shares.

Fogler (1982) identifies the following three criteria that can be used to identify these priced factors (Brevis 1998:89):

- The factor should be significant and stable, meaning that the covariance between the identifiable factors should be the same under all economic scenarios.

- The factors should be representative of all systematic movements in returns.
- The identifiable factors should be independent from one another. If the correlation between the factors is equal to zero, returns could be explained by only adding the effect of one factor to the effect of the previous factor.

Radcliffe (1990) classifies the factors that influence returns as follows (Brevis 1998:88):

- Factors that influence all the shares.
- Factors that only affect a sub-set of all the shares.
- Factors that only affect a single share.

Factors that only affect a single share can be reduced through diversification and are not priced factors. Those that affect all the shares should be considered as priced factors, but it is unclear whether those that only affect some of the shares should be included. According to Radcliffe (1990) this will depend on whether the uncertainty related to these factors could be eliminated through rational diversification. Those that cannot be eliminated through rational diversification should be considered as priced factors (Brevis 1998:89).

To conclude, the APT was developed without the factors affecting returns being identified. These factors are, however, likely to differ between industries and even between shares within industries (Laing 1988:22). It is only through empirical investigation that these factors and their characteristics can be established. Before these empirical findings are reviewed, it is first necessary to consider the theory's validity, to compare it with the CAPM and to consider its application in investment decision-making.

4.3.5 Tests and validity of the APT

The APT has relatively few assumptions, but it provides little help with the identification of the priced factors and the relationship between these systematic factors and expected returns. Herein lies the main challenge for researchers in establishing the validity of the theory. Three questions, that need to be answered through empirical testing, have been identified to establish the validity of the APT (Harrington 1987:194):

- Does more than one factor explain returns?
- Are the APT factors the only risk factors which are priced?
- What are these APT factors?

4.3.5.1 The number of factors determining returns

Only a review of the empirical evidence can provide a definite answer to this question, but it can generally be concluded that the research on the APT has found there to be more than one priced factor. Harrington (1987:195,200), however, notes that the research has also found the market to be an important factor in explaining returns and that the controversy surrounding this issue is ongoing and far from over.

4.3.5.2 The APT factors are the only risk factors which are priced

To answer this question, empirical findings must show that the factors identified are not correlated to each other and, also, that no other important factors exist. If the empirical results confirm these conditions, this would suggest that the APT provides a good description of the pricing mechanism (Harrington 1987:201).

Harrington (1987 : 202) also notes that the methods for factor estimation and testing are not as yet entirely resolved. The question of which method to use and how to interpret the results must still be solved through ongoing research and, thus, it is still unclear whether the APT is superior to the single-factor CAPM.

4.3.5.3 The factors of the APT

Again, the results of empirical testing are inconclusive as to the number and identity of the factors that affect returns. It is only through a review of the empirical tests that the current knowledge regarding the APT factors can be ascertained, but it is worth noting that different studies have found different factors for different periods and datasets. Although these studies suggest a great deal of instability in these factors, the research continues unabated and a comprehensive and stable list of factors cannot be provided at this stage (Rees 1995:173).

It is also useful to note that, up to the mid-1980s, the macro-economic variables identified were:

- Industrial production (or the market index).
- Changes in a default risk premium.
- Twists in the yield curve.
- Unanticipated inflation.
- Changes in the real rate.

  (Chen, Roll & Ross (1986), in Weston & Copeland 1992:423.)

The only conclusion that can be reached at this stage is that the factor issue surrounding the APT remains unresolved and, hence, that the controversy about the APT versus the CAPM also remains unresolved. In the next section the comparison and competition between these two models are examined in more detail.

4.3.6 The APT versus the CAPM

Ross *et al.* (1990:309) state that the APT and the CAPM are alternative models of risk and return, that there are various differences between them and that it is worthwhile to consider these differences. The following are some of the differences noted:

a. Seneque (1987:34), Laing (1988:31) and Van Rhijn (1994:154,155) list six different reasons why the APT can be considered more robust than the CAPM:

   - The APT requires no assumptions about the distribution of returns.
   - The APT requires no strong assumptions about investors' utility curves, other than that they are assumed to be motivated by risk aversion and greed.

- The APT states that equilibrium returns can be and are dependent on many factors, not only beta.
- The APT does not require that the entire universe of assets (the total market portfolio) be measured for empirical testing. It can be used to establish the relative pricing of any sub-set of assets.
- The CAPM requires that the market portfolio be known and be efficient, while the APT places no special emphasis on the market portfolio.
- The APT can easily be extended to a multi-period investment framework.

b. Assuming a one-factor state, in the APT the beta of a share measures its sensitivity to the factor, while in the CAPM the beta measures the share's sensitivity to movements in the market portfolio (Ross *et al.* 1990:308).

c. A major disadvantage of the APT is that it does not define the nature and identity of the factors that affect share returns, but requires that these be established through empirical testing (Seneque 1987:34).

This provides the CAPM with an important advantage in that it states that only one, well-defined factor is priced. Although this has had its problems with empirical testing, it may account for its continued wide-spread use (Seneque 1987:34).

d. Ross *et al.* (1990:310) identifies another important advantage the CAPM has over APT. The CAPM ensures the discussion of efficient sets, which is of great intuitive value, but this is not easily achieved through the APT.

e. Ross *et al.* (1990:310) also identify an off-setting advantage of the APT. The APT equation adds factors until each share's unsystematic risk is uncorrelated with every other share's unsystematic risk. Through this process it is not only shown that unsystematic risk decreases with diversification, but also that systematic risk does not. This result is also achieved with the CAPM, but to a lesser extent as unsystematic risk could be correlated across shares.

f. Ross *et al.* (1990:310) state further that the APT has a significant advantage in that it can handle multiple factors, while the CAPM cannot. The advantage stems from the fact that multi-factors are probably a better reflection of reality, as it is probably more realistic that a model should abstract from both industry-wide and market-wide factors in order to achieve a situation where the unsystematic risk of a share becomes uncorrelated with the unsystematic risk of all other shares.

g. According to Sharpe (1985:199), the CAPM supplements the APT and, hence, these two models should not be compared from a replacement point of view. The two models combined make stronger predictions than they could on their own and as a combination they improve investment decision-making.

h. Tests of both models have proved to be controversial, but have in general showed the APT to have greater explanatory power than the CAPM. On the other hand, investment analysts have criticised the APT in that computer analysis programs determine the factors and these factors then have no meaning on their own. This makes it difficult to develop forecasts based on the APT (Viscione & Roberts 1987:206). It is from this experience of investment analysts, that Viscione and Roberts (1987:206) conclude that investment consultants continue to use a multi-factor CAPM, which include factors such as dividend-yield, firm size, trading volume and the market factor, rather than the APT.

Following on the comparison between the two models, it is now appropriate to examine the application of the APT in investment decision-making. Obviously its application overlaps those areas already examined with the CAPM, but there are specific applications for which it is particularly well suited.

4.3.7 Application of the APT in investment decision-making

The introduction of the APT has led many to believe that it would solve the theoretical, empirical and practical problems associated with the CAPM (Harrington 1987:218). It is argued that it offers an opportunity for and approach to strategic portfolio management. Through the identification of the factors which affect share returns, investors should be able to structure their portfolios in such a way as to improve its design and performance (Jones 1998:245).

Harrington (1987:219) notes that many portfolio managers have for a long time considered basic changes in the structure of the economy when making share selection choices and establishing their portfolio management practices. With the development of the APT, these models of economic sensitivity could be formalised. Computer models which can estimate the sensitivity of shares and portfolios to economic factors have been developed, and these assist portfolio managers to select shares and structure portfolios to meet certain factor-sensitivity criteria.

Jones (1998:246) also emphasises the application of the APT in portfolio management. It provides managers with the opportunity to design investment strategies whereby their portfolios would be exposed to one or more risk factors or to structure portfolios in such a way that its exposure to unexpected changes in a factor or factors mirror that of the market as a whole.

Through active investment management, managers who believe they could forecast factor realization would be able to construct portfolios which emphasise or de-emphasise a specific factor or factors. This would enable these managers to then select shares which have exposure to the remaining risk factors that were exactly proportional to the market. In this way managers would be able to outperform the market for the forecast period, on the condition that they could accurately forecast the unexpected changes in the risk factor or factors (Jones 1998:246).

Hence, application of the APT provides opportunities for active investment management and improved share selection and portfolio construction, but this is constrained by investment managers' ability to measure these factors accurately and to accurately predict unexpected changes therein. Only time and empirical research will tell how successful such APT-based share selection and portfolio management models are. This now leads to the final part of this discussion on the APT, the review of the empirical research thereon up to the mid-1980s.

4.3.8 Research related to the APT

Sharpe (1985:394) states the following about the APT and the testing thereof:

> Since the APT assumes a factor model of security returns, any test of its predictions must incorporate such a factor model and be, in effect, a joint test of the equilibrium theory and the appropriateness of the selected factor model.
>
> Moreover, the APT makes relatively weak predictions. It does imply that when all pervasive factors are taken into account the remaining portion of return on a typical share should be expected to equal the riskless interest rate. Testing this implication is possible in principle, but difficult in practice. It may never be possible to find a set of shares so diverse that consistency of the zero factor with riskless interest rates can be used as a test of the APT.
>
> A more promising test concerns the prediction that share expected returns will be related only to sensitivities to "pervasive factors". In particular, there should be no relationship between expected returns and shares' nonfactor risks.

Two basic ways to test the APT exist:

- The first is known as factor tests, whereby factor analysis is employed in order to establish the number of priced factors and their magnitudes (Dobbins *et al.* 1994:131; Levy & Sarnat 1994:345).

- The second is specified factor tests, whereby hypotheses are formulated about the factors which are relevant to the return-generating process, for example, inflation, interest rates, changes in production, etcetera. These factors are then used in a regression analysis to establish whether they explain share returns. It should, however, be noted that this can be an ad-hoc method as there exists no theoretical foundation why these factors are more relevant than others in explaining returns. Economic theory can, however, be used as guidance (Dobbins *et al.* 1994:131; Levy & Sarnat 1994:345).

  A subset of these tests are tests whereby the APT is compared with the CAPM with the aim of establishing whether it can explain anomalies, such as the size effect and January effect, better than the CAPM (Reilly & Brown 1997:327).

Brevis (1998:97) states that the first objective of empirical testing is to establish whether share returns are affected by multiple risk factors and, secondly, to determine the nature of these factors.

Following from this the results of the international research (studies on the US market unless otherwise indicated) conducted up to the mid-1980s will be reviewed, whereafter the South African studies will be examined.

4.3.8.1 Research on the number of APT factors

Roll and Ross (1980)

In the first published test of the APT, Roll and Ross used factor analysis and daily share returns for the 1962 to 1972 period to estimate the number and importance of the factors for 42 portfolios of 30 shares each (Harrington 1987:195; Seneque 1987:34). Reilly & Brown (1997:325) note that they used the following two steps in their test:

- The expected returns and factor coefficients were estimated using time-series analysis of individual share returns.

- Using these estimates, the cross-sectional pricing conclusions of the APT were tested to establish whether the expected returns of the shares were consistent with the factors derived in the first step.

Their initial findings showed that there are at least three important pricing factors, but also that it is unlikely that there are more than four significant factors. They then allowed the model to estimate the risk-free rate and found that the original finding of three factors was probably an overestimate as only two factors were now found to be consistently significant (Reilly & Brown 1997:325).

In a further test, they tested whether the APT is valid. To achieve this, they examined whether the shares' standard deviations are significant in affecting expected returns. This should not be the case because the unsystematic component of risk should be eliminated through diversification, while the systematic risk should be explained by the factor loadings. They initially found that a share's own standard deviation is significant, but this disappears after adjusting for skewness (Reilly & Brown 1997:325).

The final test was an investigation of whether the same factors affect different portfolios and they found no significant evidence that this is not so (Reilly & Brown 1997:326).

Roll and Ross concluded that, although these initial tests were admittedly weak, their results provide support for the APT and that there are more than one factor which affect returns (Seneque 1987:34; Reilly & Brown 1997:326).

Fogler (1982)

In an attempt to show that different shares are affected differently by the priced factors, Fogler used principal component analysis on 100 shares for the 1941 to 1969 period. Four common, but unidentified, factors were used and different factor sensitivities were found. (Harrington 1987:195).

Brown and Weinstein (1983)

Using a bilinear paradigm and the 1980 data of Roll and Ross, Brown and Weinstein found results in conflict with the APT. After adjusting their test for a large sample size they found results consistent with a three-factor APT model, but not for five-factor and seven-factor models. They concluded that there are few rather than many APT factors (Van Rhijn 1994:165; Reilly & Brown 1997:329).

Chen (1983) and Reinganum (1981)

Their tests also found that at least three to four factors are important in explaining share returns (Weston & Copeland 1992:426).

Hedge (1983)

In a review of some empirical tests, using both principal component analysis and factor analysis, it was shown that the findings are generally in agreement with those of Roll and Ross (1980). However, it was found that the second and third factors do not make a significant contribution to variance and, although they are statistically significant, may not be important in asset pricing (Hedge 1983:2,117,118).

Cho, Elton and Gruber (1984)

This analysis followed the same procedure to that of Roll and Ross (1980), but with different data from a later period (Linley 1992:24; Elton & Gruber 1995:377). They examined different sets of data in an attempt to establish whether the number of significant factors remain between three and five. They found that even when a two-factor model is used to generate returns, it still requires two or three factors to explain returns. Cho *et al.* concluded that their findings support the APT model as the model allow these additional factors to be taken into account (Reilly & Brown 1997:326).

Dhrymes (1984) and Dhrymes, Friend and Gultekin (1984)

Both these studies criticized the findings of earlier studies, especially Roll and Ross's 1980 study, and even questioned the validity of empirical studies of the APT. Dhrymes *et al.* confirmed the findings of Dhrymes that the number of significant factors are an increasing function of the size of the sample analysed (Harrington 1987:196,197; Van Rhijn 1994:158; Elton & Gruber 1995:378).

Seneque (1987:35), Van Rhijn (1994:158,159) and Reilly and Brown (1997:326) note that the criticisms are centred around two main issues:

- Firstly, Roll and Ross (1980) divided their sample into numerous portfolios of 30 shares each and, thus, the results differ from those of a large portfolio. They also found no relationship between the factor loadings for groups of 30 shares and those of 240 shares.

- Secondly, the number of factors change with changes in portfolio size and they were not able to identify the actual number of factors involved in the return-generating process. They found, for example, that portfolios of 15 shares have two factors, portfolios of 45 shares have four factors and for portfolios of 90 shares there are as much as nine factors. This also creates the problem of establishing which of these factors are significant in explaining returns.

Cho (1984)

Cho disagreed with the Dhrymes (1984) and Dhrymes *et al.* (1984) studies. Using a different factor analysis technique, five to six factors were found and it was concluded that the number of factors do not depend on the size of the sample (Harrington 1987:197).

Roll and Ross (1984) and Ross (1984)

These articles were written in reply to the findings and criticisms of the Dhrymes, Friend and Gultekin (1984) study. Roll and Ross disagreed with the findings of Dhrymes *et al.* and took exception to the conclusion that the number of factors increases with an increase in sample size. While they agreed that the number on non-priced factors will increase with sample size, they stated that these are not important and can be diversified away. They concluded that the issue of the number of factors is secondary and it is more important how many factors are significant (priced) in a well-diversified portfolio and how well the model explains the return-generating process compared to other models (Harrington 1987:197; Linley 1992:25; Reilly & Brown 1997:326).

In his comments on the Dhrymes *et al.* (1984) tests, Ross stated that some tests can be classified in three basic categories:

- Tests that are wrong.
- Tests that are misdirected and beside the point.
- Tests that are mystifying and, hence, cannot be classified into either of the first two categories (Harrington 1987:200).

Dhrymes, Friend, Gultekin and Gultekin (1985)

This study repeated the previous tests of Dhrymes *et al.* (1984), using a larger group of shares. They found evidence which confirmed the earlier results, in that as the number of shares in each group increases so do the number of factors and number of priced factors. However, most of the factors are not priced. They found, further, that total standard deviation is at least as important in explaining returns as is the factor loadings, that the number in the time-series affects the number of factors and, also, that the size of the group affects the model's intercept (Reilly & Brown 1997:327).

Reilly and Brown (1997:327) conclude that these findings are evidence against the validity of the APT, since it indicates dramatic instability in the risk/return relationship and that the size of the group and number of observations affect the number of factors identified. The fact that total standard deviation was found to be significant provides further unfavourable evidence.

Most of the early research was concerned with establishing the number of significant factors influencing share returns and from these flowed the studies which attempted to identify these factors. However, by the mid-1980s there was no consensus about the number of factors and much less about their identity. Much research was still needed to establish the number and nature of the factors to ensure the APT has practical value.

4.3.8.2 Evidence on the testability/usefulness of the APT

Litzenberger and Ramaswamy (1979) and Sharpe (1982)

Both these studies, although not direct tests of the APT, showed that if factors such as dividend-yield, firm-size and the beta of long-term bonds are added to the model, it shows that a multi-factor model has better explanatory power than a single-factor model (Brevis 1998:103).

Shanken (1982)

In a critique similar to those of Roll (1977,1980) on the CAPM, Shanken questioned and challenged the usefulness and empirical testability of the APT. Linley (1992:29) describes the basis of Shanken's criticism as being concern about its apparent lack of an exact linear return relationship. Further, that the factor model can be manipulated to produce any number of variables as factors and, hence, factor analysis is an inadequate method for the identification of the random variables that are important in asset pricing.

A further source of criticism is added by Harrington (1987:200), who points out that Shanken argued that equivalent sets of shares may be subject to different factor structures and the APT may, therefore, provide inconsistent implications. Shanken also contended that if returns are not explained by the factor model, it is not considered evidence against the model, but if it does explain returns then it is considered as support for the model (Van Rhijn 1994:163; Reilly & Brown 1997:329).

Shanken concluded that as the APT provides no guidance on the nature and magnitude of the factors, it suffers from a similar problem to the impossibility of identifying the true market portfolio experienced with the CAPM (Linley 1992:29; Van Rhijn 1994:164; Reilly & Brown 1997:329). The enthusiasm about the APT as a testable alternative to the CAPM may thus not be appropriate (Harrington 1987:200).

Dybvig and Ross (1985)

Dybvig and Ross countered Shanken's (1982) criticisms and concluded that the APT is indeed testable and that the criticisms are not really relevant for actual empirical testing (Harrington 1987:200; Linley 1992:29).

According to Van Rhijn (1994:166), Dybvig and Ross's conclusions on the testability of the APT can be summarised as the following:

- The APT assumptions ensure that portfolios with identical factor loadings are close substitutes and the APT should be empirically testable as an equality.

- Both the CAPM and the APT are closely linked to separation theory, two-fund separation and k-fund separation respectively.

- If returns are generated by a factor model and no particular asset is in large aggregate supply, then the CAPM implies the APT, but the APT does not imply the CAPM.

Shanken (1985)

Shanken disagreed with Dybvig and Ross's (1985) conclusions and argued that a set of testable equilibrium APT pricing models have been developed, but that the original APT is not testable as specified (Reilly & Brown 1997:329). He suggested further that the equilibrium factor models as discussed by Dybvig and Ross (1985) are generalisations of the basic CAPM in a multi-beta format (Harrington 1987:200).

Dhrymes, Friend and Gultekin (1984) and Roll and Ross (1984)

Both these studies, the comments thereon and the resultant follow-up findings were examined earlier in section 4.3.8.1. Laing (1988:38) considers these to be evidence on the testability of the APT, which is to be considered in conjunction with the studies already listed.

The situation regarding the testability and usefulness of the APT was unclear by the mid-1980s. Although there were controversial arguments, it does appear as if there was a growing body of research that considered the APT to be an usable alternative to the CAPM, but its testability required further investigation.

4.3.8.3 Research on the nature of the APT factors

Sprinkel (1972)

In this study, performed outside the framework of the APT, Sprinkel showed that changes in money supply and changes in market indices are leader indicators of the business cycle. He also showed that changes in money supply can be used to predict changes in market indices (Brevis 1998:121). Brevis (1998:121) adds that money supply should be investigated as a possible APT factor.

Chen, Roll and Ross (1983,1986) and Roll and Ross (1983,1984)

In their 1983 study, only published in 1986 and reported on by Roll and Ross (1983), Chen, Roll and Ross analysed data on the NYSE for a 27-year period. Although they did not attempt to predict market returns, they correlated various macro-economic variables with returns on five portfolios which mimicked the underlying factors, and found the following five macro-economic variables to be significant in explaining share returns:

- Growth, both anticipated and unanticipated, in industrial production.
- Unexpected changes in the default risk premium.
- Unexpected changes in the term structure of interest rates.
- Measures of unanticipated inflation and unexpected changes in inflation.
- A market factor, that is, changes in the stock market index (Harrington 1987:91, 202; Seneque 1987:34; Reilly & Brown 1997:472).

The market index is included as a proxy for factors that may have been omitted, because if the market factor is found to be significant in pricing, then it means that either the factors have not been correctly measured or that there are one or more factors missing (Harrington 1987:204).

In 1984 Roll and Ross acknowledged that there could be many other factors which can affect returns, but those identified are the most significant since many of the others only affect returns through their impact on the four main factors identified (Linley 1992:26).

Elton, Gruber and Rentzler (1983)

This study examined the impact of inflation on returns and, after deriving an equilibrium model of real returns, the researchers employed the APT assuming inflation is not a priced factor. They contended that it is important that APT models should be used with factors which are not only statistically identifiable, but which have some real economic meaning, such as inflation and growth in real GNP (Van Rhijn 1994:163; Reilly & Brown 1997:328,329).

Gultekin (1983)

In a study outside the APT framework, Gultekin examined the relationship between share returns and inflation for 26 countries. These countries excluded the US and UK, but included South Africa. No reliable positive relationship could be found and it was also found that the inflation/return relationship is unstable and differed from country to country (Brevis 1998:113).

Solnik (1983) and Geske and Roll (1983)

Solnik examined the relationship between share returns and expectations about inflation for nine countries during the 1971 to 1980 period and found results similar to those of Gultekin in 1983. Similar results were obtained by Geske and Roll, who found a negative relationship between share prices and expected inflation. Both these studies were also not conducted within an APT framework (Brevis 1998:113).

Various studies

Various other studies, performed outside the APT framework, also found that expected inflation, unanticipated inflation and changes in expected inflation are negatively related to share returns. Such studies include those of **Lintner (1975)**, **Jaffe and Mandelker (1976)**, **Nelson (1976)** and **Fama and Schwert (1977)** (Brevis 1998:113).

The identification of the relevant priced factors is still in its inception. Considerable controversy and argument were associated with the initial testing of the APT, and much research and debate are still required to identify these factors, to understand the APT and to determine its strengths and validity (Harrington 1987:204). However, it will not be easy to determine the appropriate factors and those that have so far been identified were included for reasons of common sense and convenience, and not derived from a theoretical basis (Ross *et al.* 1990:311).

4.3.8.4 Research on the APT versus the CAPM

Brown and Warner (1980)

Brown and Warner compared the basic single-factor CAPM with various multi-factor based CAPMs in an attempt to establish which model best identify the abnormal returns included in the data. They concluded that there is no evidence that the more complex models outperform the simple models (Laing 1988:vii).

Reinganum (1981)

Reinganum investigated whether the APT can explain the small firm effect, an anomaly which the CAPM can not explain, whereby small firms (based on market value) consistently earn higher risk-adjusted returns than large firms. The study examined ten portfolios consisting of shares with similar risk characteristics and the results do not support the APT. He found that small-firm portfolios earn statistically significant positive excess returns, while portfolio for the largest firms earn statistically significant negative excess returns. Reinganum also used different factor models, a three-factor, four-factor and five-factor model, but still found that low-market value portfolios outperform high-market value portfolios. Reinganum concluded that, since the results do not support the APT, it cannot be considered a superior theory or empirical replacement for the CAPM. He did, however, acknowledge that his analysis was a joint test of several hypotheses implicit in the theory and, hence, it was impossible to determine the exact origin of the error (Laing 1988:vi, 36; Van Rhijn 1994:159,161; Reilly & Brown 1997:327,328).

Berges-Lobera (1982)

This study entailed a joint examination of the size effect in both the US and Canadian stock markets. The APT is not supported as it was found that there exists a significant negative relationship between firm size and returns, in excess of that predicted by the APT (Berges-Lobera 1982:127).

Brown and Weinstein (1983)

In their portfolio performance study, Brown and Weinstein found no improvement when the APT is used as a replacement for the CAPM (Weston & Copeland 1992:426).

Chen (1983)

The study of Chen found evidence in support of the APT against the CAPM as well as evidence contrary to the 1981 findings of Reinganum. He concluded that the APT is able to capture missing price information, while the CAPM cannot fully explain returns and is misspecified (Seneque 1987:35; Linley 1992:28; Reilly & Brown 1997:328).

Chen's analysis consisted of 180 shares and five factors and the cross-sectional analysis showed the first factor to be highly correlated with beta. Chen found that the APT is able to provide factors for the residual information related to returns, which the CAPM is unable to capture. A further test was conducted in order to establish whether there are some other variables with explanatory power not included in the APT factor loadings. No such variables were found and Chen concluded that the size effect has no explanatory power after adjustment for risk through the factor loading. Chen also contended that the problems associated with sample size and multiple factors are related to testing of the theory and not the theory itself (Reilly & Brown 1997:328).

Roll and Ross (1983) and Bower, Bower and Logue (1984)

Both these studies found that the APT provides better estimates for the cost of equity of electric utilities than the CAPM (Weston & Copeland 1992:426).

Bower, Bower and Logue (1984)

Using monthly return data for 942 shares and four treasury security portfolios for a period of nine years, Bower *et al.* performed various other tests on the APT and CAPM. They divided the 942 shares into 30 portfolios, used four factors and found that the APT explains more of the variations in returns between the portfolios than does the CAPM. They also compared both models' predictive ability. Using *ex post* analysis of 127 shares over a 10-year period, they compared both models' estimated expected returns with the actual returns of that period. The evidence strongly supports the APT, with the standard deviations of the APT estimates being up to 50% lower than those of the CAPM estimates (Linley 1992:31-33).

Chan, Chen and Hsieh (1985)

Chan *et al.* investigated whether the APT better explains expected returns and whether the size effect disappears when the APT is used to measure expected returns on 20 size-based portfolios. The researches found that the APT is a much more appropriate model than the CAPM, in that the difference in APT expected returns between the largest and smallest size-based portfolios was found to be only 1,5% per annum, while the CAPM rendered a difference of 11,5% per annum. It was also shown that the additional factor in their model, which explains the size effect's variation in returns, is the difference in return between government bonds and high risk corporate bonds (Elton & Gruber 1995:425).

Chen, Copeland and Mayers (1983,1987)

In their comparison between the CAPM and APT, Chen *et al.* found little difference in the performance between these models, except that the APT better explains the impact of dividing the sample into portfolios of similar size (Laing 1988:vii; Weston & Copeland 1992:426).

Though there is some conflicting evidence, it does seem as if the body of research renders greater support for the APT, both from a comparison with the CAPM point of view as well as from an explanatory ability point of view. However, further research is required to get a more comprehensive set of findings from which stronger conclusions could be drawn.

4.3.8.5 Research on APT equilibrium in international capital markets

Sharpe (1985:719) notes that tests on an International Arbitrage Pricing Theory (IAPT) would require the identification of an international factor model, and as no such model had been developed by the mid-1980s it is impossible to say whether the arbitrage pricing relationships hold internationally.

4.3.8.6 South African APT research

Taylor (1977), Visser (1983) and Carter (1984)

These studies showed that there are more than one factor affecting returns on the JSE and, hence, the APT will be able to better explain changes in portfolios returns than does the CAPM (Brevis 1998:6,101).

Gilbertson and Goldberg (1981)

In their study, which was not directly related to the APT, Gilbertson and Goldberg found evidence of more than one factor on the JSE and this provided impetus to the APT studies that followed (Van Rensburg 1998:17). They examined the postulate that the JSE is a small market and thus heavily influenced by its two main sectors, the mining and industrial sectors. They used the Actuaries All Mining Index and the Actuaries Industrial Index in their two-factor model and their results led them to conclude that there are at least two factors, a mining and an industrial factor, that affect share performance on the JSE (Laing 1988:vi,37; Page 1989:78; Brevis 1998:101).

Myers (1981)

In another study outside the APT framework, Myers investigated the influence of the gold price on all gold, mining financing, metals and minerals, financial and industrial indices on the JSE. The findings from the study showed that the gold price has a long and medium-term effect on all the sectors. In the short-term it has the strongest effect on the gold and mining financing indices, a lesser effect on the metals and minerals index and a delayed effect on the financial and industrial indices (Brevis 1998:116).

Page (1986)

The first published South African study on the APT consisted of two main tests for the JSE:

- Regression analysis to compare the explanatory powers of the APT and CAPM.
- Factor analysis to establish the number of priced factors affecting returns.

The main conclusions drawn from these tests were that:

- On an *ex post* basis the APT is substantially better than the CAPM in explaining the variability of returns.
- Security returns are explained by at least two factors and there is a possibility of more factors (Linley 1992:34; Van Rhijn 1994:171; Brevis 1998:101).

In addition, Page also compared his findings with those of Gilbertson and Goldberg (1981). He disagreed with their findings and concluded that it is not the mining and industrial sectors that influence returns, but rather macro-economic variables that influence these two sectors to a greater extent. He also added that a considerable amount of research needed to be done to identify these factors (Linley 1992:34; Van Rhijn 1994:171).

Linley (1992:34,35) notes a definite problem with testing both the APT and the CAPM and comparing these two models in a South African context, namely the limited tradeability of the JSE. This may result in many shares not reflecting all the known information relevant to particular shares and, hence, the effect of the various priced factors may not be reflected in the less traded shares, that is, there may be a degree of market inefficiency.

Despite this deficiency of the JSE, research has proved to be less controversial than the international, mostly US, research. It does seem, in general, as if there are more than one priced factor on the JSE and that the APT may have an advantage over the CAPM in a South African context. Again, more research is required before more comprehensive conclusions can be drawn.

4.3.9 Conclusion

The APT is a relatively new alternative to the CAPM and it does have the advantage of having less restrictive assumptions than the CAPM. By the mid-1980s it had been the subject of a number of empirical studies, but these were hindered by a particular APT difficulty - the theory does not specify the characteristics of the variables that should affect returns. This has proved to be a major point of discussion.

Although there is some evidence that expected returns are affected by more than one factor and that the APT may have greater explanatory power than the CAPM, these results were only tentative. Conclusions on whether the APT provides an accurate description of reality can at this stage only be deemed as preliminary and inconclusive. It is only through a review of additional and more recent research that a clearer and more stable picture of the status of the APT will be obtained.

4.4 THE DEVELOPMENT OF OPTIONS THEORY AND THE BLACK-SCHOLES OPTION PRICING MODEL

The CAPM and the APT deal with the expected risk and return on shares. There are, however, many other kinds of securities in the market, other than shares. A type of security that has been widely studied in recent years is options, which are the basic ingredient in many of the hybrid securities (Hendriksen & Van Breda 1992:187).

Investors can purchase securities that present a claim (an option) on a particular share or group of shares, rather than trade directly in the shares themselves. This option gives the holder the right to receive or deliver shares under predetermined conditions. Options are securities that derive most, if not all, their face value from the equity of a company, but options are often not worth exercising and investors are then able to buy or sell these equity-derivative securities (Jones 1998:526).

It is important to note that the emphasis in this study will be on share options. Other options such as interest rate options, foreign exchange options, etcetera fall outside the scope of the study. The study will examine the importance of options, their nature, types and values. Further, the emphasis will be on put and call options, how these options work, how they are valued, their role in investment management, the efficiency of options markets and the role of the B-S Option Pricing Model in the pricing of options. The final section entails a review of the empirical research on option markets and the B-S Option Pricing Model.

4.4.1 The importance of options and the B-S Option Pricing Model

Although options have been traded for centuries, they remained rather obscure and it was only with the establishment of the Chicago Board Options Exchange (CBOE) in 1973, and the introduction of exchange-traded options that options became attractive financial and investment instruments (Cox & Rubinstein 1982:3; Weston & Copeland 1992:436). The listing of options created a more orderly and active market for these securities and option trading experienced gigantic growth - being among the fastest growing markets for financial assets in the US. Subsequently, options markets were also established in several major financial markets around the world and the growth in option trading continued worldwide (Dobbins *et al.* 1994:151; Elton & Gruber 1995:570).

Prior to the establishment of options markets, traditional (conventional) options could only be bought and sold on an ad hoc basis through options dealers. There were a number of reasons why traditional options remained obscure financial instruments:

- High transaction costs and lack of uniformity among option contracts, since the date of expiration, the exercise price and the option had to be negotiated for each contract.
- Difficulties of guaranteeing option contracts against default.
- Options could only be exercised or allowed to expire since no significant secondary market for unexpired options existed (Dobbins *et al.* 1994:151).

Traded options, which are option contracts with standardised terms, are bought and sold through a central clearing system and are subject to relatively low transaction costs (Dobbins *et al.* 1994:151,152). This led to the growth in option trading and as a consequence stirred interest among academics and practitioners regarding the valuing of option contracts (Elton & Gruber 1995:570). Black and Scholes (1973) started the development of option pricing models when they published their model - the B-S Option Pricing Model. This model has become the industry standard and is used as a benchmark in academic research, is programmed on hand-held calculators and relied on for valuations by professional investors (Jarrow & Rudd 1983:ix).

Although largely falling outside the scope of this study, it is worth noting that the B-S model has been adapted and used in a number of other applications. Weston and Copeland (1992:436) note that Merton (1974) used it to analyse how the value of corporate debt is affected by risk; Galai and Masulis (1976) used it to examine how the value of debt and equity are affected by mergers, acquisitions, expansions and spin-offs; Ingersoll (1976) applied it to value the shares of dual-purpose funds; and Black (1976) used it to value commodity options, forward contracts and future contracts.

Hawinkels (1987:3,4) states that options are basically used in two ways by investors in South Africa:

- Firstly, based on a fundamental or technical outlook, they construct investment portfolios using options.
- Secondly, using an option pricing model, they value options in an attempt to identify under- and overpriced options, that is, they apply the principle of arbitrage, ensuring that the options market remain liquid and efficient.

Hawinkels (1987:4,5) adds that the B-S model is the most widely used in the South African market, but notes two limitations of the model:

- It relies on the accurate estimation of the price/yield volatility of the underlying share.
- It assumes that price relatives are normally distributed.

According to Levy and Sarnat (1994:609) options can be purchased for speculation rather than investing, but their role in corporate decision-making is increasing. Put options have an important role in portfolio insurance and shares can be viewed as call options and can be evaluated using the B-S model.

To summarise, share options trading and the development of the B-S Option Pricing Model provide significant insights into other financial assets. It is therefore useful to develop an understanding thereof and this study will examine the nature and characteristics of options and options markets, the development of option pricing models - in particular the B-S model, the application of options in investment decision-making and empirical tests on the efficiency of options markets and the accuracy and validity of the B-S model.

4.4.2 The nature, types and value of options

Two parties are involved in an options contract, the buyer (option holder) and a seller (option writer) and the buyer has the right, but not the obligation, to exercise the option and if the buyer exercises the option the seller must deliver his part of the contract, that is, deliver the share or shares. If, however, the share price does not move as expected, the buyer can let the option lapse as it has become worthless. Alternatively, if the share price does move as expected, options create the opportunity for substantial gains with very little outlay (Pike & Neale 1996:321).

These, and a number of additional aspects of options and options theory will be examined in the following sections.

4.4.2.1 The nature of options

To understand options, it is important to note that options are not issued by the companies whose shares are traded, thus options have no effect on these companies except for their informational content (Correia *et al.* 1993:726).

Generally stated, share options can be seen as securities which grant its owner the right, but not the obligation, to trade in a fixed number of shares at a predetermined price at any time on or before a given date (Cox & Rubinstein 1982:3; Ross *et al.* 1990:561). Some options have an additional right in that the option need not only be exercised on the date of expiration, but also on any date before then (Gemmill 1993:1). Hence, two kinds of options can be identified:

- **American options**. Options that may be exercised anytime up to and including the expiration date.

- **European options**. Options that can only be exercised on the expiration date (Jarrow & Rudd 1983:5; Van Horne 1992:105).

Gemmill (1993:6) notes that since an American option provides greater flexibility, its value should be at least equal to, or more, than that of an European option on the same underlying share.

Other important elements of options that require some further elucidation are:

- **Exercising the option**. The act of buying or selling the underlying share via the option contract (Ross *et al.* 1990:561).

- **The exercise (strike) price**. The fixed per-share price at which the option holder can buy or sell the underlying asset (Ross *et al.* 1990:562). Jones (1998:528) notes that most shares in options markets have options available at different exercise prices, thus providing investors with a choice, and as the price of the underlying shares rise, so new options with new exercise prices are added. Further, traded options are protected against share-dividends and share-splits, that is, if either of these occur during the life of an option, both the number of shares in the contract and the exercise price will be adjusted where necessary.

- **The expiration (maturity) date**. This is the last day on which the option can be exercised and after this date the option is dead, that is, worthless (Ross *et al.* 1990:562; Jones 1998:528).

- **The option premium**. The initial price that the buyer of the option pays to the writer of the option, both for options to buy or to sell shares (Jones 1998:528).

- **LEAPs**. Long-term options which can have maturities up to two years and beyond (Jones 1998:46,528).

- **Underlying shares**. The shares which are involved in option contracts (Levy & Sarnat 1994:609).

The two basic and most widely traded types of options are call options and put options. Most other options can either be valued as combinations of call and put options or according to the call or put option valuation methodology (Elton & Gruber 1995:570). In the next section these two types of options are examined.

4.4.2.2 Types of options

As noted, basically two types of options are available in financial markets, depending on whether the buyer wants to buy or sell the underlying share, namely call options and put options (Jarrow & Rudd 1983:4).

- **Call options**. These are the most common types of options and provide the holder with the right to buy the underlying share at a fixed price during a particular period. The value of a call depends on the value of the share on the exercise date and if the value of the share exceeds the exercise price, then the call is worth the difference. However, the value of the share may be less than the exercise price and then the call is worthless and the holder will not exercise the option (Ross *et al.* 1990:562,563).

- **Put options**. Put options are the opposite of call options. They provide the holder with the right to sell the underlying share at a fixed price during a particular period. The value of puts are also opposite to those of calls. If the value of the underlying share is less than the exercise price, the holder will buy the underlying share and use the put to sell it. However, if the value of the underlying share exceeds the exercise price, the put becomes worthless and the holder would be foolish to exercise it (Ross *et al.* 1990:564).

Sharpe (1985:471) and Elton and Gruber (1995:570,572) note that both calls and puts can either be American or European by nature, that is, can be exercised any time up to expiration or only on the expiration date.

It is also useful to look at three other option terms. These are expressed from a call option point of view, but are also applicable to its opposite, the put option.

- **In-the-money options**. The current share price exceeds the exercise price of the call and hence it will be worthwhile to exercise the option (Viscione & Roberts 1987:599; Pike & Neale 1996:321).

- **Out-of the-money options**. The exercise price of the call is above the current share price and the value of the call equals zero - it cannot be negative (Viscione & Roberts 1987:599; Pike & Neale 1996:321).

- **At-the-money options**. The exercise price of the option is exactly equal to the current share price (Viscione & Roberts 1987:599).

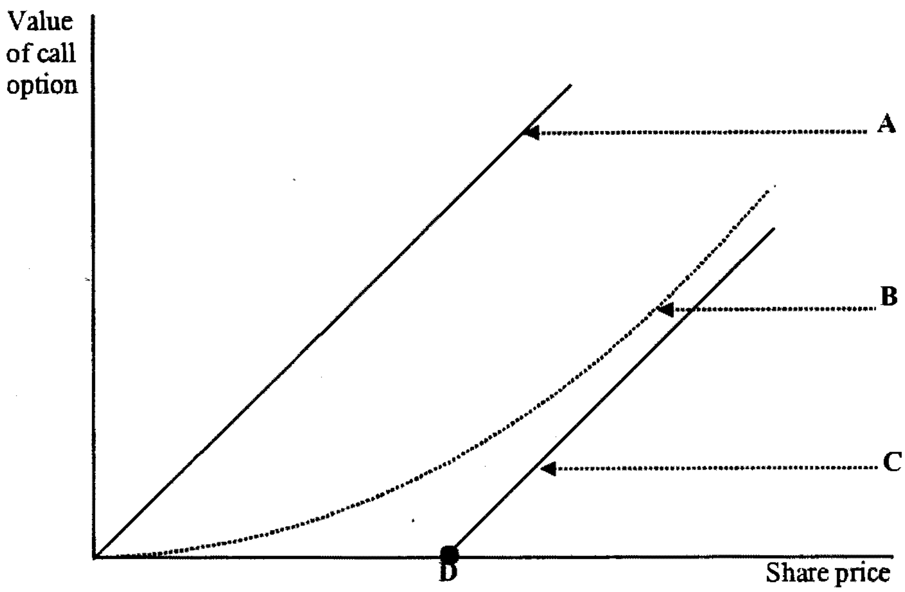
To summarise, when an option expires in-the-money the holder gains the difference between the share price and the exercise price minus the original purchase price, but if it finishes out-of-the money the option is worthless and the holder loses the original purchase price (Weston & Copeland 1992:437; Levy & Sarnat 1994:620).

The following discussion on option value will focus on European call options with a fixed exercise date. As puts are mirror images of calls, they are similarly valued. Although American options have flexible exercise time-frames, the principles of European option valuation also apply to American options (Correia *et al.* 1993:726).

4.4.2.3 Option values

The maximum value of a call is the price of the underlying share. No matter how low the exercise price, if the price of the option is higher than the share price, investors would ignore the option and buy the share directly. Against this, the minimum value of the call is the difference between the share price and the exercise price, and the call has no value if the exercise price exceeds the share price (Correia *et al.* 1993:726). These boundaries of option value are illustrated in figure 4.3.

Figure 4.3 ***Boundaries of call option values***



where:

A = Upper bound, that is, maximum value of a call option

B = Option price curve

C = Lower bound, that is, minimum value of a call option

D = Exercise price of the call option

Source: Correia *et al.* (1993:727) and Jones (1998:545).

The call option value can vary in the range between the upper boundary and lower boundary. Other things being equal, the call value moves towards the upper boundary with an increase in the exercise price and time to expiration. At worst the call value can drop to zero and it can never exceed the share price (Levy & Sarnat 1994:625).

a. Bounds of option values

Gemmill (1993:37,40-42) provides the following discussion on the bounds (limits) of option values:

- The first bound is that an option, both put and call, can not have a negative value. The right to being able to do something is either worth zero or a positive amount.

- The second bound is that the value of a call can not exceed the share price. The right to buy the share can not be worth more than the share itself, since exercising the right only gives the share and nothing more. Applied to put options, this bound is that the value of the put can not exceed the exercise price, since that is what would be paid on expiration.

- The third bound only applies to American options, which can be exercised immediately. The minimum value of an American call is the share price less the exercise price. If this was not so, the purchase of the call and the immediate exercise thereof would provide a riskless profit. For American puts, this bound ensures that the intrinsic value of the put equals the exercise price minus the share price.

- The fourth bound is that if the share price is zero, the value of the call is also zero. An option on a worthless asset must itself be worthless.

- The fifth bound is that the call value approaches its lower bound when the share price is much higher than the exercise price, since the chance that the call will be exercised becomes 100% and all uncertainty value is removed.

b. Basic relationships of option values

Elton and Gruber (1995:577-579) describe how characteristics of options should affect their values in rational markets, and describe a number of basic relationships that any option valuation model should comply with:

- **Relative values of call options with different characteristics**. An American call provides the added benefit of early exercise, hence, it cannot be worth less than the European call. The first relationship is that an European call with the same exercise price and expiration date as the American call can not be more valuable than the American call. The second relationship is that if two calls have the same expiration date, but differing exercise prices, the one with the higher exercise price cannot be worth more than the one with the lower exercise price. This is logical, as both holders will have the same share, but the latter will have some cash left over.

- **Minimum value of an European call option**. The third relationship is that the value of an European call is at least the greatest of zero and the difference between the share price and the present value of the exercise price.

- **Early exercise of an American call option**. According to the fourth relationship it is not worthwhile to exercise an American call before expiration if the share does not pay dividends or if the exercise price is protected against dividends. This relationship does not hold if the call is unprotected and the share does pay dividends. The logic behind this relationship is that the call is worth more alive than dead, since, due to its uncertainty value, it would be better for the investor to sell the option rather than exercise it.

- **Put-call parity**. The fifth relationship is put-call parity whereby a call and the underlying share can be combined so as to render the same payoff pattern as the put, or a put can be combined with the underlying share so as to provide the same payoff pattern as the call.

Weston and Copeland (1992:440,441) note that there exists a fixed relationship, derived by Stoll (1969), between European call and put options written on the same shares, with the same exercise price and having the same maturity date. As a consequence, no separate pricing models are required to value call and put options.

According to Elton and Gruber (1995:581) the put-call parity relationship, although it may not hold perfectly for American options, has been shown to be a close approximation of the actual market relationship.

The put-call parity relationship is formally expressed as an equation by formula 4.4.

Formula 4.4 Put-call parity

$$P = C - S + EP/\left(e^{rt}\right)$$

where:

P = Value of a put option

C = Value of a call option

S = Current market price of the underlying share

$EP/\left(e^{rt}\right)$ = Present value of exercise price

EP = Exercise price

e = The base of natural logarithms, approximately 2.71828

r = The riskless interest rate continuously compounded

t = The time remaining until expiration, expressed as fraction of a year

Source: Galai (1982:69,70) and Jones (1998:549).

c. Determinants of option values

There are seven basic factors which have an influence on the value of options:

- **The underlying share price**. The higher the share price for a call and the lower for a put, the greater the value of the option since there exists large anticipated returns at expiration (Jarrow & Rudd 1983:16).

- **The exercise price**. The greater the exercise price of a put relative to the share price, the more valuable the put. Similarly, the lower the exercise price of a call relative to the share price, the more valuable the call (Jarrow & Rudd 1983:17).

- **The time to expiration**. The longer the time to expiration the more the present value of the exercise price is decreased. Since a call holder has to pay this amount the value of the call increases, but as the holder of the put has to receive this amount the value of the put decreases. However, the uncertainty associated with the longer time to expiration increases the possibility of favourable outcomes for both puts and calls. In conclusion, call values increase with increases in time to expiration, but with puts the answer is less clear since two opposing factors influence their values (Jarrow & Rudd 1983:17).

- **The risk-free interest rate**. An increase in the interest rate decreases the present value of the exercise price, hence, call values will increase and put values will decrease when the interest rate rises (Jarrow & Rudd 1983:17,18).

- **The volatility of the underlying share**. The more variable the underlying share price the more valuable the call since there is a bigger chance that the exercise price will be lower than the share price. Volatility also increases the value of a put. A put that is deep-in-the-money is more valuable than one only slightly-in-the-money, but a put that is deep-out-of-the-money has the same value (zero) as one only slightly-out-of the-money. In both cases, volatility decreases the downside risk relative to upside risk and thus increases value (Ross *et al.* 1990:573, 576).

- **Dividends**. The payment of dividends on unprotected European options will decrease call values and increase those of puts. The payment of dividends generally causes share prices to drop significantly as they go ex-dividend, increasing the possibility of calls expiring out-of-the-money and puts expiring in-the-money (Jarrow & Rudd 1983:17).

- **Strong market trends**. Strong market trends, either being bull markets (moving upwards) or bear markets (moving downwards) generally have an effect on option values since the scope for making profits is increased, depending on the type of option (Pike & Neale 1996:328).

Van Horne (1992:124) and Weston and Copeland (1992:439) note that a perfectly riskless (hedged) position could be achieved using options. This could be obtained by buying the share, buying a put option on the share and selling a call option on the share. Van Horne (1992:124), further, notes that if the markets were efficient, the return on a perfectly hedged position would be the risk-free rate and this principle can be used to determine the value of the option at the beginning of the period. In the next section options markets and their efficiency are examined.

4.4.3 The options market

As can be seen from the preceding section, options, by their nature, can be valuable securities. This led to options markets being formalised whereby options, especially share options, can be traded in the same way as shares are traded on stock exchanges around the world.

4.4.3.1 Background to the development of options markets

Options are not new and options contracts on commodities, such as wheat, have been used since the middle ages. These initial option contracts were sometimes simple fixed-price forward contracts, but at other times merchants could also have the option to back out. These commodity options were not without their problems as in 1636 the Amsterdam options market for tulip bulbs collapsed when the sellers of options refused to buy the bulbs in terms of their option contracts - the price of tulips had fallen drastically and they were not prepared to still pay the high prices specified in the contracts (Gemmill 1993:6,7; Pike & Neale 1996:319).

Before the establishment of organised options exchanges, traditional put and call options (mostly of an European nature) could be bought and sold in the over-the-counter (OTC) market. Option brokers or dealers brought the buyers and sellers together and the terms of each contract had to be negotiated. This was a cumbersome process with high transaction costs and, since the option contracts were not standardised, no effective secondary market for trading in options existed (Jarrow & Rudd 1983:6; Hodges 1988:3; Jones 1998:528).

These problems were overcome with the establishment of the first traded options market, the CBOE, in 1973. The CBOE was an immediate success and options trading had a rapid growth. With this growth other exchanges also started trading in options (Hodges 1990:3). These included the American Stock Exchange, the Philadelphia Stock Exchange, the Pacific Stock Exchange and the New York Stock Exchange in the US. In Europe, both the European Options Exchange (EOE) in Amsterdam and the London Traded Options Market (LTOM) were established in 1978. LTOM later became part of the London International Futures and Options Exchange (LIFFE). In the mid to late 1980s options exchanges were established in many European countries, including France (MONEP), Germany (DTB), Sweden (OM) and Switzerland (SOFFEX) and in the far-east time zone options were traded by exchanges in Osaka, Tokyo, Singapore and Sydney (Gemmill 1993:7; Pike & Neale 1996:321).

Hodges (1990:4) notes that by 1990 options were traded in at least 14 countries worldwide and that trading volume continued to grow. Gemmill (1993:6) adds that most of the options traded on exchanges are American style.

In South Africa the development of the options market started in the early 1980s, an OTC market was established and the options were switched from European to American style. However, the OTC market was thinly traded and inefficient, which led to the establishment of a traded options market in 1987. This options market on the JSE has also shown rapid growth and options have become established financial instruments in the South African market (Mynhardt 1996:3,4).

Sharpe (1985:475) notes that not all the options written are on shares. In recent years many new and exotic options have been listed and new exchanges have opened that specialize in such instruments.

4.4.3.2 General characteristics of exchange-traded options

Although various variations of the basic exchange-traded options have been developed, including various new and exotic options, these largely fall outside the scope of this study. The discussion that follows only provides the general basic characteristics of exchange-traded options. This serves as elucidation of the aspects discussed with the efficiency of options markets and the later review of empirical research on options and options markets.

Jarrow and Rudd (1983:6) describe four basic characteristics of standardised exchange-traded option contracts:

- Fixing maturity dates so that options expire at set dates.
- Specifying the exercise prices of option contracts.
- Specifying the number of shares per option contract.
- Standardising the procedures to deal with dividends, share-splits, etcetera.

a. Expiration dates

Options generally have a maturity of six to nine months with different expiration dates approximately every three months. These expiration dates belong to an expiration cycle, for example January, April, July and so forth (Jarrow & Rudd 1983:6,7; Gemmill 1993:7).

b. Exercise prices

Exercise prices are rounded-off in bands and as the price of the underlying share moves, new options are generally introduced, but the earlier options remain valid until expiration. For example, exercise prices can be R39, R40 and R41 if the current share price is R40 (Jarrow & Rudd 1983:7; Gemmill 1993:7).

c. Number of shares

The initial number of shares in the contract is standardised so that each option represents 100 shares of the underlying asset. The number of shares and the exercise price can, however, change after share-splits or dividend payments. The options exchange controls this adjustment so that neither party involved in the contract obtains an unfair advantage (Jarrow & Rudd 1983:7).

d. Dividends and share-splits

Listed options are generally not adjusted for cash dividends, but are adjusted for share-dividends and share-splits. The listed options are adjusted on the beginning of the same day as the share's market price is adjusted for the share-dividend or share-split. Since cash dividends do not form part of the general characteristics of traded options, they can have a significant impact on option values (Jarrow & Rudd 1983:7,8).

4.4.3.3 The efficiency and tests of efficiency of options markets

The discussion in this section is based on Galai's (1982:47-50) review of empirical tests performed on option pricing models.

Since the values of options are generated by the values of the underlying shares, measurement of the efficiency of options markets relies on the synchronous price of the shares. It is important to note that synchronous markets, in this sense, are the stock market and the options market where trading in related assets take place simultaneously and the listed prices reflect this trading simultaneously. Therefore, it is necessary that these markets are synchronized and that both are efficient to obtain good predictions of option prices.

A major problem with options market efficiency is that any tests are joint tests of the validity of the model, market efficiency, market synchronization and data accuracy. Due to this problem, it can not be concluded that an option pricing model is invalid if it fails to accurately predict future prices. It may be due to nonsynchronous or inefficient markets, rather than an incorrect model. If, however, a model consistently generates abnormal risk-adjusted profits, which the others can not, this can be construed as evidence in support of the model.

If it is assumed that the data is accurate and the input parameters of the model is unbiased, then the following statements can be made about the efficiency and synchronousness of options markets:

- Given the share price, one would expect the model to predict future option prices accurately, if the markets are efficient and synchronous and the model is accurate.
- If the markets are efficient and synchronous, no model should be able to offer abnormal profits.
- If the markets are nonsynchronous and the model is correct, it should be possible to generate abnormal profits using the model.

Galai (1982:49,50) adds some other potential problems that may be experienced with tests of market efficiency:

- Trading practices may complicate the conclusions drawn from the empirical studies. With thinly traded or low-priced securities, the discreteness of trading with minimum price changes may affect results.
- Another problem is that models are unable to handle the valuation of American options where uncertain future dividends may be paid on the underlying share.
- The existence of transaction costs and taxes may cause distortions in the results obtained from the model.

It is clear from the above that option pricing models are an integral part of testing options market efficiency and, from the preceding section, in determining the value of options. In the next section the predominant and most widely used model, the B-S Option Pricing Model, is examined.

4.4.4 The B-S Option Pricing Model

Given the insights into the characteristics and determinants of call option values, Black and Scholes (1973) developed a formal model for the equilibrium pricing of European call options paying no cash dividends. Due to the existence of a put-call parity relationship, this model is equally efficient in valuing put options of a similar nature (Hendriksen & Van Breda 1992:188; Jones 1998:546).

The B-S model, although having a mathematical and seemingly complex formula, is widely accepted and used in the investment community and is widely available on computers and calculators (Jones 1998:546).

Hendriksen and Van Breda (1992:188) note that the B-S model has a number of assumptions which are similar to those of the CAPM and these assumptions are examined in the next section.

4.4.4.1 Assumptions of the B-S Option Pricing Model

The assumptions listed below are the sufficient conditions needed for the B-S model to be correct. Though, even when these conditions do not hold in reality, variations of the model often works. The B-S equation can be fine-tuned to account for dividends and empirical evidence suggests that the model and its variations do value call options accurately (Ross *et al.* 1990:582). The assumptions on which the model is based are:

- Only European options are considered, that is, that options are only exercisable at expiration.
- There are no transaction costs and no taxes.

- There are no imperfections when options are written, there are no restrictions on short-selling and short sellers receive the full proceeds from their transactions.
- The short-term interest rate is known and constant throughout the life of the option and investors can both borrow and lend at this rate.
- The underlying share pays no dividends.
- The market operates continuously and the variance of return is constant and known to market participants, that is, share trading is continuous and there are no jumps in the movement of share prices.
- The probability distribution of share prices is lognormally distributed (Ross *et al.* 1990:582; Van Horne 1992:114; Levy & Sarnat 1994:635).

Simister (1988:11,12) notes that most of the weaknesses of the B-S model are caused by market imperfections and these weaknesses are:

- Transaction costs are not zero.
- Price movements are not continuous.
- The distribution of prices is neither normal nor lognormal.
- The markets are not infinitely deep.

As noted, despite these weaknesses, the B-S model provides accurate option values and the next section examines the model's parameters and pricing equation.

4.4.4.2 <u>Parameters of the B-S Option Pricing Model</u>

The B-S model provides an exact formula for determining the value of an option and the model is based on the idea that investors can maintain a reasonably hedged portfolio over time. Arbitrage then causes returns to be equal to the risk-free rate and, hence, the price of the option will have an exact relationship with the price of the underlying share (Van Horne 1992:124,125). The equation of the B-S model is shown by formula 4.5.

Formula 4.5 The Black-Scholes option pricing model

$$C = S\left[N\left(d_1\right)\right] - \frac{EP}{e^{rt}}\left[N\left(d_2\right)\right]$$

where:

C = Current value of the option

S = Current price of the underlying share

EP = Exercise price of the call option

e = The base of natural logarithms, approximately 2.71828

r = The riskless interest rate continuously compounded

t = The time remaining until expiration, expressed as a fraction of a year

$N\left(d\right)$ = The value of the cumulative normal density function

$$d_1 = \frac{\ln\left(S/EP\right) + \left(r + 0,5\sigma^2\right)t}{\sigma\sqrt{t}}$$

$$d_2 = \frac{\ln\left(S/EP\right) + \left(r - 0,5\sigma^2\right)t}{\sigma\sqrt{t}}$$

ln = The natural logarithm

σ = The standard deviation of the continuously compounded annual rate of return on the underlying share

Source: Van Horne (1992:116), Elton and Gruber (1995:588) and Jones (1998:547).

Ross *et al.* (1990:582), Upsher (1993:13) and Jones (1998:546) identify the five variables used by the formula as being:

- The current price of the underlying share.
- The exercise price of the option.
- The time remaining until expiration of the option.
- The interest rate.
- The volatility of the underlying share.

Ross *et al.* (1990:582) add that the B-S formula is one of the most important contributions in finance, it allows anyone to calculate the value of an option and has the advantage that four of the parameters are directly observable. It is only the volatility of the underlying share that needs to be estimated.

Before reviewing the estimation of the share's volatility, it should be noted that the attractiveness of the B-S model is increased by the parameters which are not required. These are:

- The investor's risk attitude does not affect the value of the option. Anyone can use the formula, whether they are risk averse or not.

- The expected return on the share does not enter the formula. Investors may have different views on the share's expected returns, but this will not affect the value of the option. Although the value of the option depends on the underlying share's price, that price already reflects the divergent views of all investors (Ross *et al.* 1990:582).

a. Estimating the underlying share's volatility

Volatility, as used in the model, is defined as the standard deviation of the continuously compounded annual return on the underlying share and is the only parameter that is not directly observable (Mulder 1998:84). Volatility is an important variable, since the greater the volatility the greater the chance of the share price going up and, thus, the higher the value of the call option. Hence, there exists a positive relationship between option values and the volatility of share returns (Jones 1998:547).

Jones (1998:547,548) and Mulder (1998:84,85) provide the following descriptions of the methods of estimating volatility:

Historical volatility estimates. Historical data on share returns are used to estimate the standard deviation, and this estimate assumes that past volatility will continue to hold in the future. It has, however, been shown that the variability of share returns changes over time and different users will thus have different estimates, resulting in differing option values. Empirical studies have also shown that the variance obtained from sources other than historical data is more valuable than historical estimates.

Implied volatility estimates. The implied volatility is an estimate that makes the value obtained from the B-S model equal to the current market price of the option. As the current market price of the option is observable, this figure can be inserted into the equation to derive the implied volatility. Thus, the market's opinion of the share's volatility is used as an input to the model.

Gemmill (1993:93) notes that if everybody only uses implied volatility, no forecasting would be done and the consensus forecast derived from the implied volatility becomes useless. The following approach for estimating volatility is recommended:

- Estimate the historic volatility.
- Adjust the forecast for abnormal events.
- Adjust more distant volatilities towards the long-term mean.
- Adjust the volatilities towards the consensus forecast provided by the implied volatilities (Gemmill 1993:93).

b. Adjusting the Black-Scholes model for dividends

A weakness of the basic B-S model discussed so far, is that it assumes that the underlying share pays no dividends. However, traded options are not protected against cash dividends and these can have a significant effect on option values. When a cash dividend is paid, the share price declines and any reduction in share price reduces the value of a call and increases the value of a put (Jones 1998:546).

Sharpe (1985:505,506) provides a description of the procedures which can be applied to deal with dividends. These procedures are based on the assumption that dividends can be predicted with certainty and that the option will not be exercised before expiration.

- Assume that all relevant dividends have already been announced and the share price has gone ex-dividend for all these dividends. The share price is then reduced by the present value of these expected dividends.

- To consider the position where the share price has not yet gone ex-div at the expiration date, the following procedure can be followed. Assume that the option is held until just before the ex-dividend date and subtract the present value of all the dividends, except the last payment, from the current share price.

The B-S formula can be applied using these dividend-adjusted prices. The current value of the option is then assumed to be equal to the highest of these two values. Sharpe (1985:506) adds that although these procedures are not exact they are probably sufficient for most listed options.

4.4.4.3 Information required for estimation of the parameters of the B-S Option Pricing Model

Jarrow and Rudd (1983:132-138) provide a comprehensive discussion of the information requirements and information sources for each of the parameters and for any dividend adjustments.

a. The share price

The B-S formula provides a link between two simultaneous prices, and the best sources of data on share prices are:

- Those services that provide the ability to download closing share prices onto personal computers.
- Real-time systems that provide the latest information on share trading directly from stock exchanges (Jarrow & Rudd 1983:133).

b. The exercise price

This information is easy to access, since it forms part of the specifics of the option contract. However, the effect of any share-splits and share-dividends must also be taken into account (Jarrow & Rudd 1983:133).

c. The interest rate

The interest rate is assumed to be constant over the life of the option and equal to the risk-free rate of return. The rate is usually obtained from financial instruments, such as Treasury bills, which have a maturity date close to the option's expiration date. It should be noted that the B-S formula is not particularly sensitive to changes in the interest rate (Jarrow & Rudd 1983:133,134).

d. Time to maturity

Again, the expiration date is part of the specifics of the option contract and the time to maturity is simply determined by counting the number of days between the current date and the expiration date. A rule of thumb also exists whereby each non-trading day is considered to be equal to a third of a trading day. This is done as a measure of the varying risk levels which are likely to be encountered before expiration (Jarrow & Rudd 1983:134).

e. Volatility of the underlying share

The estimation of volatility, using either historical volatility or implied volatility, has already been examined in section 4.4.4.2.a.

f. Adjusting for dividends

Most companies tend to maintain stable dividend growth rates and are relatively consistent in their dividend payment dates, so it is generally not very difficult to make forecasts of the cash dividends and ex-dividend dates over the life of the option (Jarrow & Rudd 1983:138).

It is now appropriate to consider how the principles of options theory can be practically applied to investment decision-making and corporate finance.

4.4.5 The application of options theory in investment decision-making and corporate finance

Jones (1998:527) identifies four major reasons why, rather than investing in the shares themselves, share options are useful investment alternatives.

- The availability of options has expanded the investment opportunity set. Investors, therefore, have access to risk/return combinations which would otherwise not have been available and this can improve the risk/return characteristics of their investment portfolios.
- Investing in call options allows investors to control, for a short period, a claim on the underlying share at a much lower cost than investing in the share itself.
- With investment in put options, investors are able to duplicate short sales without needing a margin account and at a much lower cost than the price of the shares.

- Options provide investors with the benefit of knowing the maximum amount of their loss in advance. The maximum that can be lost when an option expires worthless is the cost price of the option itself.
- Options have a significant leverage effect, whereby percentage gains relative to cost price is magnified in comparison with investment in the shares.
- With investment in options on stock market indices, investors are able to participate in market movements with only a single trading decision.

Hawinkels (1987:5) also identifies a number of investment opportunities which are available through the use of options:

- Options provide a significant expansion in the range of portfolio returns that are available to investors.
- Options are useful instruments in hedging against risk.
- Options provide opportunities for speculation, that is, using options for their leverage effect, since the downside risk is the cost of the option while the upside potential is nearly unlimited.
- Arbitrage opportunities are available if options are mispriced.
- Capital market transactions can be transformed into money market transactions in order to take advantage of the slope of the yield curve.

Pike and Neale (1996:331) identify other applications of options theory in corporate finance and investment decision-making. They state that the implications of options theory go far beyond just trading in, and valuing of options. Options theory also provide powerful knowledge for the understanding of various other contractual agreements in finance, including:

- Share warrants which give holders the right to buy shares directly from the company at a fixed price over a specified period of time.

- Convertible debentures which give holders a combination of an option and a loan. When the option is exercised the holder exchanges the loan for a fixed number of shares in the company.
- Debentures to which a call option can be attached, thus providing the company with the right to repurchase the debentures before maturity.
- Share option schemes which provide company executives with an incentive to pursue the goals of the shareholders.
- Insurance and loan guarantees are both forms of put options. An insurance claim is a put option, while a government loan guarantee is a type of insurance. The underwriting of a share issue is a similar type of option.
- Foreign exchange and interest rate options are also ways of hedging against risk, or of speculating on movements in these markets.

Before reviewing the research done on the efficiency of options markets and the reliability of the B-S Option Pricing Model, it is first necessary to examine the various approaches to the testing of these aspects.

4.4.6 Tests on options market efficiency and the B-S Option Pricing Model

4.4.6.1 Testing options market efficiency

The testing for the efficiency of options markets can be divided into two sections:

- Firstly, testing the actual efficiency of options markets.
- Secondly, testing the impact of the existence of options markets on the prices of the underlying shares, in order to establish whether it is benign, harmful or irrelevant (Gemmill 1993:256).

Both these aspects are important (Gemmill 1993:256). If options markets were found to be inefficient, then it could either be because the market participants are ill-informed or because competition is not free and fair. More importantly, if options markets were found to have a destabilising effect on the underlying shares, and thus affect the efficiency of stock markets, then constraining their use should be considered.

a. Direct tests of options market efficiency

According to Gemmill (1993:256), options markets will be efficient if they allocate resources correctly, that is, in a manner that ensures that all marginal costs and returns are equated. In order to achieve this, option prices must reflect all available information and transaction costs must be minimised. Thus, we can refer to two elements of efficiency, namely pricing efficiency and transaction efficiency.

Pricing efficiency

Pricing efficiency in options markets are the same as those discussed earlier with the EMH. The various forms of efficiency will, thus, not be examined again.

The existence of profitable opportunities which are not exploited is evidence against pricing efficiency. It is, however, difficult to assess whether the unexploited profits are sufficient to cover transaction costs and risk and, hence, it is difficult to test for pricing efficiency (Gemmill 1993:257).

Transaction efficiency

These tests are concerned with the size of bid-ask spreads and commissions. Market makers earn at least part of the bid-ask spread as their remuneration, while brokers earn commission. Thus, the question of transaction efficiency is whether these intermediaries are able to earn excess profits relative to the risk they bear (Gemmill 1993:257).

Tests of these two aspects of options market efficiency include the following:

i. Arbitrage tests

These are the simplest kind of pricing efficiency tests. The tests for simple arbitrage opportunities are relatively easy as they do not require the use of option pricing models for its calculations, nor does risk need to be considered since arbitrage is riskless. The main arbitrage opportunities relate to the minimum bounds on call and put prices as well as put-call parity. The tests usually concern the observation of a series of transaction prices and the application of lower-bound tests and parity tests on the series (Gemmill 1993:257).

ii. Model-based efficiency tests

Option pricing models are used to test for more complicated profit opportunities. However, model-based efficiency tests do have the problem that they are joint tests of both the model and of market efficiency. In principle, models are used in order to establish whether options are mispriced, that is, whether the option can be bought and sold and hedged with the underlying share or another option to achieve a riskless profit. These tests are concerned with whether these procedures are able to deliver profits (Gemmill 1993:258).

Gemmill (1993:258) notes, however, that if these tests deliver a profit of zero, this does not necessarily mean market efficiency. Due to the joint nature of these tests, it could either indicate market inefficiency or model inaccuracy. Positive profits only indicate market inefficiency if:

- The model provides the correct riskless hedge ratio.
- All transaction costs are taken into account.
- All option values used are a true reflection of market prices.

iii. Implied volatility tests

Rather than concentrate on profit opportunities, these tests concentrate on whether information is fully reflected in option prices. The aim of these tests is to establish whether implied volatilities provide good predictions of future volatilities (Gemmill 1993:259).

b. Tests on the impact of options on the underlying shares

Gemmill (1993:259,260) considers this to be the important issue and states that if it was found that options destabilised the underlying shares, then banning options might be an appropriate action. Gemmill (1993:260) distinguishes between two potential impacts:

- The general stabilising or destabilising effect of options.
- The destabilising effect on the expiration of options.

Tests on the general impact of options

The potential impact of options depends on the particular assumptions made. In a B-S model world no market imperfections exists, so any option can be replicated almost perfectly. However, the continued existence of options must indicate that market imperfections are rewarded and may reduce the cost of speculation. Increased speculation, both well-informed and ill-informed, may cause an increase in volatility and, hence, destabilisation. However, these theoretical arguments do not solve the problem and it is only through empirical testing that the impact of options can be assessed (Gemmill 1993:260).

Tests on the impact of options on expiration

When options expire, all arbitrage positions are unwound and, according to Gemmill (1993:262), the underlying stock market may suffer a bout of 'indigestion' since, with the resultant trading in a large amount of shares, share prices may rise or fall significantly.

4.4.6.2 Testing the validity of the B-S Option Pricing Model

These tests are not only relevant to the basic B-S model, but have been used to test extensions thereof and for the testing of various other models. Many of these tests have also been comparative tests, whereby the performance and accuracy of various models have been compared.

Galai (1982:52,53) identifies four different approaches which have been used to test the B-S model's validity.

a. <u>Simulations</u>

The first approach uses simulations and quasi-simulations of deviations from the model's assumptions to test the model's sensitivity to these empirical deviations. These tests are not direct tests of the model's validity, but are used to examine the robustness of the model to varying conditions (Galai 1982:52).

b. <u>Direct comparison of model values with actual prices</u>

The second approach uses the actual prices of the underlying shares and the estimated parameters of the model to generate expected option prices. These expected prices are then compared with actual market prices. These tests attempt to establish whether the model provides unbiased estimates of actual prices or whether there are consistent deviations. These deviations can either be due to incorrect estimation or identification of profit opportunities (Galai 1982:52).

c. <u>Hedging</u>

In the third approach neutral hedge positions are created and the behaviour of the investment returns are examined. If the model is correct, these returns should be equal to the riskless rate. These tests have the advantage that the investment returns need not be adjusted for risk (Galai 1982:52).

d. <u>Implied volatility tests</u>

This fourth approach uses standard deviations derived from actual option prices. As all the parameters of the model, except volatility, are observable, the standard deviation can be imputed by equating the actual option price to the model's value. These test then examine the behaviour of the implied standard deviation (volatility) to establish the validity of the model (Galai 1982:52,53).

According to Galai (1982:53) the last two approaches have been used in the majority of recent research. Now that the tests of market efficiency and model validity have been established, the next section reviews the results obtained from empirical tests. From these tests it will be possible to make conclusions regarding the validity of the B-S Option Pricing Model and on the efficiency of options markets.

4.4.7 Research related to options markets and the B-S Option Pricing Model

This section reviews research studies done on options market efficiency and those done on the B-S Option Pricing Model. Testing of these two areas are interrelated as most tests are generally joint tests, that is, the model is used to establish the level of market efficiency and the validity of the model is examined assuming market efficiency.

The efficiency of options markets are generally concerned with whether options markets accurately price options and whether any price adjustments occur fast enough to prevent investors and members of the exchange from having the opportunity to earn abnormal profits. Another area of concern is whether options markets, which are directly connected to the underlying stock markets, have any destabilising effect on these stock markets.

As mentioned before, any tests of the B-S model are directly related to tests of options market efficiency. Without the options markets being efficient, it is almost impossible to make reliable conclusions about the validity, accuracy and performance of the model.

There are basically four different approaches to testing the B-S model's validity. In the first case the model's assumptions are examined to establish its robustness. Secondly, using the model to determine option values and comparing the values calculated with market prices to establish the model's accuracy and predictive ability. Thirdly, the model's predictions are examined to establish whether it provides an accurate description of the market pricing mechanism and, finally, its parameters are tested against the market to establish its validity.

This section starts with an examination of the efficiency of options markets, whereafter the B-S model's tests will be reviewed. The initial studies reviewed will all be from international research (on the US market unless otherwise indicated), whereafter studies in a South African context will be examined.

4.4.6.1 Research related to market efficiency

a. Simple arbitrage tests

i. Minimum bound tests

Galai (1978)

Galai tested the efficiency and synchronization of the CBOE, using daily closing prices in the first six months of its operations, April 1973 to October 1973. A significant number of call option lower-bound arbitrages were found (Galai 1982:51; Gemmill 1993:257). Galai (1982 51) summarises the major conclusions from his 1978 study as being:

- The greatest number of violations were found in cases where options approach expiration and the frequency is an increasing function of the share price, given the exercise price.
- The hypothesis of sufficient synchronization between stock exchanges and options markets is rejected.
- Profitable arbitrage opportunities can be exploited, but these profits will be small relative to the dispersion of yields.

Bhattacharya (1983)

A similar test by Bhattacharya, using the Berkeley options database, also found that violations occur, but these are not profitable since transaction costs cannot be covered (Gemmill 1993:257).

Halpern and Turnbull (1985)

In their study on the Canadian market, the researchers also found that violations occur, but their study did not take full account of transaction costs (Gemmill 1993:257).

ii. <u>Put-call parity studies</u>

Stoll (1969)

Stoll examined put-call parity for European options on OTC markets in the US, using weekly submissions by the Put and Call Brokers and Dealers Association for ten companies in 1967 (Galai 1982:70,71; Gemmill 1993:257). Stoll used regression analysis and found that there were deviations from expectations, in that the intercept was higher and the slope lower than expected (Galai 1982:71).

Merton (1973)

Merton showed that the put-call parity relationship does not hold for American put options. As it may be profitable to exercise the American put before expiration, the American put will have a higher value than an European put with similar terms (Galai 1982:70).

Gould and Galai (1974)

Their study involved the inclusion of tax and transaction costs in the put-call parity relationship for American options. It was found that transaction costs increase the upper bound and decrease the lower bound of the difference between calls and puts. Taxes, however, have no significant effect.

Gould and Galai re-examined Stoll's 1969 results and included data for 1968 and 1969. They suggested that Stoll's use of regression analysis was incorrect and found that transaction costs to a large degree explain the observed premiums on puts and calls. However, some degree of market inefficiency still remains (Galai 1982:71).

Klemkosky and Resnick (1979,1980)

The 1979 study of Klemkosky and Resnick examined the transactions data of one day per month for the period July 1977 to June 1978. They used 15 shares with their options, and were able to construct a nearly simultaneous position for the underlying share, the put and the call. They concluded that the simultaneous prices observed for the puts and calls are consistent with put-call parity (Galai 1982:72).

In 1980 they re-examined their 1979 study and concluded that the price corrections on options exchanges are fast enough to eliminate most profit opportunities for members of the exchange (Galai 1982:72).

Various studies

Brenner and Galai (1984) also concluded that the put-call parity relationship is valid and no significant profits exist after transaction costs. Similar results were obtained by **Bodurtha and Courtadon (1986)** for currency options and **Ball and Torous (1986)** for gold and silver options (Gemmill 1993:258).

It can be concluded from these studies that the put-call parity relationship generally holds and that options markets are relatively efficient in preventing abnormal profits being available after accounting for transaction costs. However, market synchronization is in doubt and possibly invalid.

b. Model-based efficiency tests

Various studies have used option pricing models in an attempt to identify overvalued and undervalued options and then to test for market efficiency. If it was found that excess returns, after transaction costs, can be earned on a consistent basis then market inefficiency is implied (Blomeyer & Klemkosky 1982:112,113).

The results of these studies have produced contradictory findings. **Black and Scholes (1972)** concluded that the hypothesis of efficient markets can not be rejected, while

Galai (1977) found a degree of inefficiency. **Chiras and Manaster (1978)** also indicated market inefficiency, but **Phillips and Smith (1980)** suggested that both Galai (1977) and Chiras and Manaster (1978) had underestimated transaction costs and that with the correct transaction costs, both market synchronization and market efficiency are indicated (Blomeyer & Klemkosky 1982:112; Gemmill 1993:258).

Later studies by **Bhattacharya (1983)** showed inefficiency in that a specific spread strategy was found to be profitable and **Evnine and Rudd (1985)** found market inefficiency in the pricing of index options. **Chance (1986)** refuted Evnine and Rudd's 1985 findings and found index options to be efficiently priced if allowance is made for the bid-ask spread. **Whaley (1986)** concluded that options on Standard and Poor 500 futures are incorrectly priced - indicating inefficiency (Gemmill 1993:258).

Again, these tests generally show that options markets are efficient in their pricing mechanism, but these tests rely on the accuracy of the model used in the tests and, hence, no firm conclusions can be drawn without establishing the model's accuracy and validity.

c. Implied volatility efficiency tests

Latané and Rendleman (1976) examined whether better forecasts of standard deviations can be obtained when the option pricing model is used to estimate implied volatilities, rather than using historical data for forecasts of standard deviation. Other studies which have examined whether volatilities implied by options are good predictors of future volatilities include those of **Schmalensee and Trippi (1978)**, **MacBeth and Merville (1979)**, **Beckers (1981)**, **Brenner and Galai (1984)** and **Gemmill's (1986)** study on London data (Gemmill 1993:259).

Most of these studies used a regression of the implied standard deviation from the option, the historic standard deviation and an error term in order to determine whether implied volatilities capture all the information in historical volatilities. In most cases it was shown that the implied standard deviation is significantly different from zero, while the historic standard deviation is not. This implies that historic standard deviation makes no information contribution and all its information content is captured in implied volatility (Gemmill 1993:259).

Gemmill (1993:259) concludes that implied standard deviation performs better than forecasts of volatility based on historical data. He notes, further, that neither implied volatility nor historic volatility provides good predictions of future volatility.

Chiras and Manaster (1978) suggested that the implied standard deviation should be weighted with the price elasticity of an option in relation to its implied standard deviation. They concluded that weighted implied standard deviation gives improved predictions of future volatility and has the benefit of not requiring information on historical share returns (Blomeyer & Klemkosky 1982:105).

These are, again, joint tests of market efficiency and the model used. Market efficiency is generally indicated, since the market-based volatility estimates have been shown to be better than historic data-based estimates.

d. Impact of options trading on market efficiency

A number of studies have examined the impact of the introduction of share options on the underlying shares. **Hayes and Tennenbaum (1979)** found that the introduction of options had in general increased the volume of share trading. Both the studies of **Trennepohl and Dukes (1979)** and **Klemkosky and Maness (1980)** found no significant effect on the volatility of shares, while **Whiteside, Dukes and Dunne (1983)** found no significant effect on either share trading or share volatility (Gemmill 1993:260,261).

No significant evidence has been found that options have a destabilising effect on the stock market, but there is some evidence that stock market liquidity has improved since the introduction of options and that there has been an increase in the trading volume of shares due to option trading.

4.4.7.2 Research related to the B-S Option Pricing Model

a. Simulation tests on the model's assumptions

i. Distribution/volatility of returns

Various studies

According to Gemmill (1993:112) it follows from the work of **Fama (1965)** and **Taylor (1986)** that the B-S model tends to overvalue both put and call options, since it understates the possibility of large positive and large negative returns. Instead of returns being normally distributed, all sorts of assets have shown fat-tailed return distributions.

The empirical evidence from option returns seems to support the fat-tailed volatility, as shown by **Rubinstein (1985)** and by **Gemmill (1986)**. Gemmill (1993:113) notes that it is difficult to adjust the B-S model for fat-tailed volatility, and that in most cases the volatility of options are simply up-rated.

Beckers (1980) and **Christie (1982)** found evidence that the return distributions for shares are skewed and that the variance rises as the price drops. According to Gemmill (1993:115), the higher variance at low prices is seen as a fat-tail on the left side of the return distribution. Further, the implication of such skewness would be that the B-S model will overvalue high-exercise-price options and undervalue those with low-exercise prices. As a consequence, implied volatilities will differ across exercise prices and this is known as the exercise-price-bias.

Various studies have confirmed the existence of such a bias. **Black (1975)** found that low-exercise-price call options have low implied volatilities. **MacBeth and Merville (1979)** found the opposite, in that high-exercise-price call options have low implied volatilities. **Rubinstein (1985)** confirmed that the bias is unstable. In the first period of his study it was found that low-exercise-price options have low volatilities, while in the second period of the study the high-exercise-price options have low implied volatilities (Gemmill 1993:115,116).

Merton (1976)

Merton showed that returns are not lognormally distributed as assumed by the B-S model. Merton assumed that return distributions are a combination of a jump and diffusion process, but showed that the B-S model can be adjusted for this as long as the jumps are diversifiable in a large portfolio. Merton concluded that the effect of the misspecification of the return distribution on option values will generally be small, except in the cases of options close to maturity, options on shares with low variance and deep-out-of-the-money options (Galai 1982:55; Gemmill 1993:113,114).

Boyle and Ananthanarayanan (1977)

This study examined the effect of using estimates of variance in option pricing models. It was in general found that the bias is relatively small, but that the dispersion of the distribution of option values may be significant (Galai 1982:55).

Bhattacharya (1980)

In this study the robustness of the B-S model was also examined. The findings from the simulation tests were that near-in-the-money and near-out-of-the-money options with five days to expiration are often statistically significantly mispriced and that at-the-money options with one day to expiration provide operationally and statistically significant excess returns. The conclusion was that the B-S model does not misprice options, except for at-the-money options with one day to expiration, and that the significance of the mispricing decreases with an increase in time to expiration (Galai 1982:55,56).

Bookstaber (1981)

Bookstaber performed simulation tests to examine the effect of nonsimultaneity of share and option price quotations on option values. He found that nonsimultaneity can have a mispricing effect where there are less than 20 option trades during a day. The effect is not as significant for at-the-money and out-of-the-money options (Galai 1982:56).

ii. Transaction costs

Leland (1985)

Leland investigated the effect of transaction costs on option values. According to the B-S model:

- It will not be worth selling an overvalued call and buying the replicating put if the expected profit does not exceed the transaction costs.
- An option hedge needs to be rebalanced with movements in the underlying share price and the more frequent the rebalancing, the higher the transaction costs, but the smaller the hedging errors.

Thus, it would seem to be possible to estimate the expected transaction costs and to add them to the value of the option in order to establish whether profit opportunities are actually profitable (Gemmill 1993:118,119).

Leland, however, suggested that this approach has three problems:

- It is difficult to estimate transaction costs when prices are volatile and more rebalancing will be required.
- Frequent rebalancing will cause transaction costs to be arbitrarily high.
- Transaction costs will be correlated with share and market returns, hence their risk will not be diversifiable and the attempted hedge will become risky.

Leland suggested that the solution would be to raise the variance by some factor, which will cause the expected return on the hedge to be zero as required and the risk will not be correlated with share returns (Gemmill 1993:121,123).

iii. Dividends

Merton (1973)

Merton developed an adjusted-B-S model that can accommodate a continuous dividend yield. This model found application on valuing currencies and bonds, but its performance for share options depends on the frequency of dividend payments. It was found that the model works well with frequent dividend payments, but relatively poorly when dividends are infrequent and large, for example half-yearly dividend payments. The model was also found to overvalue call options in some periods and undervalue it in other periods. In general, it seems that it would be better to make an adjustment to the B-S model which takes into account the lumpiness of dividends (Gemmill 1993:95).

Black (1975)

Black advocated the use of a pseudo-American adjustment for dividends, whereby the value of an option exercised just before the ex-dividend date is compared with the value of an option which is allowed to run to expiration. The correct value of the call will be the higher of the two values (Gemmill 1993:95).

Gemmill (1993:96,97) outlines the principles of the pseudo-American approach:

- It is assumed that there is only one dividend payment during the life of the option.
- The holder of an American call is considered, in effect, to hold an European option.
- The first call expires immediately after payment of the dividend and the share price is reduced by the present value of the dividend, but this is offset by the reduction in the exercise price for the payment of the dividend.
- The second call expires later and pays no dividend. The share price is again reduced by the present value of the dividend, but there is no dividend to reduce the exercise price with.
- Two B-S valuations are performed and the larger value is used as the correct value of the option.

Gemmill (1993:97) notes that the pseudo-American approach can be extended to situations where more than one dividend is paid over the life of the option. Further, this approach is widely used and reasonably accurate, although the call is generally slightly undervalued because it is assumed that the holder has to decide now when the call will be exercised.

Galai (1977)

Galai also examined the effect of dividend payments on CBOE options and found that the B-S model's ability to identify underpriced and overpriced options declines with increases in dividend yield. He concluded that the model performs better within its basic assumptions, such as no dividend payments (Galai 1982:62).

Roll (1977), Geske (1979) and Whaley (1981)

Roll developed a model that solved the B-S model's problem with the valuation of options on shares which are expected to make dividend payments before expiration. Geske continued with the development of this model and Whaley modified it slightly (Jarrow & Rudd 1983:143; Van Horne 1992:122; Weston & Copeland 1992:454).

The model is essentially a modification of the B-S model that incorporates the dividend, the time left to going ex-dividend and the decline in the price of the share on the ex-dividend date as a proportion of the dividend (Van Horne 1992:122).

Whaley (1982)

The results of Whaley's test showed that the Roll and Geske model performs well and that it eliminates all but one bias in the dividend-adjusted B-S model. He did, however, find that the model still undervalues options on low-risk shares and overvalues options on high-risk shares. Whaley concluded that these differences in value are small and that both models perform well when trading imperfections are taken into account (Jarrow & Rudd 1983:148).

Gultekin, Rogalski and Tinic (1982)

Gultekin *et al.* concluded in their study that the Roll and Geske model tends to overvalue options on high-risk shares and undervalues those on low-risk shares. In-the-money options are also overvalued and out-of-the-money options are undervalued (Van Horne 1992:122).

Sterk (1983)

Sterk found that the Roll and Geske model performs well, especially when dividends are large. The prediction errors are lower than with the dividend-adjusted B-S model (Van Horne 1992:122).

iv. Early exercise of American put options

Merton, Scholes and Gladstein (1982)

They showed in their simulation study that the possibility of early exercise of American puts has a considerable effect on option prices. Their study covered the period 1963 to 1976 and it was shown that the possibility of early exercise increases the price of American puts by between 4% and 14% above those of European puts. The biggest difference was found in periods of high interest rates. They also showed that around 44% of all at-the-money puts will be exercised before expiration (Galai 1982:70).

Unfortunately, the basic B-S model is inadequate in valuing American puts where it may be profitable to exercise the puts early, but there is no other equivalent to the B-S equation which allows for the principle that put options may be exercised any time between now and expiration (Gemmill 1993:99).

Gemmill (1993:99) adds that one approach to this problem is to use the binomial model instead of the B-S model, but the binomial model is a very slow time-consuming process. Another approach is to use some approximation of the B-S model which may be reasonably accurate and much faster. The approximation would be to use the higher of the B-S value or the exercise price of the put. This can be refined to add some other factor to the B-S model, that is, the difference between European and American put values. Two approaches to calculating this factor have been identified:

- Using an equation based on the same principles as the B-S equation.
- Using the control-variate approach.

Various studies

A number of studies have examined the use of an equation to calculate the factor. The study of **Johnson (1983)** provided a fast but complicated equation which does not perform well for long-term options. **Geske and Johnson (1984)** showed that if early exercise is considered at three or four intervals before expiration, reasonably accurate forecasts of a limit price can be made. **McMillan (1986)**, published by **Barone-Adesi and Whaley (1987)**, provided a simple but untidy equation for the calculation of the factor. The intuition behind this equation is that the factor is itself the value of the option, which can be analysed by the B-S equation (Gemmill 1993:100).

Hull and White (1988) published the control-variate approach, which had been widely used in practice before then. This approach uses two binomial estimates of the put value, one European and one American, with the factor being the difference between the two. Although the binomial method is slow (50 iterations are required for convergence of the binomial model to the B-S model), they suggested that only 25 iterations would be necessary to achieve a reasonable estimate of the factor (Gemmill 1993:99). Gemmill (1993 : 99) suggested that his experiments showed that only 10 iterations are required for options with a few weeks left to expiration, while 15 iterations will be sufficient for longer options.

These simulation studies on the assumptions of the B-S model have generally indicated that the model is extremely robust. It can be adapted to some real-life realities and still provide reasonably accurate predictions, it is only with early exercise dividend-unprotected put options that the model has some serious inadequacies.

b. Tests consisting of direct comparisons between actual prices and model values

Black and Scholes (1972)

Black and Scholes found that their model undervalues options on low-variance shares and overvalues those on high-variance shares (Weston & Copeland 1992:463).

Black (1975)

Black reported that the B-S model undervalues out-of-the-money options and overvalues in-the-money options (Jarrow & Rudd 1983:140; Weston & Copeland 1992:463).

Merton (1976)

The results of Merton's study showed that the B-S model undervalues both deep-in-the-money and deep-out-of-the-money call options (Jarrow & Rudd 1983:140).

Trippi (1977)

Trippi performed a simple test for the period 30 August1974 to 14 March 1975, whereby all options with a B-S value of 15% more than market price were bought and those with a value of 15% less were sold short. Based on the average weekly returns, Trippi concluded that the CBOE is inefficient and that the B-S model provides accurate results. It should, however, be noted that the returns were not risk-adjusted and, since option trading is quite risky, this represents a serious drawback (Galai 1982:56).

MacBeth and Merville (1979,1980)

In their 1979 study, MacBeth and Merville examined the difference between B-S values and actual call prices. They used the1976 daily closing prices of six shares as data for their test. It was assumed that the market is efficient and that any difference between actual prices and model values can be attributed to weaknesses of the model, especially its assumption of a constant variance of share returns. MacBeth and Merville concluded that the B-S model correctly values at-the-money options with at least 90 days to expiration, but overvalues deep-out-of-the-money options and undervalues deep-in-the-money options. These differences decrease with a shortening in the time to expiration and they suggested that their results may have been affected by the early exercise of dividend-unprotected calls (Galai 1982:56,76).

In their 1980 study, they compared the B-S model with the Cox model of constant elasticity of variance. They assumed that the Cox model will reduce the degree of mispricing observed in their 1979 study. They repeated their 1979 tests and concluded that the share return-generating process is better described as a constant elasticity of variance process (Galai 1982:57; Blomeyer & Klemkosky 1982:112).

Manaster (1980)

Manaster discussed the 1980 study of MacBeth and Merville and concluded that, since the B-S model is included as a special case in the Cox model, their results were not surprising. The Cox model should explain option prices at least as well as the B-S model. They also cautioned against concluding that one model is superior to another, as these were joint tests of both the accuracy of the model and market efficiency (Galai 1982:57).

Thorp and Gelbaum (1980)

Similarly to MacBeth and Merville (1980), Thorp and Gelbaum also believed Cox's constant elasticity of variance model to be better than the B-S model. From their experience in trading on the CBOE they have found that the B-S model undervalues out-of-the-money options. However, using 1979 data, they found only small deviations between actual prices and the B-S values. A number of reasons were suggested for the differences between the two studies' results, including changes in tax rates in September 1976, changes in the volatility of the market, better adjustments of results for potential early exercise of call options and more accurate estimation of the variance in share returns (Galai 1982:58).

MacBeth (1981)

Using 1978 data, MacBeth repeated the earlier work done with Merville in 1979 and 1980. The study confirmed earlier findings that the parameters of either or both the Cox and the B-S model are nonstationary over time. The results from this study showed that the B-S model provides accurate predictions of market prices in some periods, while in other periods it misprices options in a manner opposite to that observed in their earlier studies (Galai 1982:58).

Rubinstein (1981)

Results similar to those of MacBeth and Merville (1979) were found. It was further shown that the bias for in-the-money and out-of-the-money options reversed itself around 1977 (Weston & Copeland 1992:464).

Blomeyer and Klemkosky (1982)

This study compared the B-S model with the model developed by Roll. Since Roll's model is more general than the B-S model, in that it can value dividend-unprotected calls, it is expected to give more accurate predictions of market prices. Blomeyer and Klemkosky examined CBOE options for 18 NYSE listed shares for the period July 1977 to June 1978, with all the options having at least three weeks remaining until expiration and having one ex-dividend date prior to expiration. Their results contradicted those of MacBeth and Merville (1979), but are consistent with those found by Thorp and Gelbaum in 1980. They found that both models have nearly identical pricing-bias characteristics, since both undervalue out-of-the-money call options and value at-the-money and in-the-money call options fairly accurately (Galai 1982:58; Blomeyer & Klemkosky 1982:104,111).

Blomeyer and Klemkosky (1982:112) concluded that the pricing-bias characteristics found with the B-S model, the Roll model and earlier with the Cox model suggest that in-the-money and out-of-the-money pricing bias is not due to the possible early exercise of the call options, but rather to a share return-variance related problem.

Blomeyer and Resnick (1982)

This study used a subsample of the 1982 study of Blomeyer and Klemkosky to compare the Geske compound option model, a further development of Roll's model, with the B-S model. Geske's model considers options on shares to be an option on an option and the model allows for the nonstationarity in the variance of share returns. It was found that the Geske model overvalues out-of-the-money calls and undervalues in-the-money calls. These results are directly opposite to those found for the B-S model (Galai 1982:58,59).

Sterk (1982), Whaley (1982) and Geske and Roll (1984)

Both Sterk and Whaley used the dividend-adjusted model of Roll and Geske and found that it explains the time to maturity and in-the-money and out-of-the-money biases. Geske and Roll used a super variance estimator to explain the variance in share returns bias (Weston & Copeland 1992:464).

From the research discussed above, it can be concluded that the B-S model is as accurate as any other model examined and that, in general, no other model provides better descriptions of option pricing or option values. Most of the other models have additional drawbacks in that they are either mathematically more complex or slower and more cumbersome than the B-S model.

c. Hedging tests

Black and Scholes (1972)

This study proposed a method for adjusting for the risk changes that occur when an option is held. Black and Scholes suggested creating a neutral hedge by buying the option and at the same time selling the share, or selling the option and buying the share (Galai 1982:59).

They examined the OTC market for the period May 1966 to July 1969 and compared their model values with the actual prices on the date the options were issued. From this they classified the options into two groups; those that the model had undervalued and those it had overvalued compared to the market. They used this information to adjust their neutral hedge on a daily basis and expected the excess return to be riskless. It was found that the B-S model overvalues options on high-variance shares and undervalues options on low-variance shares. Historic data was used to estimate variance and they concluded that if variance can be more accurately estimated, the model's performance will be improved (Galai 1982:60,61).

They also observed nonstationarity in variance which may indicate market inefficiency, but found that excess profits disappear after accounting for transaction costs (Galai 1982:61; Dobbins *et al.* 1994:156).

Galai (1977)

Galai used the daily closing prices of all options traded on the CBOE for the period 26 April 1973 to 30 November 1973. Galai found the hedge strategy to be effective and that deviations from the model values generated excess profit. However, almost all the hedge returns are eliminated with the imposition of transaction costs (Galai 1982:61).

Chiras and Manaster (1978)

These researchers calculated the spread returns on a long position in one option and a short position in another option on the same underlying share. A dividend-adjusted B-S model was used and they formed 118 positions during the period July 1973 to April 1975. It was found that 93 of these positions were profitable and they concluded that, since the model values the options more accurately than the market, this proved market inefficiency. This conclusion, however, was qualified due to the ex-post nature of their tests and the potential nonsimultaneity of option prices (Galai 1982:63).

Boyle and Emanuel (1980) and Galai (1983)

Boyle and Emanuel simulated the effect of discreteness, that is, non-continuous trading, on hedge returns and found the effect to be quite small in absolute terms (Galai 1982:56). Galai also examined whether the discreteness of trading - the B-S model assumes continuous trading - will affect hedge returns. He showed that it does not, as the major component in hedge returns is changes in the deviation between model values and market prices, while the opportunity cost and discreteness adjustments are marginal (Brenner 1983:63).

Phillips and Smith (1980)

In an examination of the 1980 results of Chiras and Manaster, this study showed that the profit opportunities are eliminated with the introduction of transaction costs (Galai 1982:63).

Bookstaber (1981)

A further re-examination of the Chiras and Manaster (1980) results by Bookstaber provided evidence of nonsimultaneity in their data and it was concluded that the profits observed in their study are not achievable in practice (Galai 1982:63).

Blomeyer and Klemkosky (1982)

Using the hedging technique of Black and Scholes (1972), Blomeyer and Klemkosky compared the ability of the B-S model and Roll's model to identify overvalued and undervalued options. This test formed part of the test previously examined under comparative tests and, although it was expected that Roll's model will prove to be superior, it was found that the results indicated that the Roll model is no better than the B-S model in identifying under- or overvalued options. They concluded that their results support market efficiency and that the B-S model is an acceptable alternative to the mathematically complex model of Roll (Blomeyer & Klemkosky 1982:64,110,111, Galai 1982:64).

The above studies have shown that, assuming market efficiency, the B-S model is able to provide a reasonably accurate description of the pricing mechanism of options markets.

d. Implied volatility tests

Latané and Rendleman (1976)

Latané and Rendleman were the first to advocate the use of ISD (implied standard deviation) as estimator of the volatility of share returns. They used the weekly closing prices of the options and shares of 24 companies for the period 5 October 1973 to 28 June 1974 to calculate the individual ISDs. They used the weighted average implied standard deviation (WISD) as estimates of volatility of returns. Latané and Rendleman concluded that the WISD, based on the B-S model, is useful in identifying overvalued and undervalued options and to determine the proper hedge position. Further, the B-S model tends to overvalue options and, although it may not capture all aspects of the option price-generating process, the model is efficient in evaluating whether individual options are properly priced (Galai 1982:65,66).

Schmalensee and Trippi (1978)

Schmalensee and Trippi assumed the B-S model to be valid and used it to impute the ISDs of six widely traded shares and their options from weekly data over the April 1974 to May 1975 period. They used an arithmetic average of the ISDs, based on closing prices, as estimates of volatility of share returns. Based on the assumption that the model is valid, they found evidence of market inefficiency, but suggested that the model may also be inappropriate. They concluded that the B-S model is valuable in predicting volatilities, even though it is inconsistent in its estimates (Galai 1982:66).

Beckers (1980,1981,1983)

Beckers (1980) noted that, although evidence suggests that the B-S model is valuable in predicting future volatilities, there is a basic inconsistency in using the model to estimate a presumably nonstationary variance. Beckers considered alternative weighting schemes for estimating volatility and used a dividend-adjusted model on a sample of CBOE options for the 13 October 1975 to 23 January 1976 period. The ISDs derived from at-the-money options were found to be better predictors of volatility than either WISDs or historic volatility estimates. Also, ISDs were found to be extremely unstable over time and while this may indicate market inefficiency, Beckers attributed the instability to the trading mechanism and a lack of market synchronization (Galai 1982:66).

In 1981, Beckers expanded the sample period to May 1975 to July 1977 and confirmed his earlier findings, using five-day arithmetic averages of the ISDs as volatility estimators. Again, this could be attributed to market inefficiency, model misspecification or data errors. The latter seemed the most likely, since it was found that closing prices may seriously distort the ISD estimates (Galai 1982:66,67).

Beckers (1983) tested the accuracy of a high-low variance estimator and found it to be better than an estimator using closing prices. He suggested that the high-low variance estimator can be improved if the cross-sectional differences between high-low data across shares are included in the estimator (Hawinkels 1987:25).

Garman and Klaus (1980) and Parkinson (1980)

Garman and Klaus examined a number of estimators of price volatility and showed that closing prices are not the most efficient estimator. Parkinson showed that the use of high and low prices provide far superior volatility estimates than the use of closing prices (Hawinkels 1987:24,25).

Brenner and Galai (1981)

Brenner and Galai examined the distribution properties of ISDs, using five shares for the period 3 June 1977 to 21 October 1977. With ISDs based on daily averages, they found significant deviations from ISDs calculated using the last transaction of the day. Options with longer time to expiration usually have higher average ISDs than those close to expiration and there are also significant differences across exercise prices. They also found that average ISDs are unstable over time and concluded that these results confirm that the joint hypothesis - that the B-S model is correct, that markets are efficient and synchronous, and that the estimation procedure is correct - should be rejected (Galai 1982:67).

Rubinstein (1981), MacBeth and Merville (1979) and MacBeth (1981)

Rubinstein used ISDs to test a number of alternative option pricing models with the aim of establishing which model explains the B-S model biases the best. Rubinstein found that out-of-the-money options close to expiration have higher ISDs, meaning they are overpriced. He concluded that not one of the models are able to explain all the biases; some explain time to expiration biases while others explain exercise price biases.

These results confirmed the findings of MacBeth and Merville (1979), in that ISDs tended to rise with declining exercise prices for 1976 data up to October 1977. However, towards the end of 1977 and during 1978 the bias was reversed, as was also found by MacBeth (1981). Rubinstein concluded that a composite model should be developed and, further, that any bias observed in a period should be correlated with the level of some macro-economic variables, such as interest rates and stock market prices and volatilities (Galai 1982:67,68).

The volatility-based studies have identified some problems with the B-S model, but these can also be evidence of market efficiency. However, the main problem lies with estimating volatility and before more accurate estimates can be made, no serious conclusions can be drawn about the validity of this parameter of the model.

e. Tests on put options

Brennan and Schwartz (1977)

Brennan and Schwartz used finite-differences methods to solve their model for dividend-unprotected American puts. The model was tested on 55 observations of OTC puts for the period May 1966 to May 1969 and although the options were dividend protected, they were not perfectly protected. Since their model had assumptions consistent with the B-S model, they used ISDs derived from calls with the same terms for their put valuation and used the B-S model to value the puts as if they were European options. Only small differences between their model values and the B-S model values were found, although both overvalued puts by between 25% to 40%. From these findings they rejected the put-call parity relationship, but concluded that the B-S model provides reasonably accurate values for six-month dividend-protected American put options where the right to early exercise has no significant economic value (Galai 1982:73).

Parkinson (1977) and Farkas and Hoskin (1979)

Parkinson applied a numerical-integration approach to derive a model for valuing American puts, with assumptions consistent with the B-S model (Galai 1982:70).

Farkas and Hoskin tested Parkinson's 1977 model, using weekly closing prices of options and shares for options traded on the CBOE for the period 3 June 1977 to 24 December 1977. They used historical data to estimate volatility and compared the model values with the actual prices for 365 puts. They found significant differences and concluded that the model performs better for at-the-money puts than for out-of-the-money puts. No significant relationship between the accuracy of values and the time to expiration was, however, found (Galai 1982:73,74).

Studies into put option pricing have so far provided inconclusive evidence and the deviations observed could either be due to model invalidity, market inefficiency or lack of market synchronization. Much research is still required on the pricing and behaviour of put options.

4.4.7.3 South African options research

Le Plastrier and Thomas (1984)

Le Plastrier and Thomas examined the degree of correlation between the values provided by the B-S model and actual South African option prices. They found a high degree of correlation and concluded that this is not surprising as most market makers, at that stage, used the B-S model to establish option prices. Thus, the accuracy and validity of the B-S model, in a South African context, remains to be tested (Hawinkels 1987:11).

Research into the efficiency of the options market and the validity of the B-S Option Pricing Model is only in its infancy in a South African context and the only conclusion that can, at this stage, be reached is that more research is required.

4.4.8 Conclusion

From the review of the principles and nature of options and the B-S Option Pricing Model, and the review of empirical research up to the early 1980s, the following conclusions can be drawn at this stage.

- **Market efficiency**

There does not appear to be much evidence of pricing inefficiency in options markets and although some tests have reported profit opportunities, these are eliminated after proper adjustment for transaction costs. Outsiders to the exchanges are not able to consistently earn abnormal returns and even market makers, who are affected by the bid-ask spread and opportunity costs, are unlikely to generate excess profits on any consistent basis. The case for market synchronization is much clearer and, at this stage, there appears to be sufficient evidence to reject the hypothesis about market synchronization. Significant ex-post hedge returns reported in some studies indicate a lack of either data synchronization or trading synchronization and this conclusion is confirmed by the results of the tests on option boundary conditions (Galai 1982:69).

Market-based implied volatilities, although not that efficient in predicting future volatilities, also support the hypothesis of market efficiency, in that they provide better estimates than those based simply on historical data. The impact of options on the underlying shares and stock markets appears to be relatively small and benign, although there appears to be a slight destabilising effect on expiration of the options. These findings are, however, not significant enough to contemplate regulation of options markets (Van Horne 1992:263).

- **The B-S Option Pricing Model**

Blomeyer and Klemkosky (1982:119) and Dobbins *et al.* (1994:156) conclude that the B-S model generally performs well in identifying underpriced and overpriced options. Thus, it allows traders to identify profit opportunities, though options markets are not inefficient enough to allow profits to persist after transaction costs are considered.

According to Jarrow and Rudd (1983:140,141), few models in finance have such predictive accuracy as the B-S model and evidence from empirical tests show that it is sufficiently accurate to be used for investment decision-making. They do, however, add that the model has some biases, but there exists a lack of consensus about the magnitude and direction of these biases. It seems as if these biases change over time and it might be because the model fails to capture all the characteristics of the underlying share return-generating process, such as skewness and changes in variance.

While these general conclusions provide strong support for the B-S model, it is also useful to look at specific conclusions regarding various aspects of the model:

- The model provides good predictions of actual market prices for at-the-money options with a medium to long time to expiration. Some consistent deviations have, however, been found for deep-in-the-money and deep-out-of-the-money options (Galai 1982:46,59,68).

- No other model is currently able to provide a consistently better explanation of actual prices over time than the B-S model. There is some evidence in favour of Cox's constant elasticity of variance model, but these are as yet not conclusive (Galai 1982:46,59,68).

- The biggest problem experienced with the B-S model, or for that matter any other model suggested so far, is the nonstationarity in the underlying share returns and the resulting instability in the volatility estimator. The nature of the nonstationarity is as yet not clear, but the B-S model does provide good predictions of actual prices over short periods and is even able to reveal underpriced and overpriced options (Galai 1982:52,69).

- The B-S model does not, nor does any other model, account for transaction costs and taxes and these may affect market prices of options (Galai 1982:69).

- The trading mechanism and lack of market synchronization may have affected some of the test results. However, the major conclusions were reconfirmed in tests using more detailed and accurate data (Galai 1982:69).

- The B-S model can provide incorrect prices when its assumption of no dividends is violated, but it has been shown that the model can be used to value dividend-unprotected American call options without significant bias (Blomeyer & Klemkosky 1982:119).

- Other violations of the model's assumptions have generally resulted in only small and statistically insignificant deviations. These deviations also tend to decrease with an increase in the time to expiration and an increase in the depth of being in-the-money (Galai 1982:56).

4.5 SUMMARY

The **Capital Asset Pricing Model** provides the investment world with a theory that explains the risk/return relationship, including how to determine expected returns on shares. Although based on a number of clearly unrealistic assumptions, it provides a better description of the share-pricing process than existed previously. The basic principle of the CAPM is quite sensible and enlightening, that is, there exists a positive linear relationship between risk and return and the relevant risk of a share is beta - a measure of its risk relative to that of the market portfolio.

As with any other capital market theory or model, the CAPM can not be judged solely on the realism of its assumptions. It is only through empirical testing that its validity can be established. The CAPM has been subjected to a huge body of empirical testing and, although there is conflicting evidence and disagreement between the findings, the main conclusions from the early to mid-1980s tests, are the following:

- There does appear to be a positive linear relationship between risk and return, although the slope of the SML has generally been found to be less steep than predicted by the CAPM.
- The intercept alpha has generally been found to be positive, that is, higher than the risk-free rate.
- Investors are only rewarded for assuming systematic risk since unsystematic risk is not priced.
- Betas of portfolios have been found to be relatively stable over time and are reasonable predictors of future betas, but the same cannot be said about individual share's betas which were found to be quite unstable.
- Beta provides a reasonably good description of risk, but it seems that it is not a complete measure of risk, and other risk factors may also be important in determining returns.

There are, however, doubts about the validity of a large number of the CAPM studies. One of the areas of criticism is the model's dependence on the existence of a true market portfolio. Such a market portfolio is at this stage unobservable and it may never be observable. Testing the CAPM using the proxy for the market portfolio may not be a true and useful test of the CAPM and there is some evidence that using different proxies will yield varying results.

Another problem with testing the CAPM is that it is an expectational model, formulated on an *ex ante* basis, while the tests are performed on an *ex post* basis. As investor expectations can never be known with certainty, it is unlikely and even impossible that there will ever be reliable tests for an expectational model. Despite these problems, the

CAPM has received a remarkable amount of empirical support and it can be concluded at this stage that, until it has been totally discredited or until an improved model has been validated, the CAPM should continue to be used in estimating future returns.

An alternative model to the CAPM, which has received wide attention, is the **Arbitrage Pricing Theory**. The APT is a more general and simpler model with less restrictive assumptions, but like the CAPM it has its limitations.

The APT also posits a relationship between expected return and risk but, unlike the CAPM, it does not depend on the underlying market portfolio as the only source of risk affecting expected returns. The APT recognises that many types of risk may affect returns, but this also represents a major limitation, in that these economic risk factors are not identified by the theory.

Hence, much of the research on the APT has concentrated on the determination of the number and identity of the macro-economic factors that affect returns. Before these factors have been identified and shown to be stable, the APT will not have any significant practical application. By the mid-1980s, empirical studies have in general shown that more than one risk factor is significant in explaining returns, but these studies have so far only been preliminary. There are conflicting evidence regarding the number of factors, and as yet no clear picture of the identity of these factors exists. The tests have also been of such a nature that the APT can not be rejected from the information available.

For the foreseeable future, both the CAPM and APT will remain the focus of much debate and empirical testing. It is only through continued testing and investigation that it will be established which model explains and predicts returns the best.

Unlike the CAPM and APT. **Options Theory** and option pricing models, and in particular the **Black-Scholes Option Pricing Model**, are concerned about total risk and not only systematic risk. The price/value of an option is driven by the total volatility of the underlying share.

Both call options and put options can be seen as investment opportunities in their own right, or can be viewed as additions to an investment portfolio. In a portfolio sense, options provide an inexpensive and convenient way of changing the risk/return structure of a portfolio. Options are also useful tools for hedging against risk.

The B-S model provides an intuitively appealing means of valuing options in efficient markets. The first step of this valuation process requires that a neutral riskless hedge position be established and this is achieved by combining options with the underlying share. This hedged position is directly affected by movements in the underlying share's price (its volatility), and it is thus necessary to rebalance the riskless hedge portfolio on a regular basis. The value of the option, however, can be determined by using the specifics of the option contract, the price of the underlying share and the hedged portfolio which is assumed to earn the risk-free rate.

Empirical testing of the B-S model has the problem that the tests are joint tests of the hypotheses of market efficiency, market synchronization, model validity and data accuracy. From the studies reviewed it can be concluded that, by the mid-1980s, the status of each of these hypothesis were as follows:

- Options markets are efficient and relatively few, if any, opportunities exists for making abnormal profits after transaction costs have been taken into account.
- The evidence tends to suggest that the hypothesis of market synchronisation is at this stage invalid.
- While most of the parameters of the B-S model are easily identifiable and stable, the tests have supplied evidence that the distribution of share returns is nonstationary. It is only through improved estimation of the underlying share's volatility that better predictions of option values will be obtained.

- Although the B-S model assumes that the options to be valued are European options on non-dividend paying shares, it has been shown to be an extremely flexible model which can be extended to value American style options on dividend paying shares.
- Some biases in B-S model values have been reported in many of the studies, but the overall conclusion seems to be that it is an accurate model that provides good predictions and explanations of option prices.

Research into the efficiency of options markets and the accuracy of option pricing models will continue. There is a need to minimise the problem of market synchronization and to establish more accurate estimators of the volatility of the underlying shares. Further, adjusted-B-S models and new models need to be tested in order to explain some of the biases identified and to obtain more accurate valuations of dividend-unprotected American put options with the possibility of early exercise.

In a **South African context** no significant conclusions can at this stage be formed on the CAPM, the APT, the B-S model and the efficiency of the options market. Although there is some evidence against the CAPM and in favour of the APT, the limited number of studies and the resultant small body of evidence prevents the making of any definite statements about their validity. Much research still needs to be done, especially regarding the relatively new options market, before any firm conclusions can be drawn.

CHAPTER 5

RECENT DEVELOPMENTS IN THE VARIOUS CAPITAL MARKET THEORIES AND PRICING MODELS

5.1 INTRODUCTION

This chapter focuses on recent developments in the capital market theories and pricing models examined in chapters 3 and 4. Since the background to, and principles underlying these theories and models have already been extensively reviewed in those chapters, this chapter only examines new developments since the mid-1980s and only reviews and classifies the related research from the mid-1980s up to the late-1990s.

The first section examines **Portfolio Theory** and focuses, in particular, on how quickly the benefits of diversification can be attained and whether international diversification provides greater benefits than can be achieved with domestic diversification. This is followed by a review of recent research on the three forms of market efficiency, in order to establish whether the **Efficient Market Hypothesis** provides an accurate description of the behaviour of capital markets. Some alternative efficient market theories which have recently been developed and proposed, are also included in this review.

The third and fourth sections concentrate on the asset pricing models, namely the **Capital Asset Pricing Model** and the **Arbitrage Pricing Theory**. Most of the recent studies have concentrated on the validity, testability and usefulness of these models and on whether the multiple risk factors of the APT provide a superior description of the return-generating process than that provided by the CAPM's beta. Hence, numerous studies have been performed to establish the identity of the priced factors which may affect share returns.

The final section of the review examines **Options Theory** and, in particular, the efficiency of options markets and the robustness and validity of the **Black-Scholes Option Pricing Model**. More recent developments in Options Theory, such as share-index options and portfolio insurance, and their possible role in the world stock market crash of October 1987, are also examined and reviewed.

5.2 RECENT DEVELOPMENTS IN PORTFOLIO THEORY

Reilly and Brown (1997:251,253) conclude that a major advance in the investment field has been the recognition that optimum investment portfolios can not be created by simply combining shares with desirable risk/return characteristics. The development of Portfolio Theory showed that consideration of the relationship between different shares is essential in order to ensure that investment objectives are met. Portfolio Theory emphasises the importance of the risk reduction role of diversification, in particular efficient diversification.

As discussed in chapter 3, diversification has the aim of reducing the portfolio's standard deviation (risk) and, through the addition of shares, attempts to reduce the average covariance of returns (Reilly & Brown 1997:284). They (p.285) add that by including shares which are not perfectly correlated in the portfolio, the overall standard deviation can be reduced, although the variability of return will not be eliminated. Through efficient diversification the standard deviation can be reduced to the level of the market portfolio, that is, all unsystematic risk would have been diversified away and the only risk remaining would be systematic risk, which can not be eliminated.

Following on the earlier research on Portfolio Theory and the benefits of diversification, the main areas of investigation of the recent research are:

- Further investigation into how quickly the benefits of diversification can be achieved.
- An examination of whether international diversification provides greater benefits than domestic diversification.

The results of some of the recent studies are reviewed in the next section.

5.2.1 Research related to the benefits of diversification

5.2.1.1 General studies on the benefits of diversification

Tole (1982)

Tole confirmed the earlier findings that the major benefits of diversification are achieved quickly, that is, with the introduction of the initial number of shares to the portfolio. Around 90% of the benefits of diversification are obtained when portfolios consist of between 12 to 18 shares (Reilly & Brown 1997:285).

Statman (1987)

Statman examined the actual data on US shares to determine the benefits of naive diversification. It was found that with randomly selected portfolios the average portfolio risk can be diversified down to approximately 19%. Further, there is a dramatic reduction in risk when additional shares are added to the portfolio. Statman also found that approximately half of the portfolio standard deviation can be eliminated when the portfolio size reaches 10 shares. However, the benefits of random diversification do not improve significantly with the addition of further shares to the portfolio. Increasing the size of the portfolio to 20 shares eliminates only an additional 5% of portfolio standard deviation and increasing it to 30 shares eliminates only a further 2% of standard deviation. The conclusion was that large number of shares are not required to achieve a substantial benefit from diversification (Jones 1998:181).

Statman also examined the benefits of diversification in comparison with the added transaction costs incurred with more shares. The conclusion was that a borrowing investor should have a well-diversified portfolio of at least 30 shares and a lending investor should have a portfolio of 40 shares (Reilly & Brown 1997:285).

Newbould and Poon (1993)

The study of Newbould and Poon showed that a large proportion of diversifiable risk is eliminated when portfolios consist of 50 to 60 randomly selected shares (Dobbins *et al.* 1994:26).

5.2.1.2 The benefits of international diversification

Ibbotson, Siegel and Love (1985)

Ibbotson *et al.* examined the performance of numerous assets around the world. They constructed a value-weighted portfolio of shares, bonds, cash, real estate and precious metals for the period 1960 to 1984. These assets were selected from the markets of Australia, Canada, Japan, Hong Kong, Northern and Western Europe, Singapore and the US. They computed annual returns, risk measures and correlations among the returns for alternative assets. A conclusion from their study was that investors can obtain a lower level of portfolio systematic risk by diversifying globally, rather than by only investing in their domestic market. They found that systematic risk factors in one country, for example monetary policy, are not correlated with systematic risk factors in other countries and, hence, through global diversification, portfolio systematic risk can eventually be reduced to a world-systematic risk level (Reilly & Brown 1997:91,285).

Bailey and Lim (1992)

This study examined the performance of investment funds in France, Germany, Korea and Spain to establish whether these funds enable investors to attain international diversification. They found that the returns on the funds resemble US domestic share returns, rather than foreign share portfolios, and concluded that these funds do not provide the expected benefits of international diversification (Reilly & Brown 1997:977).

Reilly and Brown (p.977) state that the findings of Bailey and Lim should not be seen as evidence against the benefits of diversification, but rather as confirmation of market the efficiency research which has shown that fund managers generally perform worse than the market return.

Michaud, Bergstrom, Frashure and Wolahan (1996)

From their analysis of international equity investing over the preceding 20 years, Michaud *et al.* concluded that international diversification no longer provides the same opportunities of higher returns and lower risk as it did previously. They, however, added that the evidence indicates that investors can still improve the risk/return characteristics of their portfolios through thoughtful international diversification (Jones 1998:16,17).

5.2.1.3 South African research

Bhana (1987)

Bhana studied the benefits of global diversification, and found that if South African investors are able to split their investment portfolios - half in the domestic market and half in 17 different foreign markets - they will be able to increase their average returns and at the same time decrease the risk substantially. It was also concluded that the dramatic reduction in risk can in general be attributed to the low covariance of JSE returns with the returns on foreign stock exchanges (Ross *et al.* 1996:312).

5.2.2 Conclusion

The evidence from these studies confirms that investors do not require a large number of shares in their portfolios to achieve the benefits of diversification. It has also been shown that international diversification has additional risk/return benefits, as stated by Elton and Gruber (1995:288):

> The evidence that international diversification reduces risk is uniform and extensive... Unless there are mechanisms such as taxes and currency restrictions that substantially reduce the return on foreign investment relative to domestic investment, international diversification has to be profitable for investors of some countries, and possibly all.

5.3 RECENT DEVELOPMENTS IN MARKET EFFICIENCY AND THE EMH

According to Elton and Gruber (1995:406), the EMH and the concept of efficient capital markets have been among the predominant themes in investment management and academic literature since the 1960s. The EMH, and the testing thereof, historically consists of three categories or forms of market efficiency:

- **Weak form efficiency**. These tests are concerned with whether all the relevant information contained in historic share prices is fully and rapidly reflected in current share prices.
- **Semi-strong form efficiency**. Testing of this level of market efficiency entails investigation of whether all publicly available information is fully and rapidly reflected in current share prices.
- **Strong form efficiency**. This level of market efficiency requires that the tests determine whether both publicly available and privately held information are fully and rapidly reflected in current share prices.

The concept of market efficiency, the rationale behind the EMH and the results of research, up to the mid-1980s, on the various forms of market efficiency have already been reviewed in chapter 3. In the next two sections the recent research on the EMH, and some alternative theories, will be reviewed.

5.3.1 Research related to the EMH

The **tests of weak form market efficiency** can be divided into the following major groupings:

- Statistical tests of the independence between share returns. These tests attempt to establish whether there is any dependence between successive price changes and whether any such evidence can be used to earn abnormal returns (Reilly & Brown 1997:212,213).

- Investigation of trading rules in order to establish whether investment decisions based on trading rules render returns that differ from a simple buy-and-hold strategy. Again, the aim is to establish whether such trading rules can be applied to consistently earn above-average returns (Reilly & Brown 1997:212).

- Testing for any evidence of market irrationality, abnormal volatility and market overreaction. These tests attempt to establish whether there are significant differences between share prices and the present value of their future cash flows (Elton & Gruber 1995:437).

The **tests of semi-strong form market efficiency** can be divided into the following basic groupings:

- The first group of tests are return prediction studies, whereby researchers use time-series analysis and publicly available information in an attempt to predict future returns. Alternatively, researchers use cross-sectional analysis in order to establish whether specific variables can be used to predict which shares will yield abnormal risk-adjusted returns. It is important to note that cross-sectional return studies are joint tests of the EMH and the asset pricing model used. This creates the problem that anomalous results can be caused by market inefficiency or model misspecification (Reilly & Brown 1997:216,223).

- The second set of tests are event studies. These studies examine whether abnormal rates of return are yielded immediately after the announcement of significant economic events, that is, the tests attempt to establish whether investors can earn excess risk-adjusted returns by investing after the release of information on significant economic events (Reilly & Brown 1997:216,217).

Strong form tests can be divided into the following three main groupings, according to the investors involved (Reilly & Brown 1997:234,235):

- Firstly, trading by corporate insiders is investigated to establish whether they can consistently earn risk-adjusted excess returns.

- The second group of tests analyse whether the recommendations from stock market specialists, such as share analysts, can be used to earn abnormal risk-adjusted returns.

- The performance of professional money managers is the focus of the third group of tests. These tests, too, attempt to ascertain whether these fund managers are able to outperform the average market return on a regular basis.

  The latter group of tests can be subdivided into two sub-groups:

  i. Tests which examine whether certain market specialists/fund managers have the ability to outperform others and the market on a consistent basis, that is, whether their past performance is a reliable indicator of future performance (Reilly & Brown 1997:235,979).

  ii. Other tests examine whether certain market specialists/fund managers have superior market timing and share selection ability, that is, an ability to anticipate bull or bear markets and to correctly identify shares which will yield abnormal returns (Reilly & Brown 1997:978; Bradfield 1999:2).

The results of some of these studies are reviewed below.

5.3.1.1 Classification of EMH research

Fama (1991)

In 1991 Fama reviewed his earlier classification of the three forms of the EMH and, again, classified the tests and empirical results into three groups. The weak form category was broadened to include some of the areas previously tested in the semi-strong form category. According to the new classification, the three forms of EMH research were changed as follows:

- Weak form - Tests of return predictability.
- Semi-strong form - Event studies or studies of announcement.
- Strong form - Tests for private information (Elton & Gruber 1995:407; Reilly & Brown 1997:211; Jones 1998:262,264).

Fama also changed the basic hypothesis that the information linked to each category be fully reflected in share prices. He referred to a weaker and more sensible version, in that prices must reflect information to such an extent that no financial advantage can be obtained by acting on any information (Jones 1998:257).

In this chapter the categories will still be defined as weak form, semi-strong form and strong form, but the tests and their results will be allocated and presented according to the new categories, as presented in Reilly and Brown (1997:211-241).

5.3.1.2 Global applicability of EMH research

Hawawini (1984)

Hawawini reviewed the research on the behaviour of European share prices and the efficiency of European capital markets. The evidence showed that the behaviour of European share prices, even though the markets are smaller and less active, are remarkably similar to those of US shares. Most of the results on European shares confirmed the findings on US data and hence that European markets are as informationally efficient as the US market. It can thus be concluded that investors can assume that markets outside the US have the same level of information efficiency as the US market (Reilly & Brown 1997:246,247).

5.3.1.3 General EMH research

Stoll and Whaley (1983), Thaler (1987) and LeRoy (1989)

LeRoy concluded that reported market inefficiencies have done much to damage the reputation of the EMH, while both Thaler and Stoll and Whaley have reported that most, if not all, of the surviving anomalies are not exploitable by ordinary investors (Bhana 1994:80,81).

Keane (1986,1989,1991)

According to Keane (1986,1989) the degree of market efficiency ranges in various degrees between perfect efficiency and complete inefficiency. Keane concluded that the important issue is whether the markets are operationally efficient or inefficient, and not whether the markets are perfectly efficient or completely inefficient. In 1991 Keane added that it was not important to investors whether markets are efficient or inefficient, but rather the degree of efficiency. Keane identified four degrees of efficiency:

- Perfect efficiency. No one, not even experts, will be able to earn superior returns.
- Operational efficiency. Only a few highly skilled market participants will be able to earn superior returns and, since the market responds quickly to the release of their information, other investors will not be able to exploit their insights.
- Moderate inefficiency. The existence of market quirks and anomalies will allow analysts and other market researchers to develop rule-of-thumb investment guidelines which can also be exploited by ordinary investors.
- Operational inefficiency. Well-informed ordinary investors will be able to exploit these inefficiencies and market experts will be able to convey their knowledge to ordinary investors. Since the markets are unable to process the information quickly, investors can exploit the information (Bhana 1994:81; Jones 1998:276).

Vandell and Panino (1986)

Vandell and Panino concluded that their evidence suggest operational market efficiency and that ordinary investors are not able to spot or exploit market inefficiencies (Jones 1998:276).

Schwert (1991)

Schwert suggested that the strong support for the reported market inefficiencies is a result of the investment community's desire to believe that markets are inefficient. It is in their interest that markets should be proven to be inefficient, since it can then be shown that financial analysis is of value (Bhana 1994:81).

5.3.1.4 Weak form efficiency tests

a. Statistical tests of independence

Harris (1986), Glosten (1989) and Cambell, Grossman and Wang (1993)

These studies examined the correlation in share returns over time. The price changes for individual transactions on the NYSE were examined and significant serial correlations were found (Reilly & Brown 1997:213).

Conrad and Kaul (1988) and Lo and MacKinley (1988)

Both these studies examined whether share prices followed a random walk, using portfolios of shares based on size, that is, the market value calculated as the number of shares times the share price. They found a relationship between one week's and the next week's returns and that this correlation is stronger for small shares. These results have cast doubt on the independence of price changes in small shares, but it was noted that the results could have been affected by the infrequent trading of small firms' shares (Elton & Gruber 1995:423; Reilly & Brown 1997:212,213).

Fama and French (1988), Poterba and Summers (1988) and Fama (1991)

Poterba and Summers used variance ratios to test whether there was zero serial correlation of share returns on the NYSE for the period 1926 to 1985. They found evidence of positive correlations for the periods under one year and evidence of negative correlations for periods over two years. This evidence suggests that share prices may revert to a mean over long periods of time. They also extended their test to examine the mean reversion in share price indices in 17 other countries and found that most countries, except Finland, South Africa and Spain, have negative serial correlation for long-term returns. They examined, further, whether the mean reversion could be due to discount rates varying over time, but concluded that their findings represent evidence against the random walk hypothesis (Dobbins *et al.* 1994:127,128).

Fama and French performed a more direct test of return serial correlation. They also found evidence of the mean reversion of returns over time and found strong negative serial correlation for the years 1926 to 1940. However, after 1941 the correlations were found to be close to zero (Dobbins *et al.* 1994:128).

Fama and French argued that, since both their and Poterba and Summers' (1988) procedures had little statistical power, the results have little weight - the correlation is much smaller after 1940 and can be due to chance. Fama (1991) added that the results can be a combination of changing expected returns and expected returns reverting to their mean over time (Elton & Gruber 1995:424).

Cecchetti, Lam and Mark (1990)

Cecchetti *et al.* challenged these findings of mean reversion and suggested that much of the serial correlation found in historical returns are due to a small-sample bias (Dobbins *et al.* 1994:128).

b. Tests on technical trading rules

Brush (1986) and Pruitt and White (1988)

These studies provide support for trading rules in that technical trading rules, which use specific three-part filters or are able to adjust for the January effect, were shown to be able to outperform a buy-and-hold strategy (Reilly & Brown 1997:215).

Fama and French (1988,1989) and Kim, Nelson and Startz (1991)

In their 1988 study, Fama and French found that dividend yield can be used to successfully predict returns for periods two to four years ahead. They argued that their results indicate some market inefficiency, as high dividend yields may indicate possible high future returns due to current share prices being irrationally low, while low dividend yields may indicate that current share prices are irrationally high (Dobbins *et al.* 1994:129).

The 1989 study of Fama and French entailed an investigation of the relationship between business conditions and expected returns on shares and bonds. They found that these returns move together and that dividend yield and the default spread can be used to predict share and bond returns. Both variables predict high returns when business conditions are weak and low returns when business conditions are strong. Their regression analysis also showed that they can successfully forecast returns one to four years ahead. Although this suggests market inefficiency and the potential for profitable trading rules, Fama and French argued that their results are consistent with a world of changing business conditions and that this may affect the rate used to discount anticipated cash flows (Dobbins *et al.* 1994:129,130).

Kim *et al.* (1991), however, showed that the statistical significance of the return forecasting regressions of Fama and French may be much lower than they estimated (Dobbins *et al.* 1994:130).

Jegadeesh (1990)

Through an examination of monthly share returns over the period 1934 to 1987, the study of Jegadeesh found a pattern in share prices and, hence, provides evidence in support of technical analysis. It was found that shares with large losses in one month are likely to show significant gains in the next month, while shares with large gains are likely to show significant losses in the following month (Jones 1998:521,522).

Ball, Kothari and Wasley (1995)

The study of Ball *et al.* casts doubt on the possibility of successfully implementing trading rules in actual real-world conditions (Reilly & Brown 1997:215; Jones 1998:261).

c. <u>Tests on market volatility and market irrationality</u>

LeRoy and Porter (1981) and Shiller (1981,1984)

These studies examined the volatility of share prices relative to the volatility of the underlying fundamental variables which affect share prices. To determine whether share prices deviate more than the deviations in these variables would imply, volatility tests based on the following assumptions were employed:

- Share prices reflect expectations about future dividends.
- Real expected returns on shares are constant over time.
- Dividends grow at a constant rate and are described by a stationary process.

The studies found that actual share prices vary more than the theoretical prices do and it was concluded that markets are irrational (Elton & Gruber 1995:437,438).

Flavin (1983), Kleidon (1986) and Marsh and Merton (1986)

These studies criticised earlier findings on excess volatility and the study of Marsh and Merton also showed that if the assumption about the process of how dividends are determined was changed, results opposite to those of Shiller(1981,1984) can be found (Dobbins *et al.* 1994:126; Elton & Gruber 1995:438).

DeBondt and Thaler (1985,1987) and Zarowin (1989)

From their studies, DeBondt and Thaler argued that investors overreact to unexpected and dramatic news. They found that shares which have performed poorly are underpriced due to the over-pessimism of investors and that these shares provide abnormally good returns in subsequent periods. Similar evidence was also found of investor over-enthusiasm in that shares which have performed well are overpriced and underperform in subsequent periods. They showed that portfolios consisting of loser shares outperform portfolios consisting of winners over a three to five year period. They also found that most of the loser portfolios' abnormal returns occur in January (Bhana 1994:89; Elton & Gruber 1995:438; Jones 1998:261).

Zarowin argued that DeBondt and Thaler (1985,1987) overstated their conclusions. Part of the overreaction effect can be attributed to small firms being included in the loser portfolios and that these small firms may in any case have been expected to outperform the market, that is, firm size explains much of the overreaction effect (Dobbins *et al.* 1994:116).

Brown, Harlow and Tinic (1988)

Brown *et al.* developed the Uncertain Information Hypothesis (UIH) to show that markets does not overreact to unanticipated information and to explain how risk-averse investors adjust to the release of new information. They showed that the release of imperfect information will cause risk-averse investors to adjust share prices to match the increased risk and this initial adjustment will appear to be an underreaction to good news or an overreaction to bad news. As the uncertainty disappeared with time, risk levels will also decrease and share returns will progressively move back toward their normal levels (Bhana 1994:90).

Shiller (1988), West (1988) and Cochrane (1991)

These studies examined the argument that the evidence of excess volatility has been the result of changes in discount rates which, in turn, are caused by changes in economic conditions and perceived risk. Shiller and West argued that the amount of change in discount rates that would be required to explain excess volatility would be implausibly large. Cochrane, however, disagreed with this argument and showed that small changes in discount rates have a significant effect on share prices. He added that since the risk premium, that is, the excess of the required rate of return over the risk-free rate, is unknown, large fluctuations in share prices can be expected (Dobbins *et al.* 1994:126).

Bulkey and Tonks (1989)

This UK study also found evidence of excess volatility and Bulkey and Tonks exploited this with a trading rule which yielded an after-tax excess return of 1,5% per annum (Dobbins *et al.* 1994:127).

Cutler, Poterba and Summers (1989)

Cutler *et al.* argued that important political and economic news have little predictable effect on share prices and, hence, the effect of economic factors on share prices left room for arguments about fads unrelated to the fundamentals which drove share prices (Weston & Copeland 1992:98).

Barsky and De Long (1989)

In their study, Barsky and De Long note that the expectations about future dividends in support of share price movements are not fads, but are based on expected economic performance (Weston & Copeland 1992:98,99).

Various studies

Fama (1990) showed that more than 50% of the movement in share prices are as a result of movements in a key fundamental - changes in industrial production. Various other studies have examined other fundamentals, time periods and countries and showed that there is little room for markets to be driven by irrational fads. Such studies include those of **Cochrane (1989)**, **Barra (1990)**, **Harris and Opler (1990)** and **Schwert (1990)** (Weston & Copeland 1992:99).

Ammer (1990), Lee, Shleifer and Thaler (1991) and Levis and Thomas (1992)
These studies showed that shares of investment trusts, both in the US and the UK, are traded at prices that are significantly different from their net asset values per share. These differences between market value and net asset value, both higher and lower, vary from trust to trust and over time. They concluded that this represents evidence of market irrationality for a specific group of shares. These shares have a given dividend stream, but are traded at prices which differ from the individual shares' dividend streams (Dobbins *et al.* 1994:116,117).

Baldauf and Santori (1991)
Baldauf and Santori found little evidence that markets are becoming increasingly volatile, but also found that, although returns are serially uncorrelated, they are not independent. Large changes are more likely to be followed by further large changes of either sign, while small changes are more likely to be followed by small changes of either sign (Upsher 1993:7).

Gerety and Mulherin (1991)
Other than for the market crash of October 1987, Gerety and Mulherin found no evidence that stock market volatility has increased (Upsher 1993:4).

Haugen, Talmor and Torous (1991)
Their study entailed an investigation of share price changes with respect to volatility and found that changes in share prices occur as a result of changes in volatility, rather than due to adjustments in expected future cash flows. They also found apparent nonlinear behaviour since the market reacts differently to volatility increases than to volatility decreases (Upsher 1993:8).

Chopra, Lakonishok and Ritter (1992)
This study provided support for the findings of DeBondt and Thaler (1985,1987). They used five-year periods to form portfolios and found that extreme losers outperform extreme winners by between 5% and 10% per annum over the next five-year period.

Even after adjusting for the size effect and time variations in beta, the overreaction effect was found to be much stronger for smaller firms than for larger firms. They concluded that this represents evidence against market efficiency, since knowing past share returns helps to predict future share returns (Jones 1998:261,262).

Studies on the independence of share returns have generally shown insignificant correlation in share returns over time and have confirmed the independence of share price changes over time. Some recent studies have, however, provided some evidence of autocorrelation for portfolios of small shares and that share prices do not follow a random walk. However, it has generally not been shown that investors can use the correlation and dependence of share movements to earn abnormal risk-adjusted returns after transaction costs (Elton & Gruber 1995:417; Reilly & Brown 1997:212,213).

Most of the evidence on technical trading rules also support the weak form EMH, since it has been shown that these trading rules can generally not outperform a buy-and-hold strategy (Reilly & Brown 1997:215). Dobbins *et al.* (1994:129) note, however, that some studies on mean reversion, excess volatility and market irrationality have suggested that it can be possible to predict share returns and that these opportunities can be exploited to earn excess returns.

5.3.1.5 Semi-strong form efficiency tests

a. Return prediction studies

i. Dividend yield/Macro-economic indicators

Rozeff (1984) and Shiller (1984)

Both studies examined the postulate that dividend yield is a proxy for the risk premium on shares. Their results showed a positive relationship between aggregate dividend yield and future share returns (Reilly & Brown 1997:217).

Fama and French (1988,1989)

Fama and French examined the dividend yield/share return relationship for two to four year time horizons and found that predictive ability increases with a lengthening of the time-horizon (Reilly & Brown 1997:217).

Various studies

A number of studies have examined the relationship between share returns, dividend yield and two variables related to the term structure of interest rates - default spread and horizon spread. These studies, including **Keim and Stambaugh (1986)**, **Cambell (1987)** and **Chen (1991)**, found that these variables can be used to predict share and bond returns. **Cambell (1991)** even found that these variables are useful for predicting foreign share returns (Reilly & Brown 1997:217).

Balvers, Cosimano and McDonald (1990)

The study of Balvers *et al.* showed that share prices in efficient markets need not follow a random walk. Long-term share returns can be somewhat predictable, as long as it is only average returns that are predictable (Reilly & Brown 1997:217).

Pesaran and Timmermann (1995)

Pesaran and Timmermann investigated the predictive power of a number of business cycle variables and, although finding predictive power, found predictive ability to change over time and to vary with the volatility of share returns. The predictability of share returns were found to be low during the 1960s, while it was found that exploitable predictions could have been made during the more volatile 1970s, even after accounting for transaction costs (Reilly & Brown 1997:218).

ii. <u>Quarterly earnings and post-earnings drift</u>

Foster, Olsen and Shevlin (1984)

Foster *et al.* examined a number of possible reasons for the existence of post-earnings drift following quarterly earnings announcements. They showed that post-earnings drift could be an artifact of the model used to measure expected earnings. With different proxies for expected earnings, different results were obtained and they concluded that, since it is unknown which earnings expectational model is correct, the findings of their study are inconclusive (Scott 1997:137).

Jones, Rendleman and Latané (1984)

Jones *et al.* used a sample of over 1400 shares for 36 quarters, mid-1971 to mid-1980, and examined daily returns before, on and after the day of the announcement, to establish the response of share prices to quarterly earnings announcements. They found a significant relationship between unexpected earnings announcements and subsequent excess returns (Jones 1998:268).

Mendenhall (1986)

This study showed that share prices do not adjust as rapidly to unexpected earnings announcements as the semi-strong form of the EMH would suggest (Reilly & Brown 1997:219,220).

Clinch and Sinclair (1987)

In a study on the Australian market, Clinch and Sinclair investigated the effect of an earnings announcement by one firm in an industry on the share returns of competing firms. They confirmed earlier US findings, in that the competing firms' abnormal returns vary more when another firm in the industry announces its earnings (Henderson *et al.* 1992:303).

They hypothesised that the last firm in an industry to announce its earnings will generally have the smallest reaction in share price. Earlier announcements by competing firms will probably reduce the surprise element in the last firm's announcement. Similarly, the firms who make the initial earnings announcements will have the biggest reaction, and their findings confirm this hypothesis (Henderson *et al.* 1992:303).

Bernard and Thomas (1989)

The study of Bernard and Thomas also found evidence of the existence of post-earnings drift. They examined a large sample of shares for the period 1974 to 1986 and showed that its existence can not be attributed to changes in the risk (as measured by beta) of the shares following the announcement. They found, further, that transaction costs do not limit the extent of the post-earnings drift. They did, however, show that markets take a considerable time to correctly estimate the implications of current earnings levels for future earnings. This represents significant evidence against capital market efficiency (Reilly & Brown 1997:137,138).

Easton and Sinclair (1989)

This Australian study examined the effect of interim earnings announcements and found similar evidence to US studies on quarterly earnings announcements. Their results showed significant movements in share prices on the day of the announcement and on the day before the announcement (Henderson *et al.* 1992:299).

Easton (1990)

Another Australian study by Easton examined the impact of the announcement of unexpected extraordinary items on share returns. Using 565 announcements of extraordinary items, no evidence of a significant association with abnormal share returns was found (Henderson *et al.* 1992 :303).

iii. <u>Price/earnings (P/E) ratios</u>

Basu (1983)

Following on his earlier studies, Basu re-examined the relationship between share returns, the P/E ratio and size effect. For the period 1963 to 1980 it was found that low P/E shares generally have higher risk-adjusted returns than shares with high P/E ratios. It was also shown that P/E ratios are significant after adjustment for size, and that the size effect virtually disappears after controlling for differences in both risk and P/E ratios (Jones 1998:270).

Peavy III and Goodman (1983) and Goodman and Peavy III (1985)

Their 1983 study showed that low P/E ratio shares earn higher risk-adjusted returns than high P/E ratio shares. The 1985 study investigated whether the P/E effect is confined to low-beta shares and found this not to be the case. It is, however, clear from these studies that no matter which risk measure is used, low P/E ratio shares provide significant abnormal returns (Reilly & Brown 1997:223; Jones 1998:270).

Banz and Breen (1986)

Banz and Breen showed that look-ahead bias, using accounting information not yet publicly released in the data sample, had a significant effect on findings that low P/E ratio shares have higher returns. They also found that when the look-ahead bias is removed, return differences between high and low P/E shares are largely eliminated. They concluded that the introduction of this insider information into test results casts doubt on the representativeness of prior findings (Bhana 1994:89).

Jaffe, Keim and Westerfield (1989)

This study confirmed earlier findings of low P/E ratio shares yielding positive abnormal returns and high P/E ratio shares yielding negative abnormal returns (Bhana 1994:88). They also found that there is a correlation between P/E ratios and the size effect (Page 1996:39).

Fama and French (1991)

Fama and French argued that the P/E effect disappears after the size effect and the book value to market value ratio have been accounted for (Elton & Gruber 1995:426).

Dreman (1994)

The study of Dreman, using a sample of 1 200 small shares for the 20-year period ending 1993, found that low P/E shares outperform high P/E shares over long periods of time (Jones 1998:270).

iv. The size effect

Christie and Hertzel (1981), Reinganum (1981) and Roll (1981)

Christie and Hertzel showed that, since betas are measured using historical data, firms that have become small have changed their risk characteristics and the use of historical data may not capture this increased risk. Both Roll and Reinganum showed that the betas of small firms are underestimated, since they are traded less often and non-synchronous trading biases beta estimates downward (Elton & Gruber 1995:425).

Brown, Kleidon and Marsh (1983)

Brown *et al.* generally confirmed earlier findings on the size effect, but found that the size effect is not stable over time and that, during the 1967 to 1975 period, large firms had outperformed small firms (Reilly & Brown 1997:225).

Reinganum (1983,1992)

In 1983 Reinganum showed that the performance of the shares of small firms can not be attributed to transaction costs, and in 1992 he confirmed the findings of Brown *et al.* (1983) that the size effect is unstable. It was found that, during both the 1984 to 1987 and 1989 to 1990 periods, large firms had outperformed small firms, but he still contended that the size effect is a long-term phenomenon (Van Rhijn 1994:41,42; Reilly & Brown 1997:225).

Blume and Stambaugh (1983) and Roll (1983)

Both studies showed that if small firm portfolios are only reformed annually and not rebalanced daily, half the size effect will be eliminated through the effect of transaction costs (Elton & Gruber 1995:426).

Stoll and Whaley (1983)

Stoll and Whaley concluded that transaction costs had not been properly considered in most previous studies on the size effect. It was found that there exists definite differences in transaction costs between small lower priced shares and large higher priced shares and they concluded that future studies should consider transaction costs explicitly and with realistic holding periods (Van Rhijn 1994:40).

Amihud and Mendleson (1986)

In their study, Amihud and Mendleson showed that part of the size effect can be attributed to being compensation for illiquidity. They reasoned that small shares should have higher expected returns due to higher transaction costs and, hence, part of the abnormal returns can be attributed to illiquidity (Elton & Gruber 1995:426).

Dimson and Marsh (1986)

Dimson and Marsh showed in their UK study that the shares of small firms outperform the shares of large firms by an average of 6% per annum. They also concluded that the size effect should be considered in any event studies using long periods of time and where the share sample includes the shares of both small and large firms (Pike & Neale 1996:44; Reilly & Brown 1997:226).

Keim (1986)

In two 1986 studies, Keim showed that the largest abnormal returns are yielded by firms which have recently became small, paid no dividends or have high dividend yields, have low prices and low P/E ratios. Keim further showed that most of the size effect occur in January (Jones 1998:271).

Levis (1989)

Levis examined the London Stock Exchange for the 1961 to 1985 period and found a size effect, although smaller than found on the US market. Levis also found the size effect to be closely related to the dividend yield effect and the P/E effect. A number of factors were identified for the smaller size effect reported - a different time-period had been studied, difficulty in measuring the risk of small shares and a possible sample selection problem (Dobbins *et al.* 1994:112).

v. Neglected firms and trading volume

Arbel and Strebel (1983)

Arbel and Strebel contended that the lack of attention to certain shares also has an effect on returns. They divided the shares in their sample into three groups according to the attention given by analysts, that is, highly followed, moderately followed and neglected. Their results confirm the existence of the size effect, but also provide evidence of a neglected firm effect. The neglected firm effect was found to exist across all sizes of firms and was shown to be caused by a lack of information and limited institutional interest (Van Rhijn 1994:42; Reilly & Brown 1997:225,226).

James and Edmister (1983)

This study examined the effect of trading volume and investigated the relationship between returns, market volume and trading activity. They found a size effect, but did not find that trading volume can explain the size effect (Van Rhijn 1994:42; Reilly & Brown 1997:225,226).

Barry and Brown (1984)

Barry and Brown hypothesised that, due to a lack of information, neglected firms require higher returns. The period of listing was used as a proxy for information and, after adjusting for the size and January effects, they found a negative relationship between the listing period and share returns (Reilly & Brown 1997:226).

vi. The book value to market value (BV/MV) ratio

Rosenberg, Reid and Lanstein (1985)

The Rosenberg *et al.* study found that shares with low book value to market price ratios significantly outperform average shares and that there exists a positive relationship between the BV/MV ratio and future share returns (Reilly & Brown 1997:226; Jones 1998:371).

Chan and Chen (1991)

Chan and Chen argued that small firms are more risky since they have lower production efficiency and high leverage and that this causes small firms to be marginal and more unlikely to survive economic hardship. They concluded that the size effect is a proxy for this more fundamental risk (Elton & Gruber 1995:425).

Chan, Hamao and Lakonishok (1991)

This study of Japanese shares confirms the positive relationship between share returns and the BV/MV ratio. (Reilly & Brown 1997:226).

Fama and French (1992,1995)

The 1992 study of Fama and French examined the joint effects of market beta, P/E ratios, leverage, the size effect and BV/MV ratios and provides strong support for the latter ratio. They examined the effect of these variables on the cross-section average share returns for the 1963 to 1990 period. They found that the positive relationship between beta and returns had disappeared between 1963 and 1990, while leverage and P/E ratios remain significant even after the size effect has been taken into account. However, these variables become insignificant when the BV/MV ratio are considered and Fama and French concluded that when the size effect and BV/MV ratios are combined, all cross-sectional variation in share returns is captured. Further, the BV/MV ratio has a consistently stronger role in explaining returns (Reilly & Brown 1997:226; Jones 1998:371).

Fama and French's follow-up study in 1995 examined whether the relationship between share returns, the size effect and BV/MV ratios reflect changes in earnings. They concentrated on high or low BV/MV shares and their relationship with profitability (as measured by ROE). They found that the BV/MV ratio remains persistent in explaining returns and that the size effect is more important in portfolios consisting of small shares, while BV/MV is more important for portfolios consisting of shares with high BV/MV ratios. This confirmed that BV/MV and firm size are the two important cross-sectional variables explaining cross-sectional variations in share returns (Reilly & Brown 1997:228).

Lakonishok, Shleifer and Vishny (1993)

The Lakonishok *et al.* study entailed an investigation of returns on portfolios constructed on the basis of BV/MV ratios. They found higher returns on high BV/MV portfolios and concluded that this is not as a result of compensation for higher risk (Elton & Gruber 1994:426).

Fairfield (1994)

Fairfield compared the BV/MV ratio (referred to in the study as the price to book (P/B) ratio) with the P/E ratio and found that the BV/MV ratio depends on the level of expected future profitability, while P/E ratios depend on expected changes in future profitability. It was also shown that BV/MV ratios are more stable than P/E ratios and that firms with high differentials between BV/MV and P/E generally maintain their classifications (Reilly & Brown 1997:228).

Dennis, Poterba, Snow and White (1995)

The 1992 findings of Fama and French were confirmed by this study. It was found that optimal portfolios consist of small firm shares with high BV/MV ratios. These results persisted after providing for 1% transaction costs and the assumption of annual rebalancing (Reilly & Brown 1997:228).

Kothari, Shanken and Sloan (1995)

Kothari *et al.* examined Fama and French's 1992 results by measuring beta with annual returns rather than monthly returns. They found a significant relationship between beta and returns and suggested that the relationship between BV/MV and returns may be periodic and insignificant over long periods (Reilly & Brown 1997:227).

vii. <u>The January effect</u>

Gultekin and Gultekin (1983)

This study examined the existence of the January effect in 17 countries and found that returns are higher in January for all the countries studied (Elton & Gruber 1995:412).

Reinganum (1983)

Reinganum showed that shares which had declined substantially in December show excess returns in January. He attributed most of this effect to tax-loss selling in December, but still found some January effect for those shares which had shown gains in December (Elton & Gruber 1995:413).

Lakonishok and Smidt (1984,1986)

Both studies found a January effect in the trading volume of small shares. The last day of the year was shown to be the most active trading day and the abnormal trading activity was found to continue into January (Reilly & Brown 1997:221).

Kato and Shallheim (1985)

Kato and Shallheim examined the relationship between firm size and the January effect for the Japanese market. They found a strong relationship between January excess returns and size excess returns, but no relationship between firm size and returns in non-January months (Elton & Gruber 1995:412).

Keim (1985,1986,1989)

The 1985 and 1986 studies examined the relationship between share returns and dividend yields and found a nonlinear relationship in January. It was also confirmed that this relationship only exists in January and that a size effect exists in January (Reilly & Brown 1997:221; Jones 1998:272). In the 1989 study it was shown that most small shares trade at their bid price on the last trading day of December and at the beginning of January. As small shares generally tend to have bigger bid-ask spreads and lower prices, Keim concluded that these findings provide a partial explanation of the January differences in returns (Fuller 1993:28; Elton & Gruber 1995:413).

Corhay, Hawawini and Michel (1987)

In their analysis of share returns on the Brussels, London, New York and Paris stock exchanges, Corhay *et al.* found a January effect on all the exchanges (Bhana 1994:87).

Jones, Pearce and Wilson (1987)

Jones *et al.* examined the hypothesis that tax-selling might explain the January effect and found evidence that refute this hypothesis. They found that in the 1821 to 1917 period, before income taxes had existed, a January effect had existed which is similar to the effect after the introduction of income taxes. They also found that, although Belgium and Japan has no capital gains taxes, the January effect still exists on these markets. For Australia, which has a non-December tax year, excess returns are found in January (Reilly & Brown 1997:413).

Fama (1991)

Fama examined the January effect and its relationship with the size effect for two periods, 1941 to 1981 and 1982 to January 1991. It was found that the January effect is closely related to the size effect and that most of it occurs during the first few days of January. It was also found that the size effect had been more pronounced during the 1941 to 1981 period than in the second period (Elton & Gruber 1995:411,412).

Arnott, Dorian and Macedo (1992)

Arnott *et al.* found evidence that suggests that the size effect and the link between the size effect and the January effect have disappeared. However, they still found a significant January effect, in that shares which had performed poorly recover significantly in January, while those shares which had performed exceptionally drop back in January. They further found that the year-end BV/MV effect remains strong (Arnott 1993:19).

Bhardaj and Brooks (1992)

This study provided evidence that previous studies on the relationship between the size effect and the January effect have been biased by incomplete consideration of a price effect and transaction costs. They examined share returns for the 1967 to 1986 period and found that the January effect is not so much a small firm effect, but rather a low-price phenomenon. Further tests showed that when transaction costs are considered, portfolios of low priced shares almost always perform worse than the market portfolio.

They concluded that excess January returns on low priced shares can be explained by a bid-ask bias and higher transaction costs and, further, that the January anomaly is not persistent and unlikely to be exploited by most investors (Jones 1998:273).

Haugen and Jorion (1996)

Haugen and Jorion found that the January effect still exists on the NYSE, that its magnitude has not changed significantly and that there is no evidence that it has disappeared (Jones 1998:272,273).

Various studies

Ritter (1988) suggested that portfolio-rebalancing affected returns in January, since it was found that a large number of small investors sell small shares in early December and buy small shares in late December and early January. The study of **Jones, Lee and Apenbrink (1991)** showed that tax-loss selling does not account for part of the January effect, while **Dyl and Maberly (1992)** found that odd-lot sales of shares follow a similar pattern to that reported by Ritter (1988), and that this can not entirely be attributed to tax-loss selling (Fuller 1993:28).

viii. Other calendar effects

Various studies

French (1980) reported a weekend effect. **Rogalski (1984)** found that the weekend effect can be decomposed into two effects, Friday close of trading to Monday opening and a Monday trading effect. **Smirlok and Stacks (1986)** found evidence of a time of the day effect (Reilly & Brown 1997:222), while the studies of **Keim and Stambaugh (1984)** and **Keim (1989)** confirmed the existence of a weekend effect (Elton & Gruber 1995:411). The study of **Ball and Bowers (1988)** provide evidence of the existence of a day of the week effect (Dobbins *et al.* 1994:115).

Gibbons and Hess (1981)

Gibbons and Hess examined the period 1962 to 1978 and found negative share returns for Mondays. They also reported large positive returns on Wednesdays and Fridays (Elton & Gruber 1995:411).

Harris (1986)

Intra day and day of the week patterns for the period December 1981 to January 1983 were examined and Harris found large negative returns for Mondays, while the other four days of the week yield positive returns which are largely equal. Harris also found that half of Monday's negative returns occurs between Friday's close and Monday's opening of trade, while the other half occurs during the first 45 minutes of Monday's trading. Hereafter Monday's returns resemble those of the other days of the week. It was also shown that share prices tend to rise during the last half hour of trading of each day (Elton & Gruber 1995:411).

Ariel (1987)

Ariel's study found significant time of the month effects, whereby most of the market's cumulative advances occur during the first half of the month's trading (Reilly & Brown 1997:222).

Kim (1988)

Kim found a persistent trend of Monday's returns being low or negative, while those of Friday's tends to be positive and high. Kim also reported that this effect is evident on most, if not all, stock exchanges of developed countries and also on smaller markets like those of Hong Kong, Korea and Taiwan (Bhana 1994:87,88).

Lakonishok and Smidt (1988)

The study of Lakonishok and Smidt used 90 years of daily data and confirms the existence of anomalies in the pricing of shares around holidays, turn of the week, turn of the month and at the end of the year (Dobbins *et al.* 1994:115).

Connolly (1989)

Connolly used superior technology and corrected for the statistical flaws in previous studies of the weekend effect on the NYSE. He concluded that the Monday effect is very weak and had actually disappeared during the 1980s (Bhana 1994:88).

b. Event studies

i. Share-splits

Grinblatt, Masulis and Titman (1984)

This study examined share price reactions to a sample of share-splits and reported positive higher returns for shareholders on the day of the announcement and for several days beyond the announcement date (Reilly & Brown 1997:230; Jones 1998:263).

ii. Stock exchange listings

Sanger and McConnell (1986) and McConnell and Sanger (1987,1989)

All three studies provided evidence of potential profit opportunities immediately after the announcement of applications for listings and possible excess returns immediately after the actual listing (Reilly & Brown 1997:232).

Dharan and Ikenberry (1995)

Dharan and Ikenberry confirmed that share prices decline after the initial listing and that this provides some opportunities for abnormal profits. They did, however, show that the degree of decline depends on the size of the firm and that the largest results are yielded by small firms which list prior to a decline in performance (Reilly & Brown 1997:232).

iii. Initial public offerings

Ritter (1983,1991) and Levis (1993)

In his 1983 study, Ritter showed that initial public offerings do not provide long-term abnormal returns and generally substantially underperform, on a risk-adjusted basis, after the first day (Elton& Gruber 1995:434). The 1991 study confirmed this conclusion and Ritter showed that investing in initial public offerings on the first day of public trading and holding the investment for three years, results in a wealth of only 83% of what can be attained by investing in a portfolio of similar shares on the NYSE or AMEX. The 1993 study of Levis on the UK market yielded findings which confirm the results of Ritter's studies (Reilly & Brown 1997:232).

Various studies

The studies of **Miller and Reilly (1987)**, **Chalk and Peavy III** and **Hanley (1993)** have shown that the market corrects the initial underpricing of new share issues within one day after the initial offering. They concluded that initial public offerings are generally underpriced, but that only a few of the investors who are allocated shares in the original issue will be able to take advantage of the initial underpricing. **Hanley and Wilhelm (1995)** showed that institutional investors are able to capture most of the initial profits (Reilly & Brown 1997:230).

Ibbotson, Sindelar and Ritter (1988)

Ibbotson *et al.* reviewed some of the earlier studies on initial public offerings and concluded that new share issues are generally underpriced. The evidence show that investors who are able to purchase the new issues can earn abnormal returns. It was also shown that the market adjusts prices quickly and that investors who buy shortly after the offering will not be able to earn excess returns (Jones 1998:263).

Hanley, Lee and Seguin (1996)

The study of Hanley *et al.* examined the behaviour of market prices and trading volume following the initial public offerings of 65 closed-end funds. Their study included nearly all the new closed-end funds on the NYSE and AMEX during the period January 1988 to May 1989. They found that the shares of the newly issued closed-end funds drop in price and yield negative returns during the first few months of trading. However, upon further investigation they found that the decline in share prices only starts 30 days or more after the issues and that the initial drop is usually significant (Scott 1997:141).

Their findings also suggest that large institutional investors start selling large number of shares immediately after trading starts. The reason for the prices not beginning to decline immediately seems to be due to price management by the underwriters of the new issues. The underwriters over-allot the initial public offerings to small investors and use the sales by the large institutional investors to fill the over-allotted orders and, hence, supply and demand is kept in balance during the early days of trading. In this way the underwriters maintain their reputations with large investors and, with the time-delay, it seems unlikely that their reputations would be significantly tarnished in the eyes of small investors (Scott 1997:141).

This suggests that there are different classes of investors with different degrees of market power and market prices can, therefore, be influenced by other factors than supply and demand. In addition, it also casts doubt on the hypothesis that market prices fully reflect all available information. As the poor performance of closed-end funds during the months following the initial issue is a matter of public record, it would seem rational that small investors would wait three to four months before investing. However, they do not and this fact represents another anomaly of market efficiency (Scott 1997:141,142).

iv. Corporate unbundling and spin-offs

Miles and Rosenfeld (1983)

These researchers argued that, in efficient markets, spin-off announcements should not effect the value of a firm, unless the spin-off is expected to affect future cash flows. They did, however, find that the market has a systematic positive reaction to spin-offs and unbundling - their study showed that 14% positive abnormal returns are associated with spin-off announcements (Blount & Davidson 1996:67,68).

Hite and Owens (1983)

Hite and Owens, too, showed that positive abnormal returns are associated with spin-off announcements. They found 7% abnormal returns for the period 50 days prior to the announcement date until completion of the spin-off. They argued that these results are caused by the spin-offs and unbundling, allowing the parent firms and subsidiaries to concentrate on activities, wherein they would each have their respective comparative advantages or could not enter into as a conglomerate (Blount & Davidson 1996:68).

Cusatis, Miles and Woolridge (1993,1994)

Both studies showed that the abnormal returns continue on a long-term basis and that the market's reaction to these announcements confirms investor expectations about the advantages of corporate downsizing. These studies measured the share returns for the spin-off firms, parent firms and parent-spin-off combinations and found that the positive abnormal returns last for the three years following the announcement date. They concluded that these positive results are due to the spin-offs eliminating the inefficiencies associated with a lack of strategic fit or synergy between the parent firm and its subsidiaries (Blount & Davidson 1996:68).

v. Accounting changes

Brennan (1995)

Brennan reviewed the numerous studies on the impact of accounting changes on share prices. He concluded that these studies show that the markets react quickly to accounting changes and adjusts share prices to their true value, that is, the shares are valued on the basis of economic events and not on the basis of cosmetic accounting information (Reilly & Brown 1997:233).

vi. Corporate events (mergers, acquisitions, etcetera)

Smith (1986) and Jensen and Warner (1988)

Both these studies reviewed the earlier studies on corporate events. The evidence indicates that market prices are adjusted on the basis of the underlying economic impact of the events and that the changes in prices are quite rapid, that is, usually completed within three days of the announcement (Reilly & Brown 1997:234).

Agrawal, Jaffe and Mandelker (1990)

Agrawal *et al.* re-examined the earlier study of Jaffe and Mandelker in 1976 and found similar results. They showed that the post-merger performance of the acquiring firms anomaly (post-announcement drift) is still significant and that firms which acquire other firms show abnormal returns that generally last over the next five years (Elton & Gruber 1995:434).

Healy, Palepu and Ruback (1990)

This study showed that the reaction of stock markets to takeover announcements are a good indicator of the operating performance of the companies in the period after the takeover had taken place (Weston & Copeland 1992:100).

vii. Unexpected economic news or world events

Pearce and Roley (1985)

Pearce and Roley examined the response of share prices to announcements of money supply, real economic activity, inflation and the Federal Reserve's discount rate. They found evidence in support of semi-strong market efficiency, as it was shown that the impact on share prices does not persist beyond the announcement day (Reilly & Brown 1997:233; Jones 1998:264).

Jain (1988)

In an even more in-depth analysis, Jain examined the hourly response of share prices to surprise announcements of money supply, prices, industrial production and unemployment rate. It was found that only money supply and prices have a significant effect on share prices and that the effect is reflected in share prices within one hour (Reilly & Brown 1997:233; Jones 1998:264).

Pound and Zeckhauser (1990)

Pound and Zeckhauser examined the effect of public takeover rumours as published in the 'Heard in the Street' column in *The Wall Street Journal*. They found the market to be efficient at responding to the analysts' opinions on shares and the features on the companies published in the column. On average no abnormal returns can be earned on the day of the publication, although it was shown that abnormal returns do occur in the calender month before publication (Jones 1998:264).

viii. Non-earnings-related information

Ou and Penman (1989)

Ou and Penman investigated whether non-earnings-related financial statement information can be used to devise an investment strategy whereby abnormal returns can be earned. They used a large sample of firms and applied 68 different financial ratios for the years 1965 to 1972 with the aim of establishing which ratios best predict increases and decreases in net income for the next year. They used the 16 best ratios to estimate a multivariate regression model and applied the model to predict the earnings changes of their sample firms for the period 1973 to 1983. They used these predictions to develop the following investment strategy. They bought the shares, for each year and each firm, three months after financial year-end in cases where increases in net income were predicted and sold short the shares of the firms with negative changes in net income predictions. The shares bought were held for two years and then sold at the ruling market price, while those sold short were bought after two years at the ruling market price (Scott 1997:138,139).

The results of their study showed that the strategy yields significant risk-adjusted excess returns (14,53% in excess of market returns) before transaction costs. They concluded that transaction costs can not fully explain these abnormal returns. Their findings represent another anomaly and evidence against market efficiency, since it appears as if all financial information is not fully incorporated into share prices. It also seems as if the market only adjusts prices with the actual announcement of the next two years' earnings changes and by then their investment strategy had already yielded its excess returns (Scott 1997:139,140).

Tinic (1990) and Ball (1992)

Both studies argued that Ou and Penman's 1989 results might be due to misspecification of the CAPM, that is, beta does not fully capture all the factors determining expected returns. It is thus incorrect to conclude that markets are inefficient (Scott 1997:140).

Greig (1992)

Greig re-examined Ou and Penman's 1989 study and concluded that the reported excess returns are not due to market inefficiency in processing accounting information, but rather due to the effect of firm size on expected returns. By controlling the results of Ou and Penman (1989) for firm size, it was found that all excess returns are eliminated. He also showed that Holthausen and Larcker's 1992 findings might be explained by firm size (Scott 1997:140).

Holthausen and Larcker (1992)

In their study, Holthausen and Larcker also showed that excess returns can be earned with the use of a financial statement ratio-based investment strategy. However, when they used Ou and Penman's (1989) strategy over the 1978 to 1988 period, they found no excess returns and concluded that this suggests that the earlier results may be restricted to the time period examined (Scott 1997:140).

Stober (1992)

Stober also applied Ou and Penman's (1989) investment strategy and confirmed their findings of excess returns. Stober, however, found that the excess returns last up to six years and that it seems unlikely that it would take the market that long to adjust share prices in line with their fundamental values. This suggests that Ou and Penman's results may have been due to some permanent differences in expected returns, that is, firm size or risk, rather than to the inefficient incorporation of financial information into share prices (Scott 1997:140).

Lev and Thiagarajan (1993)

According to Rees (1995:145-147), Lev and Thiagarajan used a more recent sample for their study, 1974 to 1988, and differed from Ou and Penman (1989) in that they did not base their investment strategy model on all available line item data, but used indicators of high-quality earnings employed by analysts. These indicators included, among others, items such as:

- Increases in inventory at a rate greater than sales increases.
- Cutbacks in capital expenditure and research and development.
- Disproportionate increases in debtors and provisions for doubtful debts.
- Disproportionate drops in gross profit and changes in selling and administrative expenses.
- Changes in the effective rate of taxation.
- Changes in the workforce and qualifications of the audit report.

They found that most of these variables are statistically significant when share returns are modelled over the accounting year. Their model also showed that firms with high-quality earnings tend to have greater increases in earnings than those with low quality earnings. They concluded, similar to Ou and Penman (1989), that fundamental analysis of financial statements can contribute to superior earnings forecasts.

Reilly and Brown (1997:234) conclude that the evidence on the semi-strong form of the EMH is mixed. The results of most of the studies on events such as share-splits, initial public offerings, accounting changes, corporate events and unexpected economic news or world events tend to provide strong support for semi-strong market efficiency. It is only event studies on stock exchange listings and non-earnings-related information which yield some conflicting results. Return prediction studies, on the other hand, provide much evidence in conflict with semi-strong form market efficiency. The time-series studies on dividend yield, macro-economic indicators, quarterly earnings announcements and calendar patterns, and the cross-sectional return prediction studies on P/E ratios, the size effect, neglected firms, trading volume and the BV/MV ratio have yielded anomalous results.

Elton and Gruber (1995:424) provide five possible explanations for the anomalous results which suggest the existence of a positive relationship between excess returns and the characteristics of firms.

- Firstly, that the observed observations are not real and that the tests overstate the significance of the statistical relationships.
- Secondly, that the firm characteristics are proxies for risk variables which are not included in the asset pricing models (CAPM or APT).
- Thirdly, that the CAPM is misspecified and, hence, betas are underestimated for small firms.
- The fourth explanation addresses the continued existence of these anomalies, in that trading costs preclude the profitable exploitation thereof.
- The fifth and final explanation is that markets are inefficient.

The consistent evidence of post-earnings drift suggests that quarterly earnings surprises can be used to earn excess returns, and the importance of this anomaly led *The Wall Street Journal* to publish a section on 'earnings surprises' in quarterly earnings reports (Reilly & Brown 1997:220).

Reilly and Brown (1997:221,222) also note that the other calendar effects, for example a monthly effect, weekend effect, day-of-the-week effect and intra day effect, are not as significant as the January effect. They find the January anomaly to be fascinating due to its pervasiveness and close relationship with the size effect. They add that explanations for the January effect include that of a dividend yield effect, a trading volume effect and tax-loss selling, but that these only receive mixed support. They conclude by stating that the numerous studies on the January effect only succeed in producing as many questions as answers about this anomaly.

5.3.1.6 <u>Strong form efficiency tests</u>

i. <u>Insider trading by corporate insiders</u>

Kerr (1980)

Kerr tested the trading rule identified in the earlier study of Jaffe (1974) and concluded that the market had eliminated the inefficiency (Reilly & Brown 1997:235).

Nunn, Madden and Gombola (1983)

The Nunn *et al.* study confirm the 1974 findings of Jaffe and found that corporate insiders are able to consistently earn excess returns on their share transactions (Jones 1998:265).

Givonly and Palmon (1985)

In a review of the studies on insider trading in the US, the researchers found that the evidence generally show that corporate insiders are able to outperform the market, in particular when a large number of insiders trade in a specific share (Bhana 1994:85).

Rozeff and Zaman (1988)

This study found that the investors who act on publicly available information on insider trading are also able to earn abnormal profits. However, they showed that these abnormal profits are substantially reduced when the size effect and the P/E ratio effect are taken into account and completely eliminated when transaction costs are included. They also showed that the excess returns earned by the corporate insiders are substantially reduced with the inclusion of transaction costs. In such cases abnormal returns average only 3% to 3,5% per annum (Jones 1998:265).

Peers (1992)

Peers examined insider trading by chairpersons, presidents and other top officials of companies over the 1975 to 1989 period. He found that they are able to earn substantial abnormal profits, especially on large trades. Most other insiders are only able to perform slightly better than the market return (Jones 1998:265).

Pettit and Venkatesh (1995)

The Pettit and Venkatesh study confirm the significant relationship between insider trading and longer-term share performance (Reilly & Brown 1997:235).

Various studies

Seyhun (1986) supported the principle that it should be considered which group of insiders (chairpersons, directors, top officials or other insiders) are doing the trading. The study of **Lee and Solt (1986)** show that it is generally not possible to use the trading activities of insiders as the basis of a market timing strategy, and the studies of **Seyhun (1988)** and **Chowdhury, Howe and Lin (1993)** provide support for their conclusion (Reilly & Brown 1997:235,236).

ii. <u>The performance of analysts</u>

Dimson and Marsh (1984,1988)

In their 1984 study, Dimson and Marsh investigated the forecasting ability of 35 share analyst firms. They found a small degree of forecasting ability from the 47 000 recommendations examined, but also that these recommendations do not outperform the market when transaction costs are included. They also showed that past forecasting ability does not necessarily mean future forecasting ability and that investors, therefore, cannot predict which analysts will be able to provide superior forecasts in the future (Bhana 1994:91,92; Elton & Gruber 1995:435).

Dimson and Marsh did, however, show that combining the analysts' forecasts leads to improved predictions of the future, but also found that more than half of the information content of these forecasts are incorporated in share prices within the first month after the forecast. This means that investors need to act quickly on these recommendations (Elton & Gruber 1995:435). Their 1988 study confirmed that differences in forecasting ability between analysts do not seem to persist over time, that is, no correlation between long-term and short-term forecasting ability could be found (Bhana 1994:93).

Stickel (1985), Hall and Tsay (1988) and Huberman and Kandel (1990)

Stickel used event-study methods to evaluate the performance of the Value Line investment strategy, whereby Value Line publishes weekly share rankings by dividing shares into five groups - group one being the shares with the best prospects and group five being the shares with the worst (Bhana 1994:92; Elton & Gruber 1995:436). The study revealed an announcement effect in ranking changes, which suggests that Value Line has information that is not fully reflected in share prices. It takes the market up to three days to adjust prices to changes in rankings and these price changes are of a permanent nature. This evidence suggests either access to additional information not fully incorporated into share prices or superior forecasting ability. However, it was also noted that the price effects of the changes in rankings are too small to outperform the market after transaction costs (Bhana 1994:92; Elton & Gruber 1995:436; Jones 1998:273).

Huberman and Kandel confirmed Stickel's (1985) results (Jones 1998:274), while Hall and Tsay showed that the superior performance of Value Line has diminished in recent years, to a level whereby the returns barely cover the transaction costs of a buy-and-hold strategy (Bhana 1994:92).

Elton, Gruber and Grossman (1986)

Elton *et al.* examined the database of a large bank which also ranks shares into five groups, namely best buys, buys, holds and two classes of sells. It was found that both the classification and changes in classification have information content and that abnormal risk-adjusted returns can be earned by buying upgraded shares or shares with a high ranking, or selling downgraded shares or shares with a low ranking. The excess returns were found to exist in the month of the ranking and for two months after the ranking or change in ranking. However, no superior forecasting could be identified and larger excess returns are associated with acting on changes in rankings than with acting on the recommendations themselves (Elton & Gruber 1995:435,436).

Hulbert (1990)

Hulbert provided further evidence on the Value Line rankings and showed that the system has performed less well after 1983. In addition, the evidence suggest that these announcements do not yield abnormal returns after the consideration of transaction costs, as was evidenced by the fact that the Value Line Centurion Fund consistently underperformed the market during the 1980s (Reilly & Brown 1997:238).

Affleck-Graves and Mendenhall (1992)

These researchers argued that abnormal returns associated with the Value Line rankings are not due to superior ability, but are caused by the post-earnings drift associated with the quarterly earnings announcement anomaly (Reilly & Brown 1997:238).

Various studies

Both **Lloyd-Davies and Canes (1987)** and **Lin, Smith and Syed (1990)** suggested that analysts possess private information. They found that the prices of shares mentioned in the 'Heard on the Street' column of *The Wall Street Journal* change significantly on the day of publication. Opposite to these findings, **Desai and Jain (1995)** examined the recommendations of the money managers at Barron's round table and found no abnormal returns after the publication date, although abnormal returns do appear in the period between the meeting date and the date of publication. **Womack (1996)** analysed analysts' recommendations and found that they have both market timing and share selection ability (Reilly & Brown 1997:238,239).

iii. <u>The performance of professional money managers</u>

Various studies

Shukla and Trzcinka (1994) showed that mutual funds perform inconsistently and that inferior performance is their only consistency. These findings are supported by the studies of **Henriksson (1984)** and **Chang and Lewellen (1984)**. The studies of **Munnell (1983)** and **Brinson, Hood and Beebower (1986)** also found that pension funds perform worse than the aggregate market, while **Berkowitz, Finney and Logue (1988)** showed that the performance of endowment funds are no better than a buy-and-hold strategy (Reilly & Brown 1997:239,240).

Lehman and Modest (1987)

Although Lehman and Modest reported significant differences between the various benchmarks (market indices) used to measure performance, they concluded that mutual funds have on overage performed consistently worse than the overall market (Reilly & Brown 1997:977).

Grinblatt and Titman (1989,1993) and Connor and Korajczyk (1991)

In their 1993 study, Grinblatt and Titman examined the performance of money managers, using portfolio holdings which do not require a market benchmark. They found that money managers of growth shares had earned significant positive risk-adjusted returns during the 1976 to 1985 period (Reilly & Brown 1997:977). This confirmed their 1989 findings and those of Connor and Korajczyk (1991) regarding superior performance (Elton & Gruber 1995:665).

Ippolito (1989)

Ippolito found that mutual funds are able to outperform the market on a risk-adjusted basis. However, he also showed that once transaction costs and management fees are considered, all evidence of superior performance disappear (Bhana 1994:86).

Cumby and Glen (1990)

Cumby and Glen measured the performance of international funds against a US index and the Morgan Stanley world equity index. They used two risk-adjusted performance measures and found no evidence that these international funds are able to provide superior results (Reilly & Brown 1997:977).

Elton, Gruber, Das and Aklarka (1991,1994)

In their 1994 study, Elton *et al.* used a three-factor model to measure the risk during the period studied by Ippolito in 1989 and found that the abnormal returns are actually negative with the use of more extensive risk measures (Reilly & Brown 1997:239,240). Their 1991 study confirmed that mutual fund managers are generally unable to perform well enough to cover their management fees and expenses (Elton & Gruber 1995:437).

iv. Persistence of performance

Ang and Chua (1982)

Ang and Chua examined the consistency of funds with different objectives and found that, although the funds generally meet their objectives, they are not able to do so on a consistent basis (Reilly & Brown 1997:979).

Dunn and Theisen (1983)

This study confirmed earlier evidence that a fund's past performance should not be used to predict future performance. They examined institutional portfolios over a ten-year period and found no consistency in performance and concluded that past results do not explain future results (Reilly & Brown 1997:979).

Grinblatt and Titman (1992)

Grinblatt and Titman, however, found that differences between the performance of various funds persist over time and, hence, past performance does provide useful information about future performance (Reilly & Brown 1997:979).

Hendricks, Patel and Zeckhauser (1993)

The persistence of performance was confirmed in their study, especially over a short-term one-year evaluation period (Reilly & Brown 1997:979).

Bauman and Miller (1994)

Rather than examine calender periods, Bauman and Miller used full market cycles to predict performance rankings. They found that there is a positive and meaningful correlation between the portfolio performance rankings of one cycle with the next (Reilly & Brown 1997:979).

Brown and Goetzmann (1995)

Brown and Goetzmann examined the persistence of performance, taking into account any survivorship bias, and found evidence confirming performance persistence. They did, however, acknowledge that their results were dependent on the time period of the study and the correlation of performance of successful funds with funds having similar themes (Reilly & Brown 1997:979).

Malkiel (1995)

Malkiel confirmed the conclusions of Brown and Goetzmann (1995) regarding the time period studied, since he found evidence of performance persistence in the 1970s, but no such evidence for the 1980s (Reilly & Brown 1997:980; Jones 1998:73). Malkiel examined all diversified US equity funds for the 1971 to 1991 period and showed that the top 40 funds generally have a year-to-year pattern in their success rates. He concluded that past performance is no guarantee of future performance, although there are some funds which had outperformed the market over the 20-year period of the study (Jones 1998:72,73).

Clements (1996) and Droms and Walker (s.a.)

The study of Droms and Walker, as reported by Clements in 1996, examined the performance of 151 funds which had existed over the entire 20-year study period, ending in 1990. It was found that only 40 of these funds had outperformed the market in more than 10 of the years, while none of the funds had been able to outperform in all of the five-year subperiods examined. In addition, no evidence was found that funds which had performed well in the first 10 years were more likely than other funds to do so in the next 10 years (Jones 1998:74).

Elton, Gruber and Blake (1996) and Gruber (1996)

Both these studies provided evidence in support of the persistence of performance between different funds (Reilly & Brown 1997:979; Jones 1998:72).

v. Market timing and share selection ability

Kon and Jen (1979)

Kon and Jen examined the ability of mutual funds to select undervalued shares and to time the market. Although they found evidence of market timing ability, none of the funds examined yielded consistent superior returns (Reilly & Brown 1997:978).

Shawky (1982) and Veit and Cheney (1982)

Shawky found that mutual funds are generally able to alter their risk characteristics in line with their market timing ability and that they are able to improve the diversification of their portfolios. Despite this, most funds still generate inferior results (Reilly & Brown 1997:978). Veit and Cheney, on the other hand, examined 74 mutual funds and concluded that the funds are not able to change their risk characteristics in line with their market timing strategies (Reilly & Brown 1997:978; Jones 1998:397).

Chang and Lewellen (1984)

This study found little evidence of successful market forecasting. Chang and Lewellen concluded that mutual funds show no special market timing or share selection ability and, hence, mutual funds are not be able to outperform a buy-and-hold strategy (Reilly & Brown 1997:978; Jones 1998:397).

Henriksson (1984)

Henriksson examined 116 mutual funds and found no evidence of consistent share selection and market timing ability. The study showed that managers are not able to forecast large changes in the market and that those who show superior share selection ability have poor market timing ability (Reilly & Brown 1997:978; Jones 1998:397).

Alexander and Stover (1990)

This study confirmed the earlier findings that fund managers have poor market timing ability (Brevis 1998:4).

Lee and Rhaman (1990)

From their investigation of mutual fund performance, Lee and Rhaman concluded that some funds show superior share selection and market timing ability. The study covered the performance of 93 funds over the period January 1977 to March 1984. It was found that 15% of the fund managers showed significant positive selection ability, 10,8% negative selection ability and 17,2% showed significant positive market timing ability. Their study ignored negative timing ability (Bradfield 1998:11).

Chan and Chen (1992)

Chan and Chen examined the market timing and share selection performance of asset allocation funds. They found no evidence of any special abilities and, in fact, showed that the funds generally perform worse than their portfolio benchmark (Reilly & Brown 1997:978,979).

Wagner, Shellans and Paul (1992)

The Wagner *et al.* study compared the market timing performance of 25 mutual funds against a buy-and-hold strategy, whereby dividends were re-invested in three-month Treasury bills. Their examination covered the January 1985 to November 1990 period and found that the risk-adjusted returns of their market timing strategies yielded superior results to that of a buy-and-hold strategy. They found that 92% of the fund managers had outperformed the market during the crash of October 1987 (Brevis 1998:34,35).

Pond (1994)

Pond showed that there was considerable risk attached to market timing and if investors are not in the market at critical times, their returns would be significantly reduced (Jones 1998:397).

Hulbert (1996)

The results of Hulbert's study showed that only 3% of share timing strategies used over the most recent five-year and eight-year periods had outperformed a buy-and-hold strategy on a pure market timing basis (Jones 1998:396).

Bello and Janjigian (1997)

Bello and Janjigian examined the performance of investment funds which follow an active investment strategy. Their results show that these funds have a statistically significant market timing ability (Brevis 1998:36).

Reilly and Brown (1997:241) conclude that the results from these studies on strong form market efficiency provide mixed support for the EMH. The evidence provided by studies on insider trading clearly provides no support for the hypothesis, while those on stock exchange specialists indicate that some professionals do have monopolistic access to important information. They are, therefore, able to earn excess returns on some consistent basis. Against that, the evidence on the performance of professional money managers provides support for strong form market efficiency. The evidence on their inability to consistently outperform a buy-and-hold strategy, their lack of persistent performance and their poor market timing ability provide significant support for the EMH. As both professional money managers and average investors do not generally have access to inside information, the results of these studies are quite supportive of the strong form EMH as applied to investors in general.

5.3.1.7 South African research

a. General research

Seneque (1987)

Seneque reviewed the efficiency of the JSE and concluded that the issue is not to establish whether it is efficient or inefficient, but rather to establish the degree of efficiency. He noted that the fact that the JSE is a small market with relatively few listed shares and, more importantly, the fact that many shares are closely held and thinly traded complicates the issue of establishing the degree of efficiency of the JSE (Van Rhijn 1994:7).

Bradfield (1989)

Bradfield concluded that the problem of thin trading is probably the main cause of difficulties experienced with risk measurement in small markets and concluded that this is also the cause of the problems experienced with estimating beta on the JSE (Van Rhijn 1994:43).

Bhana (1994)

In a review of the efficiency of the JSE, Bhana concluded that only a few professional investors are able to achieve superior performance and that only company officers trading on inside information are able to consistently outperform the market. Some evidence of calender effects and the P/E effect was found, but the magnitude of the abnormal price behaviour was found to be small. Bhana concluded, further, that the JSE can therefore be regarded as an operationally efficient market (Bhana 1994:93-95).

b. Weak form tests

i. Independence of share price changes

Brummer and Jacobs (1981)

Brummer and Jacobs examined the pattern of share price changes on the JSE and found that, although price changes are not completely random, the degree of dependence is marginal and would not enable investors to consistently outperform the market (Bhana 1994:83).

Van Rhijn (1994)

The study of Van Rhijn used the industrial sector of the JSE to examine weak form market efficiency. The industrial sector was divided into two groups, a group consisting of companies which traded less than 250 000 shares per annum and, to rule out thin trading, a second group of companies with share trading of more than 250 000 per annum. Van Rhijn concluded that the JSE is not weak form efficient for individual shares, but confirmed weak form efficiency for portfolios. The study also showed that a thin trading effect exists on the JSE (Van Rhijn 1994:9,10,175,176,242,243,340).

ii. Market irrationality

Bhana (1989,1993)

Bhana found in 1989 that, during the1970 to 1984 period, the market had overreacted to unexpected favourable or unfavourable company-specific events. In the 1993 study, it was shown that the market had overreacted to earnings announcements during the 1975 to 1989 period. These results indicate that positive abnormal returns can be earned in the year following negative earnings announcements (Bhana 1994:89).

Page and May (1992)

Page and May replicated the study of DeBondt and Thaler (1985,1987) to test for market overreaction on the JSE. They found evidence in support of the Overreaction Hypothesis, in that it was shown that loser portfolios significantly outperform winner portfolios (Bhana 1994:89).

Bhana (1994)

In this 1994 study, the Uncertain Information Hypothesis (UIH) of Brown, Harlow and Tinic (1988) was used to examine whether the JSE had overreacted to the arrival of unanticipated information during the 1976 to 1991 period. It was shown that, for both good and bad news, price adjustment patterns were generally significantly positive after the initial reaction. Further, the volatility of prices also increased significantly after the announcements. He concluded that these findings provide strong support for the UIH. Bhana added that these findings do not support market irrationality, since it would appear that the market reacts to the uncertain information in an efficient, if not quite instantaneous, manner. Further, previous studies which had provided support for the Overreaction Hypothesis were incorrect in their suggestion that there are predictable patterns in post-event share returns, since the possibility that the dramatic news might increase the risk of shares had not been taken into account (Bhana 1994:90).

c. Semi-strong form tests

i. General

Firer, Ward and Teeuwisse (1987)

The study of Firer *et al.* implied that the JSE is efficient at the semi-strong level (Van Rhijn 1994:7).

ii. Earnings announcements

Knight and Affleck-Graves (1985)

This study entailed an analysis of the speed and direction of share price changes following the release of preliminary earnings announcements. Knight and Affleck-Graves found that the market reacts fairly quickly to these announcements, while there is also evidence that the market anticipates poor performance. They concluded that their findings support semi-strong market efficiency (Bhana 1994:84).

iii. Calendar effects

Bhana (1985)

Bhana examined share price behaviour on various days of the week and found that Mondays yield significant average negative returns. The other trading days show positive average returns, with Wednesdays having the higher returns. He, however, showed that these effects are not exploitable when transaction costs are considered and concluded that the results support market efficiency (Bhana 1994:88).

Bradfield (1989,1990)

The studies of Bradfield provide no evidence of a January effect on the JSE, but did show that there exists a significant December effect. Bradfield argued that the December effect is caused by thin and lacklustre trading during the holiday season in South Africa, leading to uncharacteristically low volatility. The excess return for December was found to be less than 3% and Bradfield concluded that this does not represent an exploitable inefficiency after transaction costs (Bhana 1994:87; Van Rhijn 1994:45,46).

Davidson and Meyer (1993)

From their re-examination of the Monday effect on the JSE during the period 1986 to 1991, Davidson and Meyer reported that the Monday effect had disappeared. They suggested that earlier findings had been as a result of methodology which biased results in favour of finding a Monday effect (Bhana 1994:88).

Bhana (1994)

In one of a series of 1994 studies, Bhana examined the impact of a public holiday effect on share returns on the JSE during the 1975 to 1990 period. He showed that, on the last trading day before the holiday, shares advance with a disproportionate frequency and that mean abnormal returns average five times more than during the rest of the year. He, however, showed that these abnormal return opportunities are not exploitable as the returns are insufficient to cover transaction costs (Bhana 1994:88).

iv. Size effect, dividend yield, P/E ratios and liquidity

De Villiers, Lowings, Pettit and Affleck-Graves (1986)

De Villiers *et al.* concluded that, during the period 1973 to 1983, shares of large firms earned higher risk-adjusted returns than did small firms. Although this provides evidence of a size effect on the JSE, the nature of the effect is opposite to that found in international (mostly US) studies (Page 1996:30).

Bradfield, Barr and Affleck-Graves (1988)

From their CAPM test, using 100 shares over the 1973 to 1984 period, Bradfield *et al.* investigated the size, dividend yield and liquidity effects on the JSE (Bradfield, et al 1988:14; Van Rensburg 1998:35). They found that the dividend yield effect is statistically insignificant, implying that the risk-adjusted expected returns on high-dividend yield shares are not statistically different from those on low-dividend yield shares on the JSE. They also found a statistically insignificant negative value for the size effect, implying that the size effect does not exist on the JSE. Finally, they used the bid-ask spread as a proxy for the liquidity effect and also found this value to be negative, but insignificant. Although this may imply that the liquidity effect is also not significant for the JSE, they did qualify their conclusion by stating that their bid-ask spread estimation may not have captured the true implicit bid-ask spread on the JSE with sufficient accuracy (Bradfield *et al.* 1988:16-18).

Page and Palmer (1991)

Page and Palmer found no significant size effect on the JSE during the 1978 to 1988 period, but did show that size-related signs and coefficients are positive and consistent with the earlier findings of De Villiers *et al.* (1986). They did, however, find evidence of a significant P/E effect and showed that low P/E shares yield significantly more than do high P/E shares (Bhana 1994:88; Van Rhijn 1994:38; Page 1996:30).

Page (1996)

The study of Page confirmed the 1991 results of Page and Palmer regarding the size effect. Page used the data of 145 industrial companies for the period January 1978 to September 1991 and, using both the CAPM and APT, found a persistent P/E effect (Page 1996:34,39).

v. Event studies - Accounting changes

Knight and Affleck-Graves (1983,1988)

This 1983 study examined the movements in share prices of 21 companies that had announced changing from the FIFO to LIFO method of stock valuation. Knight and Affleck-Graves found short-term negative impacts on share prices and concluded that the market had not interpreted the change in stock valuation correctly. The JSE therefore showed signs of being an inefficient market. They showed in their 1988 study that the negative impact of the change in stock valuation method had been as a result of the expectation that the companies' future earnings would be reduced. They concluded that the negative impact on share prices is, therefore, an efficient market response and evidence in support of the efficiency of the JSE (Bhana 1994:84).

Gevers (1990)

With the abolishment of South African tax concessions on LIFO stock valuation in 1984, Gevers examined the effect of the resultant higher taxes and reduced cash flow on share prices. It was found that the market's reaction had been positive for companies which had reverted from a LIFO to FIFO policy, that is, the share prices had reacted positively to the expected increase in future earnings. It was also found that the market had already discounted the positive effect on earnings by the time of the announcement of the change in stock valuation policy (Bhana 1994:84).

vi. Event studies - share issues, share-splits and share-dividends

Biger and Page (1992)

Biger and Page examined the market reaction to share-splits and share-dividends (capitalisation issues) during the 1980 to 1990 period and found evidence in support of semi-strong form efficiency. The market reacts positively to both these announcements and positive abnormal returns can be observed before and during the week of the announcement. Biger and Page noted that the systematic risk of shares which are to be split has been higher than previously perceived by the market and, hence, that the increase in share prices can be attributed to an increase in systematic risk (Bhana 1994:84,85).

Thompson and Ward (1995)

In their review of the efficiency of the JSE, Thompson and Ward found mixed evidence, although they concluded that the market's reaction to new issues of shares, capitalisation issues and share-splits generally supports semi-strong form efficiency (Ross *et al.* 1996:293).

vii. Event studies - Corporate unbundling

Picton (1993)

Picton argued that the motives for South African corporate unbundling are negative by nature and, hence, should not provide any benefits to shareholders. Where firms are moving away from their optimal capital structures, firm values are expected to drop and negative returns should thus be expected (Blount & Davidson 1996:64,72).

Blount and Davidson (1996)

In their empirical study on corporate unbundling, Blount and Davidson examined the market's response to unbundling announcements. They performed two event studies, the first examining the effect of the announcements on parent firms and the second examining the impact on the subsidiaries. They investigated the possibility of abnormal returns occurring during the 60 days prior to and the 60 days following the announcement of the restructuring. They found that parent firms show greater abnormal returns after the announcement, while the abnormal returns for the subsidiaries are not statistically significant, both before and after the announcement. They found, further, that there is no consistent trend in the cumulative abnormal returns of parent firms, while the subsidiaries show significant cumulative negative abnormal returns at the end of the observation period (Blount & Davidson 1996:64,69,70).

These share price reactions are opposite to US findings of positive abnormal returns. Blount and Davidson concluded that the results are either due to unbundling representing a movement away from efficient structures and the motives thereof not being market related, or that the South African market is not sophisticated enough to ensure that unbundling enhances shareholder wealth (Blount & Davidson 1996:63).

d. Strong form tests

i. Insider trading

Bhana (1987,1990)

In his 1987 study, Bhana showed that there is substantial evidence of insider trading connected to company takeovers. It was found that insiders earn substantial returns by trading in the shares of the acquired companies prior to the announcement. The insider trading is also accompanied by a marked increase in trading volume. The 1990 study concentrated on whether insider trading is also linked to companies who substantially change their dividend policies. Again, significant insider trading was found in the six months preceding the announcement of the change and insiders are able to earn significant excess returns (Bhana 1994:85,86).

ii. The performance of professional money managers and analysts

Carter, Affleck-Graves and Money (1982)

This study entailed an evaluation of the South African unit trust industry over the 1965 to 1980 period. Carter *et al.* concluded that unit trusts underperform the market average on a consistent basis (Bhana 1994:86).

Gilbertson and Vermaak (1982)

Gilbertson and Vermaak examined the performance of 11 unit trusts over the 1974 to 1981 period. They found that the unit trusts generally outperform the market, but the reliability of the risk-adjusted portfolio returns are questionable since the risk measure used, beta, is nonstationary and unstable. They also found that one unit trust had been able to consistently outperform the others (Bhana 1994:86).

Knight and Firer (1989)

Knight and Firer examined the performance of 10 unit trusts over the 1977 to 1986 period. Although five unit trusts were found to have outperformed the market average before transaction costs and management fees, their average annual risk-adjusted returns, after taking these expenses into consideration, were found to be less than the market return (Bhana 1994:86; Brevis 1998:37).

Lambrechts (1989,1994)

In his 1989 study, Lambrechts found that several unit trusts are able to outperform the market in certain periods, but that the industry as a whole is not able to outperform the market average. The results of the 1994 study confirmed the earlier results, since it was found that only three out of 37 unit trusts had been able to outperform their respective market indices over the period April 1991 to March 1994 (Bhana 1994:87).

Bhana (1990)

Bhana examined the recommendations of stockbrokers and investment advisory services and found that they are of limited value to investors. Profit opportunities are available prior to the publication of the recommendations, but these disappear within the week after publication. Bhana concluded that only those investors who have access to private and unpublished advice will be able to take advantage of profit opportunities. Bhana also noted that the study had only investigated a small number of stockbrokers and investment advisory services and, hence, may not provide representative results (Bhana 1994:92,93).

Biger and Page (1993)

Biger and Page examined the performance of unit trusts, using an APT multi-factor approach. They examined 25 unit trusts over the period February 1988 to March 1992 and found that unit trusts are not able to outperform a simple buy-and-hold strategy (Brevis 1998:37).

Garvin (1995) and Meyer (1997)

Meyer examined the performance of unit trusts over the July 1985 to June 1995 period and also found that unit trusts are not able to outperform a buy-and-hold strategy. These results were confirmed in Garvin's study (Brevis 1998:39).

iii. <u>Market timing and share selection ability</u>

Carter, Affleck-Graves and Money (1982)

From this 1982 study of the unit trust industry, covering the period 1965 to 1980, Carter *et al.* concluded that unit trust managers have no special share selection or market timing ability (Bhana 1994:86).

Smith and Chapman (1994)

Smith and Chapman examined 28 actively managed unit trusts and their study covered the March 1973 to December 1992 period. They found that the unit trust managers have poor market timing and share selection ability (Brevis 1998:37,38).

Bradfield (1998)

In a recent study, Bradfield confirmed earlier findings that local fund managers exhibit no positive share selection or market timing ability. Bradfield examined monthly prices of 13 unit trusts over the June 1985 to June 1995 period and found that none of the fund managers show any significant share selection ability. It was also shown that only one of the funds exhibits statistically significant positive timing ability, while six exhibit statistically significant negative timing ability (Bradfield 1998:1,7,9,11).

Brevis (1998)

Brevis examined the industrial sector of the JSE for the periods January 1970 to September 1987 and January 1989 to June 1997, in order to compare the performance of a buy-and-hold strategy with a market timing strategy. The results indicate that, with the application of a market timing strategy within an APT framework, active fund managers should, from both a theoretical and practical viewpoint, be able to earn higher risk-adjusted returns than passive managers. However, Brevis noted that both dividends and transaction costs were ignored in the study and that the study was limited to the industrial index. Only by taking all indices and the effect of dividends and transaction costs into consideration, can it be conclusively established whether an active market timing strategy can outperform a buy-and-hold strategy on the JSE (Brevis 1998:220, 253,254).

Brevis (1998:45,46,242) concludes that, as yet, no definite conclusions can be drawn regarding the degree of efficiency of the JSE. It seems as if it can be viewed as being operationally efficient, but that there also exists opportunities for market specialists to outperform the market. The average investor who does not have the knowledge and ability of market specialists is, however, unlikely to be able to outperform the market on a consistent basis. Hence, the conclusion currently seems to be that the JSE is efficient for some investors, but inefficient for others.

5.3.2 Some alternatives to the EMH

With the stock market crash of October 1987, the US stock market declined 23% on a Monday in October 1987, following a substantial decline on the prior Friday. The UK stock market also fell by a third in three days and similar declines occurred in most other world markets. No major release of bad news had been associated with these declines and it could thus not be ascribed to rational changes in investors' expectations (Dobbins *et al.* 1994:21; Elton & Gruber 1995:438).

Numerous reasons have been postulated as being the causes for the crash, including panic, failure of the trading mechanism and formula trading. If the reasons are found to be unpredictable events it implies that the hypothesis about market information efficiency remains unchallenged. It does, however, suggest some market irrationality (Elton & Gruber 1995:438).

Pike and Neale (1996:45) add that the October 1987 crash has contributed to the credence of the **Speculative Bubble Theory**.

5.3.2.1 The Speculative Bubble Theory

According to this theory, stock market behaviour is not based on the fundamental analysis of new information, but rather on the inflating of prices and the subsequent bursting of these speculative bubbles. The price inflation is caused by investors who believe that other investors will always be willing to pay more for the shares at a later stage. Bull markets are created by their trading activities, but in the end the bubble bursts and, depending on the size of the bubble, the market corrects itself with a crash (Pike & Neale 1996:45).

The crash of October 1987 has also strengthened the belief that share prices do not follow a random walk. Investigation of the pattern of past share prices and the realisation that shares had been overvalued before the crash, has led to the uncovering of evidence that share price movements do not follow a random walk. It has, for example, been found that significant market downturns occur more frequently than significant upturns. The principles of a new branch of mathematics, **Chaos Theory**, have been employed in order to explain these patterns (Pike & Neale 1996:45,46).

5.3.2.2 Chaos Theory

Chaos Theory is a branch of mathematics that is used to analyse natural systems, such as ocean currents, weather patterns and river systems. These systems appear to be chaotic, but chaos theorists suggest that their random and unpredictable patterns do follow a set of rules. Once a trend begins in such a system, it continues and the pattern becomes seemingly highly predictable until it is stopped by something. From this, it was found that these systems can be modelled and the behaviour thereof could be forecasted. However, the predictions of the behaviour of chaotic systems are extremely sensitive to the accuracy of the conditions specified at the beginning of the estimation period, that is, any small errors in the specification can lead to major errors in the forecast (Pike & Neale 1996:46; Jones 1998:275).

Peters (1991)

Peters suggests that stock markets are chaotic in the manner described by Chaos Theory, in that markets do have memories, often have major price swings and movements in share prices are not completely random. He found that today's price movements in UK share prices are affected by price changes which had occurred a number of years ago. He also found that the most recent price changes have the biggest effect on current price changes and that the impact decreases the longer the changes are traced backwards. Further, it was shown that these patterns in price movements are persistent and if prices have changed upwards, the next change is more likely to be up than down. However, Chaos Theory also suggests that persistent upward movements will be stopped and, more than likely, result in major corrections or even market crashes. Peters suggests that stock markets do exhibit patterns which are overlaid with random noise and the more noise, the more inefficient the market. He found that the US market is more efficient than the markets of the UK and Japan (Pike & Neale 1996:46).

Others have suggested that stock markets are basically rational and efficient, with only occasional chaos associated with speculation activity. It is currently not clear whether markets are efficient, chaotic or somewhere in between. Hopefully further research will provide some evidence to bring some clarity to the matter (Pike & Neale 1996:46).

Vanderwicken (1994)

Vanderwicken found that high-tech share traders have used the powerful computers which are currently available, together with recent non-financial discoveries, in order to attempt to discover how stock markets really work. These high-tech traders have found evidence that markets follow the same principles as natural systems such as weather patterns, physical structures such as molecules or biological structures such as the human brain (Jones 1998:275).

Vanderwicken identified four basic ideas on which these high-tech traders base their models:

- **Chaos Theory** is based on the idea that investors buy shares because the prices are rising and, hence, prices continue to rise with the continued buying. This pattern continues until it is stopped by some surprising occurrence, for example, unexpected economic events or news. The chaos in the market then resumes until something happens to cause a new trend to start (Jones 1998:275).

- **Neural networks** computer programs which attempt to mimic the human brain, that is, they learn from experience and can be taught to react in certain ways. Similarly to technical analysis, only much more thorough and much faster, these networks can be used to seek patterns in share price movements and to predict future movements in the market. Vanderwicken cites evidence about a fund that had used neural networks for share selection since 1989 and has outperformed the Standard & Poor 500 index by between 2% and 7% per quarter over a three-year period (Jones 1998:275).

- **Genetic algorithms** are computer programs which mimic the evolution of living organisms and is based on the principle that markets also have memories. The algorithms find patterns in stock market behaviour and then predict how the market will behave under different conditions (Jones 1998:275).

- **Microstructure analysis** uses computer programs which are derived from particle physics and are used to analyse the relationship between stock market changes and environmental changes (Jones 1998:275).

Vanderwicken notes that by 1994, 10% to 15% of stock market trading volume can be accounted for by these new technologies and that the field of investing will be revolutionised if these high-tech traders were to be shown to be consistent in their success (Jones 1998:276).

5.3.3 Conclusion

Capital market efficiency has significant implications for investment analysis and portfolio management. The activities of rational profit-seeking investors who react quickly to new information should keep the market relatively efficient, resulting in market prices that show true intrinsic values. This will ensure that the risk/return relationship remains consistent (Reilly & Brown 1997:247).

The results of most weak form efficiency tests tend to support the hypothesis that share prices reflect all market information and this means that technical trading rules which use historical data cannot be used to successfully and consistently predict future share returns (Reilly & Brown 1997:247).

The test results on semi-strong form efficiency are mixed. Most of the event studies on economic events, such as share-splits, initial public offerings, accounting changes, corporate events, unexpected news and non-earnings-related information, to a large degree provide consistent support for semi-strong form market efficiency. However, the return prediction studies have produced conflicting results, which generally do not support the semi-strong hypothesis. Anomalous evidence from quarterly earnings announcements, P/E ratios, the size effect, neglected firms, various calendar effects and BV/MV ratios have indicated that different variables can be used to predict differential rates of share returns (Reilly & Brown 1997:247).

Strong form efficiency implies that all information is reflected in share prices and this hypothesis is not supported by the evidence from the tests on corporate insiders and stock exchange specialists. The studies on analysts provide mixed evidence and it seems as if some analysts have either superior skills or access to private information. However, the performance of portfolio managers and the tests on their market timing and share selection ability generally support strong form efficiency, in that these managers are generally unable to outperform a buy-and-hold strategy (Reilly & Brown 1997:247).

Elton and Gruber (1995:439) add that evidence from the studies on weak form efficiency and semi-strong form event studies to a large degree confirm that all publicly available information is rapidly incorporated in share prices. The anomalous results on share return patterns, firm characteristics and post-earnings drift are reliant on the asset pricing model chosen and, hence, the implications of these results remain controversial. They conclude that anomalous results of calendar patterns in share returns do not support market efficiency, but add that the findings on the inability of professional money managers to outperform the market raises serious doubts about the usefulness and significance of these patterns.

The recent evidence from the tests on the EMH hold some very important implications for investors, analysts and portfolio managers. Reilly and Brown (1997:247) provide the following analysis of these implications:

- It seems as if technical analysis is of no value.

- Fundamental analysis can be useful, but its use is limited as it requires the ability to accurately predict estimated future values for the relevant economic variables.
- Superior analysis is possible if accurate projections of different variables can be provided. These projections should also be different from the consensus.
- If investors do not have access to superior analysis, their portfolios should be managed like index funds. Those with superior analysis ability and knowledge should generally concentrate on neglected firms and medium-capitalised firms. These alternatives provide the biggest likelihood of being mispriced, especially when market value/book value ratios and firm size are also taken into consideration.

Reilly and Brown (1997:247) conclude that the evidence indicates that capital markets are fairly efficient and, as a consequence, most analysts and portfolio managers find it extremely difficult to achieve superior results in any consistent manner.

Some alternative theories to the Efficient Market Theory, including Speculative Bubble Theory and Chaos Theory, together with the development of some sophisticated computer programs - based on discoveries in mathematics, physics and biology - suggest that the EMH does not hold and that there is consistent and/or predictable patterns in share price movements (Pike & Neale 1996:46; Jones 1998:274-276).

Although it is not known which of these descriptions of capital markets are correct, market prices can not be ignored, even if it is thought that they may not represent the true value of the companies. Only the examination of long-term trends will provide insight into the behaviour of stock markets (Pike & Neale 1996:46,47). Since the issue of market efficiency remains unresolved, investors should probably assume that the markets are reasonably, but not totally, efficient (Jones 1998:274,277).

5.4 RECENT DEVELOPMENTS IN THE CAPM

Blume (1993:6,7) notes that since the development of the CAPM, the use of beta as a measure of portfolio risk has been widely applied in the investment community, even though empirical studies have identified some discrepancies between the CAPM predictions and empirical data. These early tests of the CAPM found that the basic relationship between beta and expected returns is positive, although not as steep as what was predicted. It was generally found that low-beta shares have higher returns than predicted and that the returns of high-beta shares are lower than predicted. The testability and usability of the CAPM had also been questioned by Roll in 1977. The main area of criticism was centred around the CAPM's reliance on a market portfolio of all risky assets and since this market portfolio is unobservable, market proxies have to be used in the tests and application of the CAPM. Empirical tests have shown that when incomplete measures of the market portfolio are used, beta is mismeasured, resulting in inaccurate predictions of share returns. Despite these problems, it was shown at the beginning of the 1980s that the CAPM was the best pricing mechanism available at the time and that it was widely used for investment analysis.

The CAPM has been the subject of a large number of empirical tests and the results of the earlier tests have generally supported the CAPM. It was found that beta is a valid and reasonably complete measure of risk and that the CAPM, although an expectational model, generally provides useful explanations of actual events. However, since the mid-1980s, more recent studies have provided evidence that seriously challenges the validity of the CAPM (McLaney 1997:177). Most of the recent studies of the CAPM have concentrated on the following aspects:

- An examination of the relationship between beta and expected return, that is, determining whether the CAPM describes share returns and whether the relationship between beta and return is positive and linear. These tests have not only examined the relationship between beta and expected return, but have also attempted to establish whether other variables provide additional or better explanations of the return-generating process. Skewness in the return distribution, firm size, P/E ratios, leverage, the book value/market value (BV/MV) ratios, dividend yield and liquidity have also been examined to establish whether these variables are additional risk factors which, along with beta, explain returns (Reilly & Brown 1997:312-315).

- Another area of investigation is an examination of the stability of beta and the effect of stock market volatility. These tests have attempted to establish whether historical betas are useful in estimating future betas and also if there exists a relationship between share returns and stock market volatility (Upsher 1993:6; Reilly & Brown 1997:310).

- As the principle of the existence of a market portfolio consisting of all risky assets is central to the CAPM, many studies have examined the effect of the use of a proxy for the market portfolio. These studies have also provided controversial arguments regarding the testability and usability of the CAPM (Ross 1993:11; Reilly & Brown 1997:293).

The results of these recent studies are reviewed in the next section.

5.4.1 Recent research related to the CAPM

5.4.1.1 Beta as a measure of risk

a. Skewness

Sears and Wei (1988) and Lim (1989)

Both these studies have confirmed the importance of skewness in the return distribution as a means of explaining why the CAPM seems to undervalue low-beta shares and overvalue high-beta shares (Reilly & Brown 1997:314).

b. Other variables, including market capitalisation, leverage, P/E ratios and liquidity

Bhandari (1988)

The study of Bhandari found that financial leverage, as measured by the debt/equity ratio, provides some additional explanation of cross-sectional average returns. This implies that not only beta and firm size are important in explaining returns, but also that a CAPM with three risk variables (beta, size and financial leverage) will provide a better explanation of the return-generating process (Reilly & Brown 1997:314).

Baillie and Gennero (1990)

Baillie and Gennero found almost no evidence in support of the relationship between mean portfolio returns and the variance of those returns. They concluded that a simple mean-variance model, the CAPM, is inappropriate and that alternative risk measures must be found (Upsher 1993:7).

Fama and French (1992,1993,1996)

In their 1992 study, Fama and French examined the viability and usefulness of the CAPM through an evaluation of the combined roles of market beta, firm size, P/E ratios, financial leverage and the BV/MV of equity ratio. The impact of these variables was examined using the cross-section of average share returns on the NYSE, AMEX and NASDAQ (Reilly & Brown 1997:315).

They found a correlation between beta and returns, but showed that this is due to the correlation of both beta and returns to the other factors. They also showed that, even when beta alone is used to explain average share returns, the relationship between beta and average returns had disappeared during the 1963 to 1990 period. It was, however, shown that the other variables are significant in explaining average returns (Rees 1995:172; Reilly & Brown 1997:315).

They found, further, that the negative relationship between firm size and average returns persists after the inclusion of the other variables, while the positive relationship between the BV/MV ratio and average returns also persists when the other variables are included. Also, with the inclusion of both the BV/MV ratio and firm size, the BV/MV ratio has been shown to have a more consistent and significant role in explaining returns. It was also shown that returns increase with an increase in the BV/MV ratio and decrease with an increase in size and, hence, that the highest average return can be obtained with portfolios consisting of smallest size and highest BV/MV shares (Reilly & Brown 1997:315).

From these findings, Fama and French launched a severe and controversial attack on the basic single-factor CAPM, in that they concluded that beta is not the correct measure of risk and, thus, that the CAPM does not explain average share returns. Critics of their conclusions have, however, accused them of mining their data until they could find something against the CAPM (Nichols 1993:68).

In their 1993 study, Fama and French extended their analysis to include both shares and bonds, and concluded that there are at least three factors which are important in explaining share returns and two in bond returns. They found that a market factor, size factor and BV/MV factor provide a good explanation of the cross-section of average share returns, while a term premium and default premium explain most of the variation in bond returns (Rees 1995:172).

From these findings, they suggested that a three-factor CAPM should be used. They applied such a model in their 1996 study and concluded that the model explains a number of anomalies from earlier studies (Reilly & Brown 1997:315).

Chan and Lakonishok (1993) and Lakonishok (1993)

Using data for the 1926 to 1991 period, Chan and Lakonishok examined the relationship between beta and returns in order to establish whether Fama and French (1992) had been correct in their conclusions about the importance of beta. They found that the prices of high-beta shares had declined more than those of low-beta shares. This provides proof that high-beta shares are in fact more risky than low-beta shares and, thus, that investors should expect compensation for this type of downside risk. They also found that, in both up and down markets, the estimated slope of the compensation per unit of beta had been close to the expected slope as described by the CAPM. This confirmed that high-beta shares are more risky when investors are more concerned about downside risk (Lakonishok 1993:39).

Lakonishok (1993:40) concluded that Fama and French (1992) probably went too far when they suggested that there exists no relationship between beta and return. The available evidence does not support such an unqualified statement.

Fouse (1993)

Fouse also criticised the 1992 conclusions of Fama and French and suggested that they seemed to have forgotten that the CAPM is an expectational model. Fama and French (1992) did not distinguish between expected and realized returns and in fact seemed to believe that these two returns are the same. Fouse emphasised that investment managers know that this is not true. He added that most of the criticism of beta is based on evidence that it is a technical signal that does not work without fail. Sharpe (1970) suggested that an appropriate test of the CAPM depends on the intended use of the model. Fouse concluded that beta theory provides investors with a robust framework for the understanding of share prices and share price movements, and without the insights of the CAPM investors will be unable to fully capitalise on discounted cash flow, the value of factor analysis and the insights of the APT (Fouse 1993:110,117).

Dennis, Perfect, Snow and Wiles (1995)

The Dennis *et al.* study confirmed the results from Fama and French's (1992,1993) studies. They confirmed that portfolios of small firms with high BV/MV ratios provide the optimal combination, even after considering transaction costs and annual rebalancing, and that the best results can be obtained with rebalancing every four years (Reilly & Brown 1997:317).

Kothari, Shanken and Sloan (1995)

While Fama and French (1992,1993,1996) had measured beta with monthly returns, the study of Kothari *et al.* used annual returns in order to avoid the trading problems associated with using monthly data. Using these annual betas, they found substantial compensation for beta risk and suggested that the relationship between returns and the BV/MV ratio may be a time-period phenomenon, and that this may not be significant over a long period (Reilly & Brown 1997:317).

Pettengill, Dundaram and Matthur (1995)

Pettengill *et al.* also noted the Fama and French (1992,1993) problem of using realized returns to test the CAPM. They showed that when returns are adjusted for expectations regarding negative market returns, a consistent and significant relationship exists between beta and returns(Reilly & Brown 1997:317).

Grundy and Malkiel (1996) and Jagannathan and Wang (1996)

Grundy and Malkiel contended that beta is very useful in measuring risk in declining markets - which is when it is at its most important to assess risk. The Jagannathan and Wang study used a conditional CAPM, which allows for changes in beta and the market risk premium, and showed that it performs well in explaining cross-sectional returns (Reilly & Brown 1997:317).

Various studies

Handa, Kothari and Wasley (1989) and **Kothari, Shanken and Sloan (1992)** found correlation between market capitalisation and errors in beta estimates. **Banz and Breen (1986)** and **Kothari, Shanken and Sloan (1992)** also showed that selection bias has an important effect on beta estimates and, thus, that apparent anomalies can be as a result of poor implementation of the CAPM. **Fuller (1993)** argued that the small firm effect can to a large degree be attributed to such mismeasurement, and in particular the effect of the bid-ask spread and differentials in order flow across time (Harrington 1993:2,3).

5.4.1.2 Measuring beta

Some studies have examined published estimates of beta for comparability, in particular the betas published in Merrill Lynch's *Security Risk Evaluation Report* and Value Line's *Investment Survey*. These beta estimates differ in the data used, in that Merrill Lynch uses the Standard & Poor 500 as market proxy with 60 monthly observations, while Value Line uses 260 weekly observations with the NYSE composite series as market proxy (Reilly & Brown 1997:311,312).

Statman (1981)

Statman examined the betas for 195 firms over comparable periods and found small but significant differences between their beta estimates (Reilly & Brown 1997:312).

Reilly and Wright (1988)

Reilly and Wright examined 1 100 shares for three non-overlapping periods and found the same differences as had been reported by Statman in 1981. They showed that the differences are due to the different time intervals used, while both the size and the direction of the differences are affected by the shares' market value. It was found that the weekly interval yields larger betas for large firms and smaller betas for small firms. They concluded that the time interval and the size of the firm should be carefully considered when betas are estimated (Reilly & Brown 1997:293,312).

5.4.1.3 Stability of beta and the relationship between share returns and market volatility

Pindyck (1984,1988)

In the 1984 study, Pindyck investigated the decline in real share prices over the 1965 to 1981 period. It was found that profitability and the variance of returns (volatility) are significant in explaining positive share price changes. The 1988 study showed that volatility provides more of an explanation of the market decline in 1974 than profitability or interest rates could (Upsher 1993:6).

Poterba and Summers (1986)

Poterba and Summers found that shocks to volatility must occur over a long period of time in order to have any significant effect on share prices. They argued, however, that volatility shocks are short lived and that expected share returns are therefore not affected by volatility changes (Oosthuizen 1992:4; Upsher 1993:6).

Taylor (1986)

Taylor examined the stochastic process generating share returns and found that the process generating share returns and prices is not linear. He concluded that this non-linearity is as a result of changes of the variance of returns, and that this is caused by movements in the general level of market activity (Oosthuizen 1992:5).

French, Schwert and Stambaugh (1987)

From their examination of the relationship between share returns and market volatility, French *et al.* found a positive relationship between expected volatility and the expected market risk premium. It was also found that a negative relationship exists between share returns and unexpected changes in volatility (Oosthuizen 1992:5; Upsher 1993:6).

Chou (1988)

Chou used data from the same source as had been used by French *et al.* in their 1987 study, and claimed that the methodology of the Poterba and Summer (1986) study had been limited and could have provided misleading results. Chou found persistence in volatility and a strong relationship between excessive volatility and a decline in share returns (Oosthuizen 1992:6; Upsher 1993:7).

Ball and Kothari (1989)

This study showed that firms which currently have high betas and are involved in mergers or acquisitions, are likely to experience a lowering in their betas as the merged or acquired firms are likely to have lower beta values. This provides additional evidence that beta values can change over quite short periods of time (Rees 1995:170).

Schwert (1990)

Schwert investigated whether computer trading and options trading have caused an increase in market volatility, but found no evidence to support this assertion (Upsher 1993:4).

Bodertha (1991) and Lilian (1991)

Lilian found significant time variability in the return to risk ratio (index of relative risk aversion), while Bodertha tested the CAPM with time varying risk and returns and found evidence of the size effect, monthly effect and quarterly effect (Upsher 1993:8).

Poon and Taylor (1992)

Using UK data and a methodology similar to that used by French *et al.* in 1987, Poon and Taylor found no statistical significant relationship between share market volatility and share returns. They concluded that earlier studies' assumption that share returns are normally distributed, caused an overstatement of the significance of the relationship (Upsher 1993:9).

5.4.1.4 <u>The market portfolio - testability and usability of the CAPM</u>

Roll and Ross (1993,1994) and Ross (1993)

In their 1994 study, Roll and Ross confirmed that the use of an incorrect index as proxy for the market portfolio can lead to invalid results and conclusions (Ward 1994:101). The paper of Ross, based on the 1993 review of the academic literature by Roll and Ross (1993:11-13), provides the following criticisms and conclusions about the testability and usability of the CAPM:

- No empirical systematic relationship between expected return and beta can be discerned.
- Most empirical studies do not support the theoretical relationship between expected return and beta, whereby the CML should rise at a rate that is equal to the slope of the return of the market portfolio in excess of the risk-free rate.

- Beta is of limited use in estimating expected share returns and beta has nothing to say about the CAPM. It is therefore an illusion to conclude that the CAPM is the same as finding that expected returns and beta are related to each other.
- The CAPM states that the market portfolio is mean-variance efficient and all knowledge about the CAPM is contained in this statement, that is, expected returns should be linearly related to the beta of the market portfolio. Ross added that this was not found to be the case. The empirical evidence does not support the linear relationship of expected share returns, whereby share portfolios with higher betas has higher returns.
- Although the CAPM provides an elegant explanation of the risk and return issues and how they are related, it can not be tested in any practical way and, hence, can not be proved to be either valid or invalid.
- Since the CAPM is not useful in providing expected returns, it is a wonderful, but rather useless, theory. Beta, however, does have some practical use, in that it can provide some information on the relative risk of different portfolios, and that it shows that the prices of shares with high betas tend to increase more when the market goes up and decrease more when the market went down than, do the share prices of shares with low betas. It can, however, not be stated with confidence that high beta portfolios will yield long-term higher expected returns.

Reilly and Akhtar (1995)

Reilly and Akhtar confirmed that the choice of market proxy can have a serious impact on the testing of the CAPM. They found significant differences in beta estimates for 30 shares for three alternative periods, using three different market proxies. They concluded that this can have a significant effect on expected returns. They also showed that, since the covariance is much lower, while the variance is only marginally smaller, betas tend to be lower with a world share index than with a domestic market index (Reilly & Brown 1997:296, 320,321).

Various studies

The results of the studies of **Amihud, Christensen and Mendelson (1992)** and **Kandel**

and Stambaugh (1993) confirmed that, even though a relationship between beta and expected returns may not exist, proxies for the market portfolio may actually be close to being mean-variance efficient. They also showed that this may be true, even when there exists an exact linear relationship between beta and expected returns for optimal mean-variance portfolios. **Jagannathan and Wang (1993)**, hence, concluded that the CAPM may actually be true and the observed anomalous results may have been caused by the true market portfolio not being used (Harrington 1993:2).

5.4.1.5 South African research

a. Beta as a measure of risk

Seally and Knight (1987)

Seally and Knight used 107 shares, allocated to 10 portfolios, over an eight-year period, starting 26 January 1973, to examine the systematic effect of dividend policy on JSE share prices. They included a dividend yield variable in the CAPM to test the impact of dividend policies on realised share returns. They found that the CAPM's positive risk-return relationship does not hold and that the actual risk premium offered for bearing risk is not statistically different from zero, or is at best only marginally positive. They did, however, find a significant positive relationship between share returns and dividend yield over the full period of their study (Seally & Knight 1987:33-41).

Westwell (1987)

Westwell showed that the movement of the market, as expressed by the JSE All Share Index, is the most important factor influencing share returns (Oosthuizen 1992:7).

Bradfield, Barr and Affleck-Graves (1988)

Their study entailed an investigation of the applicability of the CAPM for the JSE and, secondly, whether variables other than beta has significant additional influences on JSE share returns. They used a sample of 100 shares, with weekly prices for the period January 1973 to December 1984 and a series of returns taken at four-weekly intervals for their study. They found a linear risk/return relationship and that *ex ante* estimates of beta are successful in predicting share returns on the JSE, although it was found that beta is not as successful with predicting returns on gold shares. They concluded that their findings provide support for the validity of the CAPM and that the CAPM should be accepted as a reasonable model in the context of the JSE (Bradfield *et al.* 1988:14; Van Rhijn 1994:143,144).

The second part of their study found no evidence that the additional variables examined, namely dividend yield, firm size, market capitalisation and liquidity, have any significant additional explanatory power of JSE share returns. They concluded that these effects do not exist on the JSE (Barr 1990:18; Ward 1994:100).

Bradfield and Barr (1989)

Bradfield and Barr confirmed that the CAPM stands up well to South African empirical testing and that the CAPM can be relied upon for valuing JSE shares (Ward 1994:100).

Viljoen (1989)

Viljoen examined the performance of the CAPM on the JSE during the market crash of October 1987. It was found that the CAPM does explain the relationship between risk and return, although the relationship was not found to be completely linear or static. Further, some weaknesses in using beta as a risk measure were identified and it was found that no significant correlation between share returns and betas exists for the sample of shares examined (Viljoen 1989:80).

Ward (1994)

Ward used monthly index and dividend data from 38 JSE sectoral indices over the January 1983 December 1992 period and found the CAPM to be an acceptable model for both mining and industrial shares. It was also found that firm size and financial gearing represent a major dimension of risk in these sectors. Some evidence was found in support of the 1992 findings of Fama and French, in that it was shown that there is a significant relationship between share returns and market capitalisation. However, the relationship between market price and net asset value was not found to be statistically significant (Ward 1994:99,103,111,112).

b. The stability of beta and the relationship between share returns and market volatility

Oosthuizen (1992)

Oosthuizen used 13 years of daily closing levels of the JSE All Share Index, Industrial Index and All Gold Index as data for his investigation of the relationship between share returns and the volatility of share returns. The time periods January 1979 to August 1985 and September 1985 to January 1992 were examined and it was found that the market responds quickly to volatility and the best results are obtained with the use of a five-day variance to determine volatility (Oosthuizen 1992:6,17,48).

Upsher (1993)

The study of Upsher extended the work of Oosthuizen (1992) and found that share returns do not comply with the assumptions of the CAPM. Upsher, also, used the daily closing prices for the JSE All Share Index, Industrial Index and All Gold Index, but over the October 1978 to February 1993 time period. A strong negative relationship between expected returns and unpredictable volatility was found, although it was shown that for the All Share Index there exists a strong positive relationship between expected returns and predictable volatility. Upsher concluded that this provides some support for the CAPM, but that the overall evidence from the study was inconclusive (Upsher 1993:iv,v,16,39,68).

Keogh (1994)

This study examined the stability of beta and the usability of the CAPM and beta in a South African context, using seven industrial sectors over the 1965 to 1993 period. It was found that beta does not remain stable over time and that this has a negative effect on the usability of beta and CAPM in the South African context (Keogh 1994:1,2,205).

Van Rhijn (1994)

Van Rhijn also examined the stability of beta and the usability of the CAPM for financial and investment management under South African conditions. He examined the shares of the companies listed in the industrial sector of the JSE over period January 1980 to December 1992, using monthly return data. Dividends were only included to establish the beta coefficients. The findings on the stability of beta confirmed the results obtained by other researchers, in that portfolio betas were found be much stabler than those of individual shares. However, they were also found to have a higher degree of instability during the years after 1990. Van Rhijn identified some major considerations which should be taken into account when estimating beta on the JSE:

- The thinly traded nature of the JSE.
- The choice of market proxy.
- The distribution of share returns.
- The time varying element of systematic risk.
- The inclusion of prior beliefs about systematic risk measures.

The major conclusions from this study were that the relationship between average returns and risk for the JSE supports the CAPM and that the CAPM can be used to test the risk/return relationship on the JSE. Further, higher returns are associated with higher betas and this, too, is consistent with the theoretical beta/return relationship (Van Rhijn 1994:4,5,9,175,176,276,297,338).

Bowie and Bradfield (1997)

Bowie and Bradfield (1997:1-4) measured the predictability of betas on the JSE from one five-year period to the next, namely January 1977 to December 1981, January 1982 to December 1986 and January 1987 to December 1991, in order to establish the stability of beta on the JSE. They found that, once the distortion of thin trading on the JSE was eliminated, the levels of beta stability are similar to those reported for UK and US stock markets. Betas were also found to have a tendency to regress to some average mean over time.

c. The risk-free rate

Bradfield, Barr & Affleck-Graves (1988)

Bradfield *et al.* found that the 12-month fixed deposit rate of major South African commercial banks provides a reasonable proxy for the risk-free rate and that, for the JSE, the intercept of the CAPM is not significantly different from this rate (Bradfield *et al.* 1988:15; Oosthuizen 1992:46).

Firer (1993)

Firer (1993:29) reviewed the South African CAPM research, in particular the interest rate used as proxy for the risk-free rate. He found that the choice of rate had varied from the 90-day Treasury bill rate, the 360-day Treasury bill rate to the 12-month fixed deposit rate. He concluded that this diversity in choice reflects the fact that interest rates are to a degree managed by the authorities and that no financial instrument is completely riskless. He added that the lack of clarity regarding this component of the CAPM detracts from its practical application.

Various studies

The study of **Laing (1988)** used the 91-day Treasury bill rate as proxy for the risk-free rate (Van Rhijn 1994:172), while **Ward (1994)** used an index of monthly returns based on the 91-day Banker's Acceptance discount rate as proxy (Ward 1994:103). On the other hand, **Page (1996)** used Black's (1972) zero-beta portfolio approach in preference to a Treasury bill rate as proxy for the risk-free rate (Page 1996:31).

d. The market portfolio

Venter, Bradfield and Bowie (1992)

Venter *et al.* investigated the predictive power of the CAPM using different market indices as proxy for the market portfolio. They showed that the error between predicted returns and actual returns can be reduced with the selection of an appropriate market sector index (Ward 1994:101).

Various studies

Bowie and Bradfield (1993) concluded that the use of an incorrect market proxy results in beta being underestimated, causing a reduction in the predictive power of the CAPM. **Ward (1994)** found that the JSE All Share Index is an acceptable proxy for the market portfolio and that the All Share Index is preferable to the major sectoral index (Ward 1994:100,111). **Laing (1988)** also used the All Share Index as a surrogate for the market portfolio (Van Rhijn 1994:172). **Page (1996:31)**, on the other hand, used an equally weighted index of all the shares examined in the study as market proxy.

e. The CAPM versus the APT

Page (1989)

Page compared the performance of three single-factor CAPM-based models with the performance of a two-factor APT-based model and concluded that the APT approach provides superior results on the JSE (Ward 1994:101).

Biger and Page (1993)

Biger and Page found that the observed superior performance of South African unit trust managers disappears when their performance are evaluated using a multi-factor APT approach rather than a CAPM-based approach (Page 1996:41).

Ward (1994)

Ward concluded that his findings provide some support for the APT in preference to a single factor CAPM and that, for the JSE, an APT framework with two or more factors could be considered in place of the CAPM (Ward 1994:111,112).

Page (1996)

Page (1996:28,29,41) undertook a comparative analysis of the CAPM and APT frameworks to test whether observed results and conclusions on efficient market size and earnings anomalies are substantially changed by using an APT multi-factor framework. He found that the use of the APT has no significant impact on the results obtained with the CAPM and concluded that the APT does not remove any possible misspecifications within the CAPM.

5.4.2 Conclusion

Although it has been found that high-beta shares earn lower returns than expected and low-beta shares higher returns than expected, most of the empirical evidence regarding the beta/return relationship have tended to support the CAPM at the beginning of the 1980s. More recent studies, however, have considered other variables in order to establish whether a better explanation of the risk/return relationship could be obtained (Reilly & Brown 1997:315,316).

Several studies have provided support for the inclusion of skewness in the distribution of returns as a variable, since it was found that there exists a correlation between positive skewness and high beta values. The inclusion of skewness is advocated on the assumption that investors prefer positive skewness and that they would be willing to accept lower average returns in exchange for the opportunity to earn very high returns (Reilly & Brown 1997:316).

Based on the results from EMH research, some studies have also examined other variables - firm size, financial leverage, P/E ratio and BV/MV of equity ratio - in order to establish whether these variables, in addition to beta, can provide an explanation of cross-sectional returns. Some of these studies have shown that these variables have explanatory power beyond beta. Firm size and BV/MV, in particular, have been identified as the most significant variables. These findings are, however, still controversial - some of the recent studies have supported these variables, while others have differed and found a significant and consistent relationship between beta and share returns (Reilly & Brown 1997:317,330).

Other studies have examined the risk-free rate and market portfolio, in order to establish the validity of using proxies for these parameters or to establish whether the use of proxies invalidates the tests of the CAPM (McLaney 1997:177; Reilly & Brown 1997:321). Ross (1993) and Roll and Ross (1993,1994) extended the earlier critique of Roll in 1977 and they contend that, without using the true market portfolio, testing of the CAPM and using it to evaluate portfolio performance is meaningless. Other studies support this contention and showed that the use of different market proxies can yield significantly different beta values and, hence, significantly different expected returns (Reilly & Brown 1997:330).

Reilly and Brown (1997:321), however, contend that the problems and arguments associated with the market portfolio do not invalidate the CAPM. The dilemma surrounding the market portfolio and choice of correct market proxy only represents a measurement problem in testing the CAPM or in using the model to evaluate portfolio performance. Therefore, the challenge lies in identifying or developing better proxies for the market portfolio and/or to find improved measures whereby portfolio performance measurement can be adjusted to reflect this dilemma.

According to Karnosky (1993:56), criticism of the CAPM on the grounds that it provides unreliable forecasts of short-term market conditions, is misdirected. The CAPM is an expectational model that attempts to explain the relationship among variables and should not be viewed as a trading mechanism or a means for active portfolio management. The CAPM only serves as the basis for the development of models that can be used to predict future share prices and returns. Comparing the CAPM and APT on the basis of their ability to replicate history and to forecast market prices is a futile exercise. These two models should not be seen as alternatives, since the APT attempts to provide an explanation of current market conditions , while the CAPM attempts to describe the fundamental relationships underlying the market.

Karnosky (1993:56) concludes that the CAPM should be judged on the basis of the insight it provides on the risk/return relationship and that without the CAPM, knowledge of the market and market conditions will be severely limited.

5.5 RECENT DEVELOPMENTS IN THE APT

Given the evidence of beta instability and the arguments regarding the CAPM's dependence on the existence of a true market portfolio, Ross(1976) developed an alternative asset pricing theory - the Arbitrage Pricing Theory. The APT requires less assumptions and contends that share returns are affected by multiple factors, not only beta. The APT, however, does not specify the number or identity of the factors affecting returns and most empirical studies have, firstly, attempted to establish whether three, four or five factors are significant in share returns and, secondly, whether factors such as inflation, growth in GNP, changes in interest rates, etcetera are the relevant variables (Reilly & Brown 1997:297-299).

While some recent studies have attempted to establish the number of factors, most studies were concerned with establishing the identity of these factors. Brevis (1998:98) notes that the first group of tests are known as unspecified factor tests, while the second group of tests are known as specified factor tests.

- **Unspecified factor tests**. These tests generally use factor analysis to determine the number of statistically significant factors in a sample of returns. Factor analysis does, however, have the disadvantage that it is used to determine the number of factors and the sensitivity of shares to these factors. This is a complex process and the number of shares which can be analysed at any one time are limited. A further disadvantage with the application of factor analysis is that the signs of the factors and the sensitivity of each share to each factor can not be determined in any unique way. Further, a unique hierarchy of factors for different shares can also not be determined (Brevis 1998:98-100).

Hence, Brevis (p.99) notes that the usability of the APT depends on the reliability of the statistical methods used to apply it. If these statistical methods are unreliable, and even though the APT might be correct, it can not be successfully applied in the investment process. Any tests of the APT are, therefore, combined tests of the APT and the statistical methods that are used to apply the APT.

- **Specified factor tests**. Since the unspecified factor tests do not provide an indication of the nature of priced systematic risk factors, researchers generally use a set of hypothetical factors to establish whether these variables are priced. These hypothetical factors can either be firm characteristics (dividend yield, size, etcetera), macro-economic factors (interest rates, inflation, etcetera) or a group of portfolios used as indices that combine the factors which may affect share returns (Brevis 1998:102,103).

The results of some recent international and South African APT research are reviewed in the next section.

5.5.1 Recent research related to the APT

5.5.1.1 The number of priced factors

Conway and Reinganum (1988)

These researchers established that there are two priced factors, a major priced factor and a minor priced factor. They found that, when applying factor analysis, no positive relationship exists between the number of factors analysed and the number of priced factors identified (Barr 1990:18).

Connor and Korajczyk (1993)

Connor and Korajczyk examined the cross-sectional monthly share returns on the NYSE and AMEX over the 1967 to 1991 period. They concluded that there are between one and six factors generating share returns on these markets and that all the factors after the first one have a particularly significant effect during January (Van Rhijn 1994:170).

Fama and French (1993)

Rather than using macro-economic variables, Fama and French used a set of portfolios in their model to determine the number of factors which explain share and bond returns. They found that a five-factor model performs well in explaining cross-sectional average returns and variations in share and bond returns (Elton & Gruber 1995:385,386; Brevis 1998:103).

5.5.1.2 The identity of the priced factors

Burmeister and Wall (1986), Burmeister, Wall and Hamilton (1986), McElroy and Burmeister (1988) and Berry, Burmeister and McElroy (1988)

These studies identified five macro-economic variables that are significant in explaining returns and found that such a five-factor APT model has greater explanatory power than the CAPM (Brevis 1998:105). Brevis (1998:105,106) and Jones (1998:245) note that these studies have identified the following five priced factors:

- Unanticipated changes in the risk premium.
- Unanticipated changes in the term structure of interest rates.
- Unanticipated changes in inflation or deflation.
- Unanticipated changes in the long-term growth rate of the economy.
- The residual market risk not captured by the other factors.

Berry *et al.* (1988) found that the significance of these factors changes between industries and various economic sectors. They suggested that there is no correct collection of macro-economic factors and that a collection of equivalent factors can yield results similar to that of the five identified factors. The explanatory power of such an equivalent collection will, however, not be greater than the identified factors (Brevis 1998:107). Berry *et al.* also identified three characteristics which risk factors must possess in order for them to be priced APT factors. It must be noted that it is the unexpected changes in these factors that are important.

- Firm-specific factors are not APT risk factors, since they do not have a pervasive influence on share returns.
- The factors must be priced, that is, influence expected returns.
- The factors must be unpredictable to the market as a whole. Hence, since the macro-economic variables are at least partially predictable, they themselves are not the APT factors, and it is only the unexpected (unpredictable) changes therein which are the APT risk factors (Jones 1998:243).

Beenstock and Chan (1988)

In their UK study, Beenstock and Chan examined share returns on the London Stock Exchange over the period 1977 to 1983. They did not apply factor analysis and avoided the anonymity of the market risk factors. Instead, they specified an economic model generating share returns and used an iterative procedure to establish the parameters of the model. They found that four macro-economic variables explain share returns, namely interest rates, money supply, inflation and fuel and material costs (Barr 1990:18; Pike & Neale 1996:288,289).

Fama (1991)

Fama concluded that rather than using factor analysis to identify factors, macro-economic variables should be tested to determine whether these variables are correlated with share returns and, then, whether the loadings of returns on these factors explain cross-sectional share returns. The use of factors with an economic motivation will, therefore, ensure that multi-factor pricing models improve the understanding of share prices (Van Rensburg 1998:21).

Poon and Taylor (1991)

When Poon and Taylor extended the techniques used by Chen *et al.* in 1986 and applied it to the UK market, they did not find that the same macro-economic variables affect UK share returns. They concluded that this may be due to other macro-economic factors being important, inadequate methodology of pricing relationships, or a combination of the two (Rees 1995:173).

McGowan and Francis (1991)

This study found that changes in industrial production, inflation, personal consumption, money supply and interest rates are important APT factors in the US market (Pike & Neale 1996:288).

Clare and Thomas (1994)

The UK study of Clare and Thomas examined 56 portfolios, each consisting of 15 shares, sorted firstly by beta and then according to firm size. The important factors identified by the beta-ordered portfolios are oil prices, corporate default risk, private sector bank lending, current account bank balances, the Retail Price Index and the redemption yield on UK corporate loan stock. However, for the size-ordered portfolios, only default risk and the Retail Price Index are important factors. They found some degree of correlation among the variables, but as with McGowan and Francis (1991), showed that the return on the market index is not an explanatory factor (Pike & Neale 1996:289).

5.5.1.3 The APT versus the CAPM

Connor and Korajczyk (1986)

Connor and Korajczyk tested a five-factor APT model and concluded that it explains the abnormal return results of the size effect and January effect better than does the CAPM (Elton & Gruber 1995:379).

Gultekin and Gultekin (1987)

This study investigated the January anomaly within an APT framework and found that the APT can not explain the January anomaly any better than can the CAPM (Linley 1992:28,29; Reilly & Brown 1997:328).

Burmeister and McElroy (1988)

They, too, concluded that the APT can not explain the January effect any better than the CAPM. However, when their test went beyond the January effect, they concluded that the APT is superior to the CAPM in explaining returns (Reilly & Brown 1997:328).

Elton and Gruber (1988,1989)

According to Elton and Gruber, studies on the Japanese market have clearly demonstrated that the APT is superior over the CAPM in selecting shares and explaining past returns. Their studies found that a five-factor APT model explains and predicts expected returns better than the CAPM. Unlike other markets, small shares on the Japanese market have smaller betas than large shares, and they suggested that this should imply lower expected return using the CAPM. It was, however, found that small shares still show significantly higher excess returns. They concluded that when small shares on the Tokyo Stock Exchange are defined as anything but the largest 100 shares, the multifactor APT explains returns much better than the CAPM. Elton and Gruber added that the APT is almost universally used in the Japanese market as a replacement for the CAPM (Elton & Gruber 1995:380).

Lehman and Modest (1988)

In order to determine the sensitivity of each share to each factor, Lehman and Modest constructed portfolios which imitated the returns of systematic risk factors. They concluded that their findings show that the APT is able to explain certain phenomena which the CAPM does not explain (Brevis 1998:100).

Mei (1993)

The study of Mei confirmed the findings of earlier studies, in that the APT provides a slightly better description of share returns than does the CAPM (Van Rhijn 1994:167).

5.5.1.4 <u>South African research</u>

a. <u>Number of priced factors</u>

Van Rensburg and Slaney (1997)

Van Rensburg and Slaney examined monthly JSE data over the January 1985 to December 1995 period and concluded that there are at least two, but not more than three, priced APT factors on the JSE. It was found that the first two factors explained more than 50% of share returns and they suggested that the first two factors can be a gold/mining factor and an industrial factor. It was also suggested that the third factor can be from a non-precious metal mining source (Van Rensburg 1998:21-23).

b. The identity of the priced factors

Jordaan (1986)

In a study outside the APT framework, Jordaan investigated whether exchange rate risk should be included as an additional variable in the CAPM, that is, whether there exists a correlation between share returns and the Rand/US dollar exchange rate and whether the inclusion of such a variable can increase the explanatory power of the CAPM. The sample used for the study consisted of 90 JSE shares from the mining, financial and industrial sectors, covering the January 1983 to May 1986 period. He found that only 17 of the shares show significant correlations between share returns and the exchange rate. It was also found that these correlations are unstable. Jordaan concluded that there exists no statistically significant relationship between share returns and the Rand/US dollar exchange rate (Brevis 1998:109,110).

Westwell (1987)

Westwell examined share returns on the JSE over two periods, July 1975 to May 1980 and June 1980 to February 1985. He found that, although these factors are not the only significant ones and that their relative importance changes over time, the market index, the gold price and possibly the Rand/US dollar exchange rate are significant factors in explaining share returns (Laing 1988:37,80; Brevis 1998:110).

Correia and Wormald (1988)

The study of Correia and Wormald investigated whether there exists a relationship between share returns, inflation and expected inflation. Their study covered the 1960 to 1986 period and they found no significant relationship between share returns and inflation variables for the JSE. However, when they used contemporaneous changes in the Bankers Acceptance rate, rather than the Treasury bill rate, as a proxy for changes in expected inflation, they found a significant negative relationship between JSE share returns and inflation variables (Van Rensburg 1998:27).

Barr (1990)

The study of Barr (1990:18,20), following on the earlier study of Page (1986), attempted to establish the identity of the two most significant APT factors on the JSE. The data used in the factor analysis consisted of the month-to-month annualised returns of 26 non-gold JSE Actuarial Indices over the August 1978 to July 1987 period. The data of indices was used to eliminate the problems associated with thin trading.

Barr concluded that the two main factors affecting JSE share price movements are an industrial type index and a financial type index. It was also found that the gold price and short-term interest rates are the two variables affecting the industrial type index, while local business confidence and the performance of overseas stock markets are the main variables affecting the financial type index (Barr 1990:25; Brevis 1998:110; Van Rensburg 1998:26).

Both Barr (1990:20) and Van Rensburg (1998:26) note that gold indices were omitted from the study since the gold price has been shown to be the macro-economic variable which dominates the pricing of gold shares.

Bradfield (1990)

Bradfield examined the monthly return data of 30 shares listed on the JSE over the September 1978 to November 1987 period with the aim of establishing the correlation between JSE share returns and those on the London, New York and Tokyo stock exchanges. It was shown that the correlation coefficients between the international markets are positive and statistically significant, while the NYSE was found to be the most influential (Brevis 1998:119,120; Van Rensburg 1998:27).

Reese (1993)

Reese examined share returns over the period January 1980 to December 1989 to establish whether the Rand/US dollar exchange rate, gold price, term structure of interest rates, growth rate, market return and corporate default risk are priced APT factors on the JSE. The effect of these factors on both mining and industrial shares were tested and it was found that shares in these two sectors are influenced by different priced factors. It was, for example, shown that the combinations of gold price and market return, exchange rate and market return, and inflation and market return have the same explanatory power of industrial share returns as the combination of default risk, gold price and market return. The results of the study indicate that the Rand/US dollar exchange rate, inflation, gold price, market returns and corporate default risk are priced APT factors on the JSE, while the term structure of interest rates and growth rate are insignificant in explaining JSE share returns (Brevis 1998:111-123).

Van Rensburg (1994,1995,1998)

Van Rensburg's 1995 study entailed an examination of the simultaneous effect of the gold price, inflation rate, term structure of interest rates and the return on the Dow-Jones Industrial Index on the 1980 to 1989 monthly share returns of four sectors of the JSE. He found that there is a statistically significant negative relationship between the rate of inflation and share returns of all four sectors. He also identified the gold price and Dow-Jones returns as priced factors, and concluded that Reese (1993) had not measured the unexpected changes in the term structure of interest rates and, hence, had been incorrect in concluding that it is not a priced factor. Van Rensburg found a significant negative relationship between share prices and the term structure of interest rates (Brevis 1998:114-120).

The 1996 study found that the unexpected changes in the Dow-Jones Industrial Index, short-term interest rates, the term structure of interest rates and the residual market factor are significant priced factors on the JSE (Van Rensburg 1998:28). The 1998 study reviewed some recent unpublished APT research and concluded (Van Rensburg 1998:36) that growth rates of the following variables are also significant in explaining

JSE share returns:

- The level of gold and foreign reserves.
- The money market shortage.
- The balance on the current account as a percentage of GDP.
- Future indexed sectoral accounting earnings.

In addition, the study also examined monthly JSE share returns over the period January 1965 to December 1995. It was found that Dow-Jones returns and changes in money market rates affect returns on industrial shares, while they have an insignificant effect on gold shares. He also showed that both the gold price and changes in long-term interest rates affect gold and industrial shares, and that the gold shares are three times more sensitive to the gold price than industrial shares (Van Rensburg 1998:33,35).

Buijs (1996)

The study of Buijs used monthly return data over the 1988 to 1993 period and confirmed the significant relationship between gold sector share returns and the US dollar gold price (Van Rensburg 1998:27).

Du Plessis (1996)

In a study outside the APT framework, Du Plessis attempted to establish the determinants of industrial share prices on the JSE. The study covered the 1985 to 1994 period and it was found that the Rand/US dollar exchange rate has the biggest effect on share prices. The results showed a strong negative correlation between share prices and the exchange rate and a significant correlation between inflation and share prices. Both interest rates and economic production were found to have no significant correlation with share prices (Brevis 1998:111).

Van Rensburg and Slaney (1997)

These researchers concluded that there are at least two and maybe three priced factors on the JSE and suggested that the first two factors are a gold/mining factor and an industrial factor. The third factor was thought to be a non-precious metal mining nature. They found that the returns on the All Gold and Industrial/ Financial & Industrial Indices can be legitimate proxies for the first two factors (Van Rensburg 1998:21-23).

Brevis (1998)

Brevis (1998:107,163,218) examined the relationship between 15 variables and the industrial index of the JSE. The variables used in the study had either been identified in earlier studies or were based on economic theory. The study covered the periods January 1970 to September 1987 and January 1989 to July 1997 and it was found that the relationship between the industrial index and some of the factors had changed between the two periods. She concluded that this is proof that the nature of the priced factors affecting share returns changes over time. The results of the examination of unexpected changes in the potentially priced APT factors are summarised by Brevis (1998:163-170) as follows:

- Both periods of the study show a positive, though statistically insignificant, relationship between the JSE Industrial Index and the Dow-Jones Industrial Index.
- The first period show a statistically significant positive relationship between the Rand/US dollar exchange rate and the industrial index, while the relationship is negative and insignificant in the second period.
- The relationship between the industrial index and company liquidations was also found to be positive, but statistically insignificant, for both periods.
- Both periods show a statistically significant relationship between the gold price and industrial index, although the relationship weakened in the second period. Brevis (1998:165) suggests that this is due to gold having a less significant role in the South African economy.
- A statistically significant negative relationship between short-term interest rates and the industrial index was found in the first period, which changes to an insignificant positive relationship in the second period.
- A similar relationship to the one of short-term interest rates was found for long-term interest rates, although the positive relationship in the second period re-

mains statistically significant.

- The relationship between the term structure of interest rates and the industrial index was also found to be similar to that found with short-term interest rates, except that the first period yields a significant positive relationship and the second period an insignificant negative relationship.
- GNP was found to have a statistically insignificant relationship with the industrial index, the first period's being positive and the second negative.
- The industrial index shows a statistically significant relationship with business confidence in both periods, although it was found to have weakened in the second period.
- The relationship between money supply and the industrial index was found to have been negative and insignificant in the first period, which changes to a statistically significant relationship in the second period.
- Both periods show a statistically insignificant positive relationship between retail sales and the industrial index.
- The relationship between wholesale sales and the industrial index was also found to be positive, but statistically significant in the second period.
- The relationship between building plans approved and the industrial index was shown to be positive, though statistically insignificant, in both periods.
- A similar, though negative relationship was found for buildings completed.
- The relationship between new car sales and the industrial index was found to be positive and statistically significant in both periods, although with some weakening of the relationship in the second period.

Since the sensitivity of share returns to the various factors has been shown to change over time, Brevis (1998:249,250) concludes that the research into the priced APT should be performed on a continual basis. She adds that the factors identified above should also be applied to all other sectors of the JSE and other factors, not yet tested, should be identified in order to obtain even better explanations of share returns.

c. <u>The APT versus the CAPM</u>

Page (1987,1989)

In his 1987 study, Page used JSE share data that did not include any known events and concluded that APT-based models significantly outperform CAPM-based models (Laing 1988:vii,xi,82). The 1989 study used the weekly data from 30 randomly selected non-thinly traded shares over the 1981 to 1984 period. He compared three CAPM-based models with a two-factor APT-based model and concluded that the APT approach is superior in measuring share price performance on the JSE (Page 1989:79,81; Van Rhijn 1994:173,174; Van Rensburg 1998:18).

Laing (1988)

The study of Laing examined whether APT-based models can better explain share returns than does the CAPM. The study consisted of two parts: the first part attempted to establish whether significant differences in abnormal return estimates are obtained by the different models and, the second part, whether the APT models provide smaller differences between actual and predicted returns than the CAPM. Laing examined 79 shares which had experienced mergers activity during the March 1973 to May 1985 period and ignored the effect of dividends in the return calculations. The results of the study are very different from the 1987 study of Page, in that it was not found that APT models significantly outperform the CAPM (Laing 1988:xi,4; Van Rhijn 1994:171-173).

Laing (1988:xii,82,83), however, noted that the data used in the study contained real events, while the 1987 data of Page data did not contain any known events. Thus, some uncertainty exists regarding the fluctuations and distortions caused by the events and the effect of the inclusion of some thinly traded shares. It was shown that the CAPM minimises abnormal returns in comparison with the APT models, but Laing concluded that the findings are inconclusive.

Biger and Page (1993)

Biger and Page evaluated the performance of 25 South African unit trusts over the February 1988 to March 1992 period and concluded that APT models with three to five factors perform better in explaining the pricing and return of shares on the JSE, than does a single-factor model (Brevis 1998:102; Van Rensburg 1998:19).

Page (1993,1996)

The 1993 study confirmed earlier findings that the APT is superior to the CAPM in its description of the return-generating process on the JSE. Page also suggested that the APT provides significant insights into share price behaviour, even though the relevant priced macro-economic factors have not been properly identified (Brevis 1998:102). Contrary to the 1993 findings of Biger and Page, the 1996 study of Page did not find that the APT can explain the size and earnings anomalies on the JSE any better than the CAPM can (Page 1996:27,31).

Various studies

The studies of **Knight and Firer (1989)**, **Smith and Chapman (1994)**, **Garvin (1995)** and **Meyer (1997)** also suggested that APT-based models are able to provide better descriptions of returns on JSE share portfolios than the CAPM can (Brevis 1998:6).

5.5.2 Conclusion

Brevis (1998:102,103,122,123) summarises the results from the specified and unspecified APT factor research as follows:

- The combined tests of the APT and the statistical methods applied to determine the number of factors and the sensitivity of shares to these factors generally show that multiple systematic risk factors are priced and that they affect share and portfolio returns.
- The specified factor tests, using firm characteristics and groups of portfolios, provide some evidence that a multi-factor model has greater explanatory power

than a single-factor model.

- The use of hypothetical macro-economic variables in empirical tests provides the strongest support for the APT's explanatory ability.
- There exists no single and unique group of APT factors, since these factors change between markets and over time.

Elton and Gruber (1995:388) add that the evidence that groups of macro-economic variables or portfolios are priced differently than implied by the CAPM, is significant from both a theoretical and practical viewpoint, since it provides a more complete description of share returns. They warn, however, that these additional variables may have been found to be priced, not because the APT correctly describes expected returns, but because the market has been incorrectly identified in the construction of the APT models used in the studies. They conclude that the APT provides a better explanation of returns than the CAPM does and, hence, the use of multi-factor models in share selection, portfolio management and portfolio evaluation is growing.

Adding to these conclusions, Reilly and Brown (1997:330) conclude that, since it has as yet not been conclusively shown that one model is superior to the other, both the CAPM and APT will probably be used and tested for the foreseeable future.

5.6 RECENT DEVELOPMENTS IN OPTIONS THEORY AND THE B-S OPTION PRICING MODEL

Both Black (1990:17) and Tompkins (1992:11,12) note that, since the breakthrough insights into option pricing by Black and Scholes (1973) and their development of the B-S model, the growth in options trading has escalated enormously and share options are now traded in many exchanges around the world.

Except for the recent development of aspects such as share-index options and portfolio insurance, the recent research has generally continued to focus on those areas investigated in earlier studies. Again, the review of research is divided between studies on options market efficiency and those on the validity of the B-S model. In addition to these studies, studies into the more recent introduction of share-index options and portfolio insurance, and their possible role in the market crash of October 1987, are also examined.

Gemmill (1993:257-260) notes that the following aspects of options market efficiency continue to be examined:

- Arbitrage tests looking for general pricing inefficiency.
- Model-based efficiency tests, whereby it is investigated whether option pricing models can be used to identify mispriced options.
- Implied volatility tests, which attempt to establish whether implied volatilities provide good predictions of future volatilities and, hence, whether information is fully reflected in option prices.
- Tests on whether options in general and the impact of their expiration have any destabilizing effect on stock markets.

Recent examination of the B-S model has to a large degree concentrated on implied volatility tests. The stability of volatility is a key assumption underlying the model and the behaviour of volatility has continued to be examined. Direct comparisons between model values and actual option prices have also been performed on an ongoing basis. The aim of the volatility tests is largely to establish the validity of the model, while the direct comparisons are more concerned about possible misspecification.

Numerous studies have also been done on the methods and procedures for estimating volatility and valuing newer exotic share options, interest rate options and currency options. These studies, however, fall outside the scope of this study and are not included in the next section's review of recent developments in options theory and options pricing.

5.6.1 Recent research related to the efficiency of options markets

a. Simple arbitrage tests

Chance (1988)

Chance examined Standard & Poor 500 index options and found that, after taking transaction costs into account, the number of violations of the minimum bounds on call and put prices to be insignificant (Gemmill 1993:257).

b. Model-based efficiency tests

Gemmill and Dickins (1986)

The UK study of Gemmill and Dickins found that the London market for individual options is only efficient when transaction costs are ignored (Gemmill 1993:258).

Kemna (1989)

Kemna examined the Amsterdam options market and found persistent biases between market prices and prices provided by the B-S model. Kemna, however, was unable to establish whether these biases are due to market inefficiency or model misspecification (Gemmill 1993:259).

Dawson and Gemmill (1991)

The study of Dawson and Gemmill found that the bid-ask spreads of London share-index options are inefficiently set by market makers (Gemmill 1993:258).

Gemmill (1992)

Gemmill (1993:258,259) also found evidence of inefficiency in the pricing of London share-index options. It was shown that the prices had not reflected the 1987 opinion-poll information on the election and that almost-riskless arbitrage opportunities had existed between the individual options and the index options (Gemmill 1993:258,259).

c. Implied volatility efficiency tests

Figlewski (1989)

Figlewski provided a warning about the use of implied volatilities. It may reflect the true level of volatility, but may also reflect any misestimations inherent in the valuation process (Reilly & Brown 1997:901).

Kemna (1989) and Scott and Tucker (1989)

Both these studies examined the forecasting performance of implied volatilities. Kemna concentrated on the Dutch options market and Scott and Tucker studied currency options. Their results confirmed earlier findings that implied volatilities provide better projections of volatility than do historical volatilities (Gemmill 1993:259).

Leong (1990) and Robb (s.a.)

Leong (1990:60) noted that Robb had identified two implied volatility anomalies in options markets. Firstly, a weekend effect, whereby the implied volatilities of at-the-money call options on treasury bond features generally tends to rise from before to after the weekend. Secondly, an economic statistics effect, whereby it has been observed that the implied volatilities of listed options tends to drop, rather than increase, after the release of important economic statistics.

Leong concluded that both these observed anomalies can be explained by the simplifying assumptions of the B-S model. Most people trading in listed options use the basic B-S model with calendar time as an input. However, economic time would be a more practical measure, since it would provide implied volatilities which are more time-homogeneous. Weekends represent lapses in calendar time, but not of economic time, and option values should therefore not change when everything else remains the same. The lapses in calendar time, however, cause an artificial time decay in the B-S model and result in lower option values, but if the markets are efficient, such time decays should not affect option prices and implied volatilities.

The economic statistics effect was explained by the fact that the estimation of implied volatilities, using the constant volatility method, are the market norm, while the moving-average method provides a more exact picture of reality. The difference between these two methods can be especially significant for short-dated options (most listed options) and with the passage of important economic events, the moving-average volatilities over the remaining lives of options should be substantially reduced. In efficient markets, any anticipated increase in volatility should be incorporated into the pricing volatility and, hence, implied volatility should not rise after the release of economic statistics which have already been discounted by the market. Further, as the market applies the moving-average volatility method, implied volatilities should drop after the release of the news (in order to reflect the fact that one important day in the averaging process had passed) (Leong 1990:60,61).

An alternative and equivalent explanation is linked to the weekend effect which has already been discussed. The release of the economic statistics represents a passage of economic time, but not calendar time, and the implied volatilities has to drop to simulate the fact that the B-S model does not recognise the time decay in economic time (Leong 1990:61).

d. <u>The impact of options trading on market efficiency</u>

Snelling (1987)

This study examined the price behaviour of options and their underlying shares for 135 earnings announcements during the period August 1979 to November 1979. It was found that the option prices lead the share prices in anticipating and reacting to the announcements, but only by minutes rather than hours (Hodges 1988:27).

Stoll and Whaley (1987,1990)

Stoll and Whaley investigated the impact of the expiration of share-index options and their 1987 study examined data for the years 1984 and 1985. They examined both single days, on which only Standard & Poor (S&P)100 options expired, and triple days, on which S&P 500 futures, S&P 500 futures options and S&P 100 options expired. It was found that prices fell by 0,48% during the last trading hour of triple Fridays and that this drop was reversed during the first half hour of trading on the following Monday. There was also an increase in volatility on the triple Fridays, but the single Fridays showed no significant changes in price or volatility. They did a follow-up study in 1990, after the June 1987 switch of the settlement time of US contracts from the Friday closing period to the Friday opening period. They found a drop in prices of around 0,3% on the Friday opening, which is about half of the bid/ask spread of S&P 100 options (Gemmill 1993:262).

Nabar and Park (1988)

Using daily price data over the 1973 to 1985 period, Nabar and Park examined the impact of the listing of 390 new share options. They found a drop in the volatility of the underlying shares of between 4% and 8%, with the most significant impact four months after the listing of the options (Hodges 1988:27; Gemmill 1993:261).

Van den Bergh and Kemna (1988)

In an examination of the expiration of options on 13 shares during the period January 1984 to October 1987 on the Amsterdam market, these researchers found that volatility actually decreases on expiration (Gemmill 1993:263).

Conrad (1989)

Conrad used daily data to examine the impact of 96 new options listed during the 1974 to 1980 period. She found that when the options start to trade, the underlying shares' prices on average increase relative to the other shares. In a further examination, Conrad studied 76 of the underlying shares to establish whether there is any increase in share price at the time of the announcement that trading of the options will commence. She found that the share price volatility decreases after the introduction of the options (Gemmill 1993:261).

Gemmill (1989)

In a study on the London market, Gemmill examined 10 shares and found a 17% drop in the volatility of the share prices after the introduction of the options. In addition, 18 shares with options were compared with 18 shares, of similar size, without options. Gemmill used three months of daily data around the crash of October 1987 and found that the shares with options had a larger trading volume and higher volatility. Regression analysis was applied to establish the impact of these two variables and it he found that options trading causes a 4% to 12% reduction in volatility (Gemmill 1993:261).

Skinner (1989)

Skinner examined 304 new options for the 1976 to 1986 period and found a significant decline in share price volatility. Similar to Conrad in 1989, Skinner attributed the drop in volatility to a reduction in company-specific risk since the beta values of the shares remain unaffected. Skinner also found an increase in trading volume after the introduction of the options and concluded that the drop in volatility had been caused by the total market becoming larger and an improvement in liquidity (Gemmill 1993:261).

Lamoureaux (1990)

Lamoureaux suggested that a failure of earlier US studies had been that they had not considered market-wide movements in specific risk over time. It was found that most of the options examined in these studies had been introduced in the mid-1970s, prior to a drop in company-specific risk. He concluded that, when the results were adjusted for this drop in specific risk, the introduction of options did not have a destabilizing effect (Gemmill 1993:262).

Pope and Yadav (1992)

Pope and Yadav examined the impact of individual options expiring on the London market during the October 1982 to September 1987 period. Their data consisted of 46 expiration dates and 465 options of individual firms expiring and it was found that prices fell by an average of about 0,5% at the time of expiration (Gemmill 1993:262).

5.6.2 Recent research related to the B-S Option Pricing Model

a. Assumptions - Distribution and volatility of returns

Various studies

The studies of **Fama and French (1987)** and **Poterba and Summers (1988)** showed that long-term volatilities have a lower mean than short-term volatilities and, hence, long-term options may be priced with lower implied volatilities than short-term options. They concluded that share prices revert towards a long-term mean over time. **Kim, Nelson and Startz (1991)** suggested the results from these studies could have been due to peculiarities of the 1926 to 1946 period examined (Gemmill 1993:117).

Galai (1987)

From a review of empirical studies on option pricing, Galai concluded that, although the B-S model can provide incorrect values when its assumptions are violated, these deviations in value appear to be small and generally insignificant (Gemmill 1993:118).

Hull and White (1987) and Johnson and Shapiro (1987)

Both these studies found that volatility does not appear to be constant over time. They also showed that, if the changes are random, it will only have a small impact on option prices (Gemmill 1993:117).

Jarrow (1987)

Jarrow concluded that when implied volatilities are used in the B-S model, these implied volatilities would ensure that the model takes any generalisations of its assumptions into consideration (Hodges 1988:26; Gemmill 1993:118).

Hodges (1988)

Hodges suggested that Jarrow's (1987) conclusion had been overly optimistic and that, although implied volatility reflects market consensus, the market's consensus might actually be wrong (Hodges 1988:26).

Kemna (1989)

This study on Dutch options confirmed prior findings that return distributions, rather than being normal, show fat tails. He did, however, not find any evidence of an exercise-price-implied-volatility-bias (Gemmill 1993:113,116).

Gemmill (1991)

In a study on the London market, Gemmill found that low-exercise-price share-index options generally tend to have higher implied volatilities than high-exercise-price share-index options. It was also found that the degree of skewness changes on a month-to-month basis (Gemmill 1993:116).

Leong (1991)

Leong noted that there are three basic difficulties associated with the estimation of volatility. These are non-stationarity (volatility changes over time), non-uniformity (volatility is higher on certain days than others) and mean reversion (the volatility time-series moves away from extremely high or low values and reverts to some long-term mean). Further, that there generally exists two approaches to estimating volatility, using historical data, in order to overcome the B-S model's problem with the fact that volatility is not constant over time. These two approaches are:

- Using as much historical data as possible to ensure that sampling errors are reduced.
- Using the most recent 30-day to 90-day data in order to eliminate the problem of non-stationarity.

Leong, however, recommended that estimates should be made using both approaches. These estimates should then be compared in order to establish whether volatility is reasonably stable and, hence, whether it would be reasonable to estimate volatility using historical data (Leong 1991a:63,66).

Day and Lewis (1992)

Day and Lewis examined the implied volatilities which are derived from share-index options and concluded that these implied volatilities are extremely sensitive to model misspecification (Upsher 1993:8).

b. <u>Assumptions - Transaction costs</u>

Figlewski (1989)

Figlewski examined the effect of the rebalancing interval on Leland's (1985) conclusions and showed that, for US share-index options, rebalancing risks are not significant, except in illiquid markets where hedges are required for long periods. Thus, narrow spreads will be found in active options markets, while the spreads demonstrated by Leland can be found in some OTC markets (Gemmill 1993:123,124).

Hodges and Neuberger (1989)

These researchers concluded that Leland's (1985) formula leads to an increase in the values of call options and that it overestimates transaction costs (Gemmill 1993:123).

c. <u>Comparative tests</u>

Geske and Torous (1988)

Geske and Torous (1988:50-58) examined 2 323 call options on non-dividend paying shares over the period August 1976 to October 1977, in order to establish whether the B-S model misprices options. They used a random sample of CBOE call option transactions data for one date per month to minimise any problems of non-simultaneity between share and option prices. The following summarises Geske and Torous's results:

- When the underlying share sample's standard deviation of returns is used to estimate volatility, the B-S model systematically undervalues calls with respect to volatility and skewness.

- The B-S model undervalues options on low-volatility shares and overvalues options on high-volatility shares.
- The B-S incorrectly values call options with longer than 30 days to expiration.
- The B-S model provides incorrect values for deep-in-the-money and deep-out-of-the-money call options, although the degree of error does not appear to be economically significant.

d. South African research

Hawinkels (1987)

Hawinkels (1987:9,12-17,26,35) examined close to 160 price relatives over a seven month period and found that returns are not normally distributed. Although this can have significant implications in applying the B-S model, the extent to which this result affects the accuracy of the model had not been established in the study. The study also examined the estimation of volatility in the South African market and found that the high-low estimator appears to provide better predictions of volatility than does the close-to-close estimator. He also identified a definite need for comprehensive comparative option pricing model research for the South African market.

Beaven (1990)

Beaven compared actual with theoretical option prices for options with less than 60 days to maturity. Only small differences were found and it was concluded that these differences cannot be attributed to market efficiency (Bird & Page 1991:14).

Bird and Page (1991)

Bird and Page (1991:14,20,21) found large differences between theoretical and actual option prices in the South African market and concluded that the market is inefficient in the pricing of options. They also found that the closer the options come to maturity the less inefficient the market becomes in its pricing, and concluded that this explained Beaven's (1990) findings. They suggested that, although this inefficiency provides profit opportunities for arbitrageurs, if the market takes the unavailability of realistic arbitrage strategies into account, then its pricing is actually efficient as the differences will not be exploitable. It was also suggested that the thin trading of these options is a possible cause of the perceived inefficiency.

Wood (1997)

Wood noted in her article that the trading in share options, which had recently become available on the South African Futures Exchange (SAFEX), had reached the R13,5 million mark and that it was expected that the number of options would be increased from six to ten in the near future (Wood 1997:93).

Delport (1998,1999)

Delport noted in 1998 that 375 million options with a value of R367 million had traded to date. It was also noted that options have increased in popularity with South African investors and that the options section is one of the most active sectors on the exchange (Delport 1998:5). In the first of two 1999 articles, Delport concluded that it was likely that more than half of the 10 listed options that will reach maturity on 16 September 1999 will expire out-of-the-money. Most of these options are call options and it was found that, similar to the Australian market where around 80% of options are sold before maturity, most investors sell their options before expiration (Delport 1999a:57).

In the follow-up article, Delport noted that trading in listed options had increased from four million in October 1997 to 112 million in June 1999. The number of listed options had also increased to 66 and it was found that investors still prefer call options over put options (Delport 1999b:71).

5.6.3 Share-index options, portfolio insurance and the market crash of October 1987

Since 1973 , both put and call options have been available on organised exchanges and, although the way they have been viewed has since changed, they have been popular with investors ever since. They were initially viewed as speculative instruments and were generally purchased to obtain leverage benefits. In 1983, share-index options were introduced and these also appealed to investors, since they provided investors with the opportunity to trade in industries or the market as a whole, while also providing the benefits of leverage. Since 1984, portfolio insurance, using share-index options, have been used to increase portfolio yields and many investors sold put options to take advantage of the rising share prices of the 1980s. These strategies worked well until the crash of October 1987, after which, due to the losses incurred, options were again viewed as purely speculative instruments. It was only in the early 1990s that options trading had reached its pre-crash levels and were again considered to be an essential element in strategic portfolio management (Gemmill 1993:149; Jones 1998:551 - 555).

5.6.3.1 <u>Share-index options</u>

Share-index options are options on stock market indices and provide investors with the opportunity to invest in options on a portfolio of shares (Levy & Sarnat 1994:633). They can be used to increase (speculate) or decrease (hedge) the exposure to a particular market (Gemmill 1993:151; Jones 1998:555).

Share-index options also have fixed exercise prices and expiration dates and allow investors who are bullish about the market to buy a call on the market index, while those who are bearish can buy a put on the market index. This has the advantage that investors do not have to make an industry or individual share decision, but only a market decision. They do, however, differ from options on individual shares in that they do not require the delivery of shares on expiration, but the buyers receive cash from the sellers upon exercise of the contract. This settlement amount is the difference between the closing price of the index and the strike price of the option (Jones 1998:552).

As with the valuation of individual share options, the B-S model needs to be adjusted for dividends, transaction costs and the return distribution of the index when valuing share-index options (Gemmill 1993:155).

a. Dividends

Since an index consists of a number of individual shares, the level of the index will drop on the shares' ex-dividend dates. Also, the larger the number of shares in the index and the more frequent the dividend payments, the smaller will be the effect on the level of the index at any one time. Thus, early exercise of index call options will not really be worthwhile where the dividends are a relatively smooth series of payments. In the valuation of share-index options, however, the values based on continuous dividends may actually be quite different from those based on actual dividends and, also, the problem of undervaluation of American put options still remains (Gemmill 1993:155-157).

b. Transaction costs

Since the B-S model is based on an arbitrage position between the option and the underlying share, and since it is difficult to simultaneously trade in all the shares in the index, transaction costs have a larger impact on share-index option values than options on individual shares. Hence, market makers in options generally hedge their portfolios with index futures which have very low transaction costs (Gemmill 1993:157).

Yadav and Pope (1990)

Yadav and Pope found that, for both the UK and US markets, the present value of the futures price are lower than the spot index. This is opposite to what had been found in Japan, and this disequilibrium creates the problem of knowing whether option values should be based on the present value of the futures or upon the spot index. It was found that market makers generally use the present value of the futures price, since they are also using the futures to hedge their positions in options (Gemmill 1993:157).

c. Return distribution of the share index

An assumption of the B-S model is that share returns are lognormally distributed and if share returns do not follow such a distribution, then the returns on the share index (the sum of the lognormal distributions) can in theory not be lognormally distributed. The same principle also applies to the situation where share returns are normally distributed (Gemmill 1993:157).

Badrinath and Chatterjee (1988)

Their study provided evidence that the distribution of share-index returns is close, if not closer, to a normal distribution than those of individual shares (Gemmill 1993:158).

Gemmill (1993:158,159) concludes that, where dividend payments are a smooth series, Merton's dividend-adjusted model should be used to value European share-index options. But, since share-index options are American by nature and dividend payments are lumpy, a pseudo-American adjusted B-S model or the binomial model would be preferred for valuing calls. The B-S model has the advantage that it is much faster than the more accurate binomial model. For puts, however, it is advised that the binomial model be used.

d. Share-index options, share-index futures and the market crash of October 1987

As previously noted, share-index options prices are more likely to wander around their fair values than would individual option prices, because the higher transaction costs associated with the index options makes arbitrage with share-index options more expensive. Hence, market makers prefer using futures for hedging their option positions and futures index prices may consequently have a strong influence on index option prices. Therefore, by implication, if it was found that share-index futures had a role in the crash of October 1987, share-index options, through their close relationship with share-index futures, may also have played a role.

Where there is drop in the prices of share-index futures, investors can use index arbitrage - an arbitrage between share-index futures and the underlying shares - to sell the underlying shares and buy the futures and, thus, gaining the difference in price between the two. Through this action a link between the share prices and share-index futures prices is created and index arbitrage has the benefit that it brings the cash market and the futures into line (Levy & Sarnat 1994:645).

Levy and Sarnat (p.645,646) summarise that, despite this positive role of index arbitrage, futures have been blamed for the October 1987 crash, in that the futures and share markets had become unhinged because brokers had not been able to cope with the number of sell orders. This had been caused by the fact that shares had not been traded on the NYSE by the morning of 20 October 1987, resulting in the sell orders being transferred to the futures market and ending with share-index futures selling at a discount of 22%. This had provided significant profit opportunities for arbitrageurs, which could not be exploited since the shares could not be sold, with the result that arbitrageurs did not enter the market. Thus, the drop in the futures market had not been the cause of the crash, but had only reflected the panic in the stock market. There is general agreement that the futures market plays a positive economic role and index arbitrageurs play a beneficial role in linking the futures and cash markets.

Levy and Sarnat (p. 633) add that share-index options also play a positive economic role, in that, rather than buying numerous individual options, a portfolio of options can be obtained with the purchase of a share-index option. Share-index options also play a significant role in facilitating portfolio insurance, which is examined in the next section.

5.6.3.2 Portfolio insurance

Portfolio insurance is an investment strategy whereby portfolios are hedged in such a way that the portfolios will yield a minimum return, while also providing the opportunity to gain the additional benefits of rising share prices. Portfolio insurance is usually obtained with either share-index options or share-index futures (Levy & Sarnat 1994:633; Jones 1998:541), but in this section only the use of options will be considered.

In situations where investment funds invest in large numbers of shares and fund managers wish to protect their funds against share price declines, put options can be bought on every share in the portfolio to protect the fund. However, this is usually not possible in practice since options are not available on all shares and, hence, the insurance effect is attained with the purchase of share-index put options. The higher the correlation between the returns of the share index and the share portfolio, the greater the protection offered by the portfolio insurance (Levy & Sarnat 1994:633).

Jones (1998:541) adds that the principle of portfolio insurance is quite simple. A protective put option is bought to ensure that the portfolio can be sold at a price sufficient to provide the minimum return. The remaining portfolio funds are invested as normal and the put option protects it against declines in share prices, since the value of the portfolio must be equal to or exceed the exercise price of the put option at the end of the investment period - otherwise the put option will be exercised, yielding the minimum return.

Leland (1988:119,120) notes a further way by which portfolio insurance can be attained with the use of options. This technique is based on the Black and Scholes (1973) option pricing theory, whereby options can be priced through arbitrage and options can be replicated through dynamic rebalancing between shares and the risk-free asset. Shares are sold when prices drop, meaning that losses are limited, and shares are bought when share prices rise, that is, upside opportunity cost is limited to the equivalent of the option price. This strategy, therefore, represents a series of stop-loss orders and these stop-loss orders are reversed when the market starts moving up again. Under ideal conditions such a hedging strategy would provide the same portfolio insurance as that of buying a put option.

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To ensure that the desired level of protection is achieved, portfolio insurance policies are programmed to buy shares when prices rise and sell shares when prices drop. These automatic computer-generated buy and sell orders have also been blamed for the crash in the stock markets. Levy and Sarnat (1994:634) provide the following summary of the possible role of portfolio insurance in the October 1987 crash.

To protect against losses, portfolio insurance can be achieved by selling share-index options and/or shares after the market has dropped and buying them after the market has started to rise. By 19 October 1987, $60 to $90 billion's worth of assets had been insured and all these assets had been managed using program trading, which is quite similar to stop-loss selling (a prearranged order to sell shares when their prices had fallen to a certain level). Many fund managers had used program trading and when all the sell orders came through on the same day, not enough buyers had been available and the share prices dropped sharply. This had increased the number of sell orders, causing even further drops in prices and, hence, portfolio insurance had not been able to provide the required protection. It is still unclear how big a role portfolio insurance played in the crash, but it still remains a powerful investment tool.

Constantinides (1987)

Constantinides suggested that an increasing number of investors had decided to adopt hedging strategies prior to the market crash of October 1987 and found that many of the portfolio insurers' clients had "ratcheted" up their protection during the preceding bull market (Leland 1988:112,121).

Shiller (1987)

Shiller found that more investors had been using informal hedging, such as stop-loss orders, rather than formal portfolio insurance on 19 October 1987 (Leland 1988:105).

Leland (1988)

According to Leland (1988:105,109), the evidence suggests that only about 10% to 15% of the trading on 19 October 1987 had been related to portfolio insurance. The fact that portfolio insurance had also not been available with the crash of 28 October 1929 would seem to suggest that it can not be blamed for the 1987 crash. However, although portfolio insurance had not been available in 1929, closely related hedging techniques such as stop-loss selling had been used by investors. Leland suggested that a large number of hedgers had increased the volatility of the market and showed that, even though no new information had been released, such an increase in volatility could have led to a market crash.

Leong (1991)

According to Leong (1991b:85), portfolio insurance would still have failed as a hedge strategy, even if the cash and futures market had not become decoupled and the market had not become illiquid with the crash of October 1987. The reason, Leong suggested, was that portfolio insurance would have failed anyway with such an increase in market volatility, since the principle of a riskless hedge has not been designed to perform well in extremely volatile markets.

5.6.4 Conclusion

The evidence from simple arbitrage tests show that options markets can generally be considered as being efficient (Gemmill 1993:258). Both model-based studies and implied volatility efficiency studies have presented evidence of pricing inefficiency, but since the models used (mostly the B-S model) are based on simplifying assumptions and volatility needs to be estimated, these results are inconclusive since they are joint-tests of the model and market efficiency or the method of estimating volatility and market efficiency (Jones 1998:550). The results from the empirical studies on the effect of options trading and the expiration of options on the underlying shares have provided some evidence of inefficiency. Gemmill (1993:261,262) summarises that options trading has generally not been found to significantly increase volatility and that it has led to a decrease in specific risk. However, there is some evidence, though not strong, that options trading has led to an increase in trading volume and market liquidity. Van Horne (1992:263) adds that there is evidence that the expiration of options has a temporary effect on share prices and volatility, but also that the effect is rather small and soon reversed after expiration.

From the evidence provided by the studies on the B-S Option Pricing Model, Gemmill (1993:118,124) concludes the following:

- There is clear evidence that the returns distribution has fat tails and that options are valued accordingly.
- The evidence on skewness of the distribution of returns is less clear. There may be a case for higher volatilities for low-exercise-price options in order to reflect the effect of leverage, but the studies have also shown that skewness tends to change from period to period.
- There is also evidence that short-term volatilities are higher than long-term vola-

tilities, and that volatility may revert to some mean over time.

- Bid-ask spreads on options appear to be relatively large, but do not necessarily indicate inefficiency in pricing. Most of the problems associated with transaction costs and the distribution of returns can be eliminated with adjustments to the volatility estimates.
- The B-S model is valid and robust, and more complicated models have parameters which are not well-defined and difficult to estimate.

Further, Jones (1998:550) concludes that the empirical studies generally support the efficiency of options markets and the validity of the B-S model. Although some biases have been identified, these can largely be attributed to difficulties experienced with the estimation of volatility and, hence, can not be seen as conclusive evidence of model invalidity or market inefficiency.

Very few empirical studies on the South African options market exist and, since there is clear evidence that options are becoming more popular and that options trading has shown significant increases, there is a distinct need for studies on both options market efficiency and the robustness of the B-S model under South African conditions.

Reilly and Brown (1997:907) conclude that the B-S model, in a dividend-adjusted form, is also quite suitable for the valuation of share-index options. Since share-index options are well-diversified portfolios, the volatility of the share index's price is usually significantly lower than that of individual shares. The applicable dividend yield might also be readily available, since it can be assumed to be the average of the annualised yield on the index during the options life.

It has been shown that share-index futures and, due to their close relationship, by implication also share-index options, had not played a significant role in the market crash of October 1987. However, significant evidence has been provided from which it can be argued that portfolio insurance, and the use of share-index options therein, had played a significant role in the market crash.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The purpose of this study has been to establish whether the existing capital market theories and pricing models provide a reliable description and explanation of the working of the capital market; whether the recent studies and research have led to any new developments in the field of capital market theory and pricing models; whether the research can be summarised in order to provide a framework for future research; and into which areas future research, especially South African research, should be directed in this field of study.

To this end, the literature study, firstly (chapter 2), examines the capital market theories and pricing models in the context of accounting theory and investment decision-making. The role of these theories and models in the formulation of accounting theory and their importance for investment decision-making are reviewed in this first section. The second part of the study (chapters 3 and 4) entails a review and examination of the historical background to and the principles and implications of the various theories and pricing models. Included in these sections of the study, are the reviews and summaries of the research conducted since the development of these theories and pricing models up to the early 1980s. The final section of this study (chapter 5) concentrates on a review and summary of the more recent research and empirical studies. An examination of the recent developments in the capital market theories and pricing models is also included in this final section of the literature study.

This chapter consists of a summary of the main aspects of the literature study, Followed by a summary of the main conclusions drawn from the review of the research conducted. It ends with recommendations for future research studies in this field of study, especially under South African conditions.

6.2 SUMMARY OF THE LITERATURE STUDY

The whole study consists of a literature study of the main capital market theories and pricing models, in the context of accounting theory. Before conclusions can be drawn and recommendations made from the review of empirical studies and other research, it is first useful to briefly summarise the current knowledge on these theories and models.

6.2.1 Accounting theory and investment decision-making

Although there exists no single comprehensive theory of accounting, a collection of theories has resulted from the use of different approaches to the formulation of an accounting theory. No matter which approach is followed, an accounting theory must be confirmed before it can be accepted (Belkaoui 1992:58,65) and a theory can generally only be confirmed through empirical testing. The aim of the empirical testing is not so much to establish whether the theory is true, but rather if it works. As Rees (1995:39) notes, it is not the validity of a theory or model's assumptions that is important, but rather its descriptive and predictive power. When applied to accounting and investment decision-making, the process begins with the formulation of a theory and ends with the empirical testing thereof to establish its validity or falsity (Kam 1990:511,512).

One of the approaches to the formulation of accounting theory is known as the predictive approach, that is, it uses the principle of predictive ability to choose among the options which are available to predict the events that are of interest to investors and other related parties. One stream of the predictive approach to the formulation of an accounting theory is known as the market-based approach. This approach is concerned with the ability of accounting information to explain and predict capital market reaction to accounting disclosure (Belkaoui 1992:139).

Rees (1995:153) identifies two crucial aspects of the market-based approach to the formulation of an accounting theory. Firstly, there are the pricing models (CAPM, APT and the B-S model), which are based on the principles of Portfolio Theory. These models are used by investors, analysts, portfolio managers and academics to make sense of the important investment decision-making variables, that is, security prices, risk and expected return. The second aspect is the EMH, which asserts that market prices rapidly incorporate all publicly available information, including accounting information, in an unbiased manner. The pricing models also have a role to play in the empirical testing of the EMH, since they provide the benchmark values against which market prices are measured.

The investment decision is a complex one and the solution to the problem may be a product of many variables. However, the essence of the decision is that an investment's expected return should provide adequate compensation for the risk involved (Broadbent 1992:8). Portfolio Theory and the asset pricing models are concerned with risk and expected return and the main advantage of the CAPM, the APT, the B-S model and the supporting EMH and Portfolio Theory is that they are empirically testable (Hendriksen & Van Breda 1992:185). These pricing models and related capital market theories, as elements of the market-based approach to the formulation of an accounting theory, and the empirical testing thereof are the objects and main focus of this study.

6.2.2 Portfolio Theory

The implications of Portfolio Theory, and in particular the benefits of diversification and the insights it provides into the pricing of shares, are key fundamentals for investment decision-making, portfolio management and investment risk management.

Portfolio Theory deals primarily with investors' main concern about how risk will affect their total wealth. Hence, Portfolio Theory only evaluates the risk of individual investments to the extent to which they affect or contribute to the overall risk of investment portfolios. The concept of diversification flows directly from this principle and from the fact that there is a degree of independence among the risk sources which affect the shares in portfolios. Hence, according to the diversification concept, the risk of a portfolio will show a rapid decline with the initial addition of shares to the portfolio and, also, that only a small number of shares will provide substantial risk reduction benefits (Jones 1998:178-181).

Since the principle of risk reduction through diversification allows investors to limit or minimise their exposure to risk without adversely affecting their returns, the concept of diversification can be viewed as providing the key to the management of investment portfolios and portfolio risk. However, it is important to note that, since all shares are to some degree affected by common sources of risk, risk cannot be completely eliminated. Risk can thus be divided into two components, namely systematic (non-diversifiable) risk and unsystematic (diversifiable) risk (Jones 1998:180,181).

Although the concept of diversification has significant benefits, it does not provide a direct method for investors to select efficient and optimal portfolios. Efficient portfolios are evaluated according to expected return and risk (as measured by the standard deviation) and are those portfolios which provide the highest return for a given level of risk or the lowest level of risk for a given return. From the set of available efficient portfolios, investors are then able to select the optimal portfolio, which best suits their needs and risk preferences, using the principles of utility theory (Jones 1998:204-206).

Apart from the risk reduction and portfolio selection benefits, Portfolio Theory also has important implications for the pricing of shares. Since only part of the risk of shares can be eliminated through diversification, investors need to focus on the non-diversifiable systematic component of risk, because this is the component of risk that should be priced in stock markets. The risk that is relevant to an individual share can be estimated by measuring its contribution to the overall risk of a well-diversified portfolio. Against this, the share returns that can be expected on the basis of this contribution to risk need to be estimated using the CAPM or APT, and in the case of share options the B-S Option Pricing Model (Jones 1998:219-221).

6.2.3 Market efficiency and the EMH

Some of the most interesting and important empirical research has analysed whether capital markets can be regarded as efficient. Although the efficiency of capital markets remains a controversial area in investment research, it has real-world implications for investors, analysts and portfolio managers (Reilly & Brown 1997:208).

The modern version of market efficiency states that market prices adjust rapidly, although not instantaneously, to new information becoming available and that the price adjustments occur in a correct and unbiased manner, that is, the errors in adjustments on average balance out. The EMH is concerned with the extent to which market prices fully and quickly reflect new information and can be divided into three forms of efficiency, namely weak form, semi-strong form and strong form efficiency. Each of the three levels of market efficiency relies on different levels of information-processing efficiency and each requires different types of tests to establish its validity. The key to the empirical testing of the EMH is to establish whether investors can consistently earn abnormal returns, that is, returns in excess of those commensurate with the level of risk involved. Short-lived random inefficiencies and one-off short-term unusual returns do not constitute evidence of market efficiency in an economic sense (Jones 1998:255-259).

Pike and Neale (1996:42,43) and Jones (1998:266-269) summarise the following important implications of EMH market efficiency for investment management:

- Market efficiency implies that fundamental analysis, that is, the study of the intrinsic value of securities, will have no value unless the analyst has access to inside information or has superior analytical ability.
- The EMH also casts doubt on the value of technical analysis, that is, the study of patterns or trends in price movements over time.
- Active investment management will also have no value in efficient markets and passive buy-and-hold strategies will, on average, outperform active investment strategies. This, however, does not imply that investment and portfolio management has no value. The principles of efficient diversification and risk assessment

must still be applied and the level of transaction costs must still be monitored.

It should, however, be noted that the strong form of the EMH cannot hold completely, since it is clearly unrealistic to assert that market prices can fully reflect all information, including non-public inside information. Further, although the evidence on market efficiency largely supports the EMH, especially at the weak form and semi-strong form levels, several anomalies have as yet to be satisfactorily explained. These anomalies tend to suggest that there are opportunities to exploit for those investors and investment managers who have share selection abilities (Jones 1998:258,267).

Despite some anomalous evidence of market inefficiency and irrationality, a large body of research tends to suggest that market prices are fair and generally reflect the value of shares, given the available information. This implies that market prices do appear to respond very quickly to new information, that market prices are difficult to predict based on publicly available information and, if the market misprices some shares, that there is no obvious way of identifying mispriced shares (Ross *et al.* 1996:294).

6.2.4 The CAPM

The fundamental principle underlying the CAPM is that there is a linear relationship between systematic risk (as measured by beta) and expected returns (Arnott 1993:16). The CAPM, building on the insights of Portfolio Theory, attempts to explain this relationship between expected return and risk and assumes that investors will only invest in risky assets if a sufficient return can be gained as compensation for the risk taken (Harrington 1993:1).

Another fundamental assumption of the CAPM is that investors hold well-diversified portfolios and that they can construct optimal portfolios by combining investment in the risky market portfolio with borrowing or lending at the risk-free rate of interest. Thus it has been concluded that investors are concerned only with how a share contributes to the risk of the portfolio and, based on the principles of Portfolio Theory, that with the assessment of the risk of a portfolio, investors are concerned only with the non-diversifiable systematic component of risk. The CAPM uses beta as the measure of risk that cannot be eliminated through diversification and describes expected returns as being the return on the riskless asset plus a risk premium. This risk premium equals the market return in excess of the risk-free rate times the share/portfolio's beta. Beta, therefore, explains the differences between shares/portfolios' expected returns (Harrington 1993:1).

The CAPM has been the subject of a vast amount of theoretical investigation and empirical research and the controversy surrounding it continues. Part of this controversy is concerned with whether beta is the only measure that explain returns, and some evidence suggests that variables such as dividend yield, P/E ratios, firm size and the BV/MV ratio provide additional explanatory power. Even more controversial is that some studies have failed to show a significant relationship between beta and expected returns (Harrington 1993:1).

Another problematic aspect of the CAPM is whether the use of proxies for the market portfolio casts doubt on the usefulness of the results obtained from empirical tests of the CAPM. There are two dimensions associated with the fact that the true market portfolio is unobservable. In the first instance, the market proxy may be close to being mean-variance efficient and the tests may thus yield results in support of the CAPM, even though the CAPM relationships may not hold. Secondly, the choice of market proxy may be the cause of the observed anomalous results and beta may in fact provide a true description of expected returns and. Hence the CAPM might be true (Harrington 1993:2).

Another question is whether the CAPM is correct in its description of expected returns or whether the alternative model, the APT, may describe returns better. The comparative tests between the two models and their ability to describe anomalous results depend, however, largely on the efficiency of the markets, hence no definite conclusions can be drawn from such tests. Closely linked to this problem, is the fact that some anomalies have not persisted consistently over time and that some of the evidence brought against the CAPM may have been unearthed through data mining or data snooping (Harrington 1993:2).

An even more fundamental problem is that the statistical tests which have been used to examine the CAPM may not have been implemented or interpreted correctly. This relates to problems whereby parameters of the CAPM are incorrectly measured or estimated and whereby the statistical significance of the results is either overstated or underemployed in comparison with their economic significance (Harrington 1993:2,3).

Important to the whole controversy surrounding the CAPM, is Arnott's (1993:22) conclusion that, since the CAPM is an expectational model, its linear relationship between beta and expected returns can never be proved or disproved.

6.2.5 The APT

The APT was developed a number of years after the CAPM, and this alternative asset pricing model suggests that share returns are a function of various common risk factors, not only beta. The APT is a more general theory than the CAPM, but it has been found that the two models can be shown to be identical in conditions where there is only one risk factor (Arnott 1993:16; Jones 1998:247).

One of the advantages of the APT is that it is not dependent on the existence of the CAPM's market portfolio, but has the problem that the priced risk factors are not well specified, especially on an *ex ante* basis. The evidence from empirical testing suggests that several risk factors are priced, generally between three and five, and also that some of the factors identified are not compatible with the theory of market efficiency (Arnott 1993:16; Jones 1998:247). Arnott, however, notes that the APT, rather than being seen as an asset pricing model, can be viewed as a risk model, that is, it explains the risk factors that affect returns, but is somewhat silent on the pricing of shares and expected share returns.

Various criticisms have also been levelled at APT studies that have used factor analysis methodology. These criticisms are based, firstly, on the fact that there exists no adequate factor extraction rule, and hence, different numbers of risk factors are extracted and found to be priced for different sample sizes and different numbers of observations. The second criticism is that there is no guarantee of risk factor consistency across different portfolios. Thirdly, and possibly the most serious criticism, is that factor analysis provides statistical risk factors which may not have any observable relationship with any economic variables (Van Rensburg 1998:20,21).

These criticisms have led to alternative tests of the APT, whereby macro-economic variables are preselected and tested to establish whether significant risk premiums are associated with these macro-economic factors. The benefit of these tests is that the identified priced risk factors have economic significance (Van Rensburg 1998:16).

6.2.6 Options and the B-S Option Pricing Model

Since the 1970s, and with the development of sophisticated capital markets, options have become indispensable financial instruments, not only to manage risk but to also fulfill the need to manage uncertainty. The management of risk has led to the development of Portfolio Theory, the CAPM and APT. However, although these theories and models are elegant, they rely on investors' expectations of risk, expected return and the correlation between risk and return. These theories and models did, however, not solve the problem of uncertainty, since investor expectations about uncertainty are generally not the same, hence the problem remained of how to determine the value of uncertain securities (options) upon which all investors could agree (Tompkins 1992:11,12).

The problem of valuing options, both call (buy) options and put (sell) options, of either an American or European nature, was solved with the development of the B-S Option Pricing Model. The model simply removes investor expectations about uncertainty, that is, share prices are based on expectations about uncertainty and options on those shares are based on expectations about the share prices, and by simply subtracting the one from the other, the expectations about uncertainty are eliminated. This procedure ensures that it is a relatively simple matter to determine option values, that is, the price of the share minus the price of the option on that share should equal a riskless investment (an investment with no uncertainty) and when this equation is rearranged the value of the option can be calculated (Tompkins 1992:12).

Empirical testing has shown that it is rare for B-S option values to be equal to the actual market prices of the options. Black (1988:51) notes three reasons, other than errors in calculation, that generally account for such differences, and adds that a combination of the three usually explains the differences between value and price:

- The option values calculated using the B-S model may be correct and the market prices may be out of line.
- Some of the different inputs, especially volatility, used when applying the B-S model may be wrong.
- The B-S model in itself may be wrong.

A particular problem, other than the effect of the early exercise of American options, associated with the B-S model, is estimating the underlying share's volatility. This has a tremendous impact on the values of certain options and is a significant area of empirical research (Black 1988:52,53). Another important topic related to the B-S model is the efficiency of the options market, and with it that of the stock market, and the related effect on option prices compared with option values (Reilly & Brown 1997:873). Significant empirical testing has been performed on this and the related implications for option pricing theory, and this represents an area of vital importance for the field of derivative financial instruments (Hodges 1988:8).

Although the B-S model is based on several unrealistically simple assumptions, Black (1990:17) notes that this weakness is also its strength since it allows the average investor to use it. Black (1988:51) adds, however, that it is not the realism of its assumptions that is important, but rather how well it works, and as yet no other model has been developed that has the descriptive and predictive power of the B-S model.

6.3 CONCLUSIONS

6.3.1 General

With reference to the problems defined in chapter 1 of this study, the following general conclusions can be drawn:

- Although empirical studies have provided some evidence of anomalies and while there are some controversial issues still to be resolved, the body of evidence generally confirms that the main capital market theories and pricing models reviewed in this study do provide a reasonably accurate description of reality.

- The literature study has been able to provide an exposition of how each of the theories and models describes and explains the nature and working of the capital market.

- Although some imperfections have been identified, research has shown that the theories and models are valid and do have descriptive and predictive ability.

- Recent research has made significant contributions to the available body of knowledge and, as regards the EMH, some alternative theories have been posited. It is, however, still unclear whether the CAPM or APT is superior and which provides the best description and explanation of share returns.

- With the review of empirical research, especially recent research, it has been possible to provide a framework and establish specific areas for future South African research in this field of study.

It is, however, also useful to draw specific conclusions about each of the main capital market theories and pricing models reviewed in this study. The following sections deal with these specific conclusions, starting with Portfolio Theory.

6.3.2 Portfolio Theory

- Investors can reduce the level of investment risk through diversification and can thus reduce the level of risk associated with a given expected return.

- The major risk reduction benefits of diversification can be achieved relatively quickly, that is, most of the benefits can be obtained when portfolios consist of between 10 to 20 shares.

- Global diversification enables investors to improve the risk/return characteristics of their investment portfolios. Investors can obtain lower risk levels by diversifying globally or can earn higher returns for a given level of risk, compared with the returns that can be achieved by investing only in their domestic markets.

6.3.3 The EMH

- The empirical evidence generally supports the weak form of the EMH. Despite some evidence of mean reversion, excess volatility and market irrationality, it is reasonable to conclude that capital markets, including the JSE, are weak form efficient.

- Regarding semi-strong market efficiency, the empirical evidence is mixed and less conclusive. For both the South African market and international markets, results from event studies provide strong support for semi-strong market efficiency. Against this, the return prediction studies, that is, studies on calendar effects, the size effect, the BV/MV effect, etcetera, have yielded anomalous results.

- The results from empirical studies on strong form market efficiency are also mixed. The evidence on the general inability of professional money managers to show consistent superior performance and market timing ability provides significant support for the EMH. The inability of these professionals to consistently outperform the market also raises doubts about the significance and usefulness of the semi-strong form anomalies. Against this, the evidence from insider trading activities and those of stock market specialists clearly provides no support for the EMH.

- Current knowledge therefore suggests that capital markets, especially markets of developing countries like the JSE, are operationally efficient. This means that the markets are efficient for investors and professional money managers in general, but stock market specialists and insiders are consistently able to outperform the market return.

- Alternative market efficiency theories, such as the Speculative Bubble Theory and Chaos Theory, have been proposed, but these still have to be shown to have better explanatory power and predictive ability than the EMH.

6.3.4 The CAPM

- There is a positive linear relationship between risk and return, but the slope of the SML appears to be less steep than predicted by the CAPM.

- Although it has been found that betas of individual shares are far less stable than those of portfolios, it can generally be concluded that beta is a valid and a fairly complete measure of risk. The relative stability of portfolio betas means that the CAPM is more useful in structuring share portfolios than in estimating returns on individual shares.

- The CAPM is an expectational model and should not be judged on the basis of the realism of its assumptions, but rather on how well it explains and predicts. It is, however, the difficulty of measuring investor expectations that has caused some researchers to conclude that the CAPM may basically be untestable.

- The CAPM , although not misspecified, may be inadequate, because other risk factors (other than beta) may provide a better description of the risk/return relationship.

- The CAPM has received a considerable amount of empirical support, and it is reasonable to conclude that the model should continue to be used in estimating expected returns until it has either been discarded or an improved model has been validated.

6.3.5 The APT

- The APT is by nature descriptive and may or may not be able to explain what should be.

- There is evidence that expected returns are affected by more than one risk factor and that the APT may be superior to the CAPM, but these results are as yet not conclusive. It is therefore reasonable to conclude that both models will be continued to be used and that only continued empirical testing will determine whether one model is superior to the other.

- There is as yet no consensus about the number of APT risk factors, nor about their identity. Different studies have found different factors for different periods and datasets and have also found evidence that the factors and their impact on returns can change quite rapidly. Thus ongoing research is required to establish a comprehensive and stable list of factors and their impact on returns.

6.3.6 Options and the B-S Option Pricing Model

- The put-call parity relationship generally holds and options markets can be regarded as being efficient in their pricing of options. The evidence on the hypothesis of market synchronization is less clear and requires further research.

- The B-S model is valid and is an accurate and flexible model that provides good predictions and explanations of option prices. No other option pricing model currently provides better descriptions of option pricing or option values and the B-S model can even be used to identify underpriced and overpriced options.

6.4 RECOMMENDATIONS

The recommendations listed below are aimed at future South African research into the capital market theories and pricing models under local conditions. However, these recommendations can largely also be applied internationally.

- Research is needed to establish whether and to what degree international diversification still has risk/return benefits for South African investors.

- Ongoing research is required into the issue of stock market efficiency. It is necessary to establish whether the level or degree of efficiency of the JSE has changed, to determine its exact level or degree of efficiency and to ascertain whether other theories, such as Chaos Theory or the Speculative Bubble Theory, provide complementary or better descriptions of the efficiency of the JSE.

- Since it has not yet been conclusively shown whether either the CAPM or APT is superior to the other, both models should continue to be tested. The aim of the research should be to improve the parameter estimation of both models, to compare their predictive and explanatory power and to establish whether the two models, when used jointly, provide better results than when a model is used on its own.

- Since the sensitivity of share returns to the various APT risk factors has been shown to change over time, research into these factors should also continue. Other factors should also be identified and tested in order to obtain an even better explanation of share returns.

- Very few empirical studies of the South African options market have been conducted and there is a distinct need for research into the efficiency of the South African options market, the degree of synchronization between the stock market and the options market and the accuracy and robustness of the B-S Option Pricing Model under South African conditions.

6.5 SUMMARY

The review of the principles and nature of the main capital market theories and pricing models, together with the review of empirical research thereon, have shown that these theories and models have contributed much to the understanding of the working of capital markets and of investment risk and return. All these theories and models have predictive ability and explanatory power, but, with possibly the exception of Portfolio Theory, current knowledge of the validity, accuracy and robustness of these theories and models has much scope for improvement. Ongoing research is required to improve understanding of the efficiency and pricing mechanism of capital markets and to establish whether other theories and models, some yet to be developed, can provide better explanations and descriptions of capital markets and investor behaviour. This broadening of knowledge can only be to the benefit of investors, as investment practitioners, and academics, as investment theoreticians and contributors to the development of an accounting theory.

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