BEHAVIOUR
OF
THE KUALA LUMPUR STOCK EXCHANGE
(1984 - 1994)
Some Comparative, Descriptive and Inferential Analyses

by
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Doctoral research - a venture into unexplored territory - is a great challenge. Completing a Ph.D. thesis requires self-discipline, creative imagination, organisational skills and emotional resilience. It requires a supportive environment, guidance and cooperation from many parties.

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Lastly, of course, I alone am responsible the remaining errors (of omission and/or commission).

DECLARATION

I declare that this thesis is the result of my own research. My indebtedness to other sources is indicated in the text and References and Bibliography. No part of the thesis has been published before, unless indicated in the text.

I further declare that this work has not already been accepted in for any degree and is not being concurrently submitted in candidature for any other degree.

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Candidate,
Mat Saad Abdullah

ABSTRACT

The behaviour of a nation's stock market is increasingly seen as a barometer of its economic growth, strength and stability. While the behaviour of well established equity markets is well researched and documented, the behaviour of small and developing exchanges is still not much studied. This thesis examines and analyses some aspects of the behaviour of an emerging equity market known as the Kuala Lumpur Stock Exchange (KLSE) - the national stock exchange for Malaysia.

To serve as the groundwork for our empirical investigation, this study begins with a survey of the related literature. The literature on efficient market hypothesis (EMH); the literature on various theories and models which are complementary and contradictory to the EMH - are reviewed.

Empirically, four major aspects of the behaviour of the KLSE are examined. Using both share price indices and individual company share prices/returns for a sample period 1984:01 through 1994:12, we study some statistical properties of stock returns, correlations with other markets, stock market forecastability and the presence of mean reversion/mean aversion in stock returns. The behaviour of the KLSE market indices are compared in several respects with the indices of selected developed markets.

Our study has resulted a number of findings, some of which could be considered as intriguing and novel for a relatively unresearched market like the KLSE.

Similar to many previous researches, our study has provided evidence that the distributions of stock returns are not normal. Rather, they are *leptokurtic*. Variances/standard deviations of stock returns on the KLSE were found to be large compared with, for example, the New York and London stock exchanges, but the realised returns were not significantly different for the period of study.

The KLSE is found to be positively correlated with most foreign exchanges, although these correlations are far from unity. These correlations however, are not constant/stable through time.

Our evidence also suggests that the Malaysian market tends to exhibit strong regional links. Additionally, the KLSE appears to have significant lagged correlations with a number of developed exchanges.

Three equity markets are identified as the most influential foreign exchanges to the KLSE in terms of their comovements (and/or lagged correlations). They are, the Stock Exchange of Singapore, the Hong Kong Stock Exchange and the New York Stock Exchange.

We found no evidence that the "forecastability" of stock prices/returns on the KLSE could be improved when an 'out-of-sample' forecasting procedure known as the *multi-process models* was employed. Moreover, we have found that the returns for some stocks are more forecastable than others.

Variance ratio tests indicate that over long horizons, some stocks listed on the

KLSE tend to exhibit mean reversion, some are mean aversive and the rest seem to follow a random walk.

The present research has also raised a number of issues which might be interesting for further study. These issues are discussed in Chapter Seven of the thesis.

CHAPTER ONE

INTRODUCTION

1.1-Introduction to Chapter One

The International Finance Corporation (IFC), a member of the World Bank Group, classifies stock market into two major categories: developed and emerging markets[1]. The principal concern of this thesis is the behaviour of an emerging market, the Kuala Lumpur Stock Exchange (KLSE) - which is the national stock exchange for Malaysia.

This introductory chapter is divided into three sections. In Section 1.2 we highlight and explain the objectives of the study. The plan or the structure of the thesis is given in Section 1.3.

[1]While there is no universally accepted definition of an emerging capital market [Barry and Lockwood (1995)], the International Finance Corporation (IFC), defines an emerging stock market as one in a developing country. It follows from the World Bank's guideline that a developing country is one with low-to-middle income, which in 1992 had a per capita GNP (gross national product) of less than US$8,356. See also Errunza (1983).

1.2-Objectives of the Study

Studying some facets of the behaviour of stock prices/returns[2] on the KLSE, is the domain of the present thesis. Essentially, the thesis is designed to meet the following objectives:

(i) To determine whether the statistical distributions of prices/returns of shares traded on the KLSE are different from those of shares traded on developed exchanges:

Towards this end, some statistical properties of stock prices/returns on the KLSE - mean, standard deviation, skewness and kurtosis - will be examined and compared with the those of shares traded on a number of selected well-established exchanges.

Stock markets in developing countries are relatively young, small in size and less sophisticated. Given their idiosyncrasies; given the socio-economic and political environments in which they exist - it is commonly perceived that prices/returns of stocks traded on these exchanges behave somewhat differently compared with those

[2]As featured in Hsu (1984), empirical studies of the behaviour of stock returns are important for several reasons:

(i) The nature of stock return behaviour is fundamental to the formulation of the concept of risk or uncertainty in various financial theories and models.

(ii) The measurement of risk depends heavily on properties - such as stationary, long-tailedness, finiteness of the second and higher moments - of empirical stock return distributions.

(iii) Various tests for the empirical validity of financial models and the applications of these models rely to a considerable extent on the steadiness over time of stock return distributions and the constancy of systematic risk.

(iv) Several important pricing models for stock options, warrants, convertible debentures, and other similar financial instruments usually require explicit estimates of stock return variances: The usefulness of such models depends largely on the adequacy (e.g., the finiteness, accuracy) and the stationarity of the variance measurements.

traded on the exchanges in the developed nations. Do such characteristics describe the KLSE which, in the recent past, has been growing quite fast in terms of size, activity and sophistication?

Our investigation into the statistical properties of stock prices/returns on the KLSE could be viewed as a stepping stone towards comprehending other aspects of the behaviour of stock prices/returns on the Exchange. This preliminary empirical investigation could possibly (directly or indirectly) shed new light on some old issues or problems and/or raise some new issues - which deserve further investigations.

(ii) To measure the extent to which the KLSE is integrated with or segmented from other national exchanges:

As a consequence of several political and economic reforms that have taken place on many countries since about the turn of the past decade, so-called *global investing* has become more interesting for the investment community[3]. As a result, it has been contended that international stock markets have become more integrated[4]. Would increased international market integration necessarily imply increased correlation between equity markets? Do correlations between equity markets change through time? If the correlations between the KLSE and overseas exchanges have increased in recent years, are they likely to become lower/higher in the future? The

[3]*The Economist* of February the 17th., 1996, begins its 'Finance and Economics' column with the following sentence:

"Pick up any investment newsletter these days and you will read about the joys of international investing" (p. 91).

[4]Several recent studies - including those by Cho *et.al* (1986), Wheatley (1988), Eun and Shim (1989) and Jeon and Von Furstenberg (1990) - have produced results which support the proposition that international stock markets are integrated. See also Corhay *et.al* (1992); Smith (1991); *IMF Survey* (March 7, 1994, p. 72); Rogers (1994) and Sewell *et.al* (1996).

structure of international equity correlations plays an important role in asset management/asset allocation decisions. Knowledge of the magnitude of interrelatedness of the KLSE and other national stock exchanges is considered essential to investors in planning their investment strategies or trading positions, particularly from the international investing point of view.

To obtain a general picture of any correlations between the KLSE and foreign exchanges, we begin our study on this subject by using the technique of *hierarchical cluster analysis*. Then, the results obtained under this procedure are reexamined by using the method of *correlation analysis*.

For the markets which are detected to be highly correlated with the Malaysian stock market, we study their interrelatedness in further detail, in order to verify and assess whether it is likely that 'common factors' or 'global factors' [see e.g., Grinold *et.al* (1989); Beckers *et.al* (1996)] affect their covariations. Here, the method of *partial correlation analysis* is applied.

The presence of low correlations between the KLSE and certain overseas exchanges would imply that there is potential for investors to diversify their portfolios comprising the Malaysian shares. Conversely, if the KLSE is found to be highly correlated with the exchanges in certain countries, innovations on these particular stock exchanges might feasibly be utilized by investors as clues when trying to understand movements on the KLSE [see e.g., Campbell and Hamao (1992); Chang *et.al* (1994)].

(iii) To assess the "forecastability" of stock prices/returns on the KLSE:

Evidence for the view that stock market returns are predictable appears to be

growing[5]. If stock returns are predictable, how well can an analyst forecast future returns based essentially on historical returns?

While we all know that financial market forecasts are inherently difficult (see e.g., Gray (1989), p. 36; Jacobs and Levy (1989), p. 26], this study attempts to provide some evidence on the above question, which seems to be interesting from both theoretical and practical points of view. To accomplish this, some techniques of assessment and measurement from the *theory of forecasting* are employed.

(iv) To determine whether the price changes or returns of shares traded on the KLSE follow a *random walk* or exhibit *nonrandomness*:

While the evaluation of the statistical memory of stock returns has always been an attractive topic in both theoretical and practical financial economics [see Chapter Three), the revisiting of this issue for the KLSE is justified by the fact that recent findings suggest that stock prices and returns on a number of stock exchanges do not follow a random walk, but they rather follow a *mean reverting* or *mean averting* process [see Chapter Four].

To meet this objective, the behaviour of stock returns on the KLSE (i.e, for individual company shares) are examined by implementing some *variance ratio* tests. As can be found suggested in the literature, values of the variance ratio below one are consistent with stock prices models implying negatively correlated returns: the mean reversion model. Values above one are consistent with positively autocorrelated returns: the mean aversion model.

The presence of mean reversion/mean aversion in long-term stock returns

[5]This subject is discussed in some detail in Chapter Four.

would have some ramifications for investment management. For example, if stocks are found to exhibit mean reversion in their long period returns, then portfolio choice would not be invariant to the investment horizon.

To generalise, in trying to obtain the above objectives, our empirical investigations will involve *comparative, descriptive* and *inferential* approaches. Some aspects of the behaviour of the KLSE are compared, contrasted and correlated with those of some selected foreign exchanges.

Both stock market prices of individual companies and indices covering the period of 1984 through 1994 are employed as the data base for the study. Nonetheless, since stock markets in general appear to be more stable during the periods after the worldwide crash of October 1987, in most cases our analyses concentrate on the sample period of 1988 through 1994 (rather than 1984 through 1994).

1.3-Organisation of the Thesis

Given the aforementioned objectives, this thesis can be divided roughly into three parts and is organised in eight chapters. Part one which represents the introductory part for the thesis, comprises Chapters One and Two. Chapter One provides the general introduction to the thesis and Chapter Two introduces the stock market of interest for this study - the KLSE.

Essentially, in Chapter Two we examine the historical, institutional, organisational and operational aspects of the KLSE. This chapter also highlights the growth and performance of the Exchange since its inception; besides attempting to

identify its principal characteristics (including its problems and prospects) as an *emerging stock exchange*. Some comparisons will also be made with a number of other selected exchanges. The information provided in this chapter helps to provide a context for the analysis of the behaviour of stock returns on the KLSE in subsequent chapters.

Part two of the thesis, which particularly deals with the theoretical aspects of share price behaviour, contains Chapter Three and Chapter Four. The objective of these two chapters is to gather information (theory and evidence) from the research literature concerning the behaviour of stock markets. Theories and evidence from previous works reviewed in these two chapterscould also provide us insights into the contemporary issues or problems that deserve concentration in our empirical work.

Chapter Three concentrates on the controversial issue of stock market efficiency. It attempts to provide a critical examination and discussion of the concepts, theory and evidence of stock market efficiency in some detail.

Chapter Four generally reviews investment approaches - stock market theories, models and evidence - which appear to be supplementary and contradictory to the theory of stock market efficiency. Some of the most recent developments and findings in stock market research and literature are also foci of discussion in this chapter.

The final part, which can be described as the empirical and concluding part' for the thesis, consists of Chapter Five, Chapter Six, Chapter Seven and Chapter Eight. Chapter Five presents statements of the issues to be addressed in our empirical work together with a review of literature (methodologies and evidence from previous studies) more directly related to these issues.

Chapter Six covers the statistical techniques employed in our empirical

investigations. Results and findings of our empirical tests are reported and discussed in Chapter Seven.

Chapter eight is the final chapter, providing the general conclusions for this research. Specifically, the chapter summarises the empirical issues addressed in the thesis; it recapitulates the empirical findings gathered in Chapter Seven and suggests some investment management implications of our empirical findings; it highlights some limitations of our empirical study. Lastly, this chapter suggests some directions for future research.

CHAPTER TWO

THE KUALA LUMPUR STOCK EXCHANGE

2.1-Introduction

Foreign investor interest in emerging equity markets is one facet of the recent trend of internalisation of the global securities business. Sseveral previous studies have documented that these relatively young and thinly traded exchanges have some peculiarities. The salient ones are as follows:

a) Both returns and risks (volatility, liquidity and political) have been higher for emerging equity markets relative to developed markets [Errunza (1983); Errunza and Padmanabhan (1988); Wilcox (1992); Harvey (1995); Solnik (1996)].

b) Correlations among emerging markets and between emerging markets and developed markets have been shown to be very low [Errunza (1983); Divecha *et.al* (1992); Speidell and Sappenfield (1992)]. A study by Hauser *et.al* (1994) concludes that, despite the low correlations between emerging and developed markets, only investors who can stand higher levels of risk may gain from including stocks of emerging markets in their portfolios.

c) Emerging market returns are more likely than developed markets to be influenced by local information/local country factors [Divecha *et.al* (1992); Harvey (1995)].

In fact, emerging equity markets vary in their 'maturity', structure, performance, prospects and principal features. Accordingly, these markets offer a rich set of environments for studying important financial issues.

This chapter provides a close examination of the institutional, organisational and operational aspects of the Kuala Lumpur Stock Exchange (KLSE). It explores the microcosm of the Malaysian stock market, aiming at providing the background information for studying (and comparing) the behaviour of share prices in later chapters.

The present chapter is developed as follows: We begin, in Section 2.2, by examining the securities industry and the stock market in Malaysia from an historical perspective. In particular, this section traces the establishment history of the KLSE. Section 2.3 discusses the various regulatory, legislative and organisational changes and advances that took place in the early stage of the KLSE's development. We proceed further by examining, in Section 2.4, the various changes and improvements introduced into the Exchange in recent years.

To ensure that a market for stocks and shares is well organised; to ensure that the trading in stocks and shares is conducted in a healthy and fair manner such that the interests of the investing public are protected; and to ensure that the growth of a stock exchange is consistent with the nation's aspirations, a regulatory body or bodies are necessary. The watch-dog bodies that supervise and oversee the operations of the securities industry and stock market in Malaysia are introduced in Section 2.5. The following section, Section 2.6, presents the organisational structure of the KLSE.

Each stock exchange around the globe practises its own trading system and procedures which might be different in one way or other, from those practised in other

exchanges. For the KLSE, we discuss these aspects in Section 2.7. It highlights the technical market details of the KLSE. This is followed by Section 2.8 which touches on the two listing boards of the KLSE - the Main Board and the Second Board. Then, in Section 2.8, we consider the two major indices of the Exchange - the KLSE Composite Index and the EMAS Index.

As a relatively young stock exchange, one might be interested in knowing how the Exchange has performed in its history of about three decades. We discuss this in Section 2.10. A brief comparison of the KLSE with other stock exchanges is also made, and this can be found in Section 2.11. Lastly, before we conclude the chapter in Section 2.13, in Section 2.12 we briefly highlight the vision of this ambitious Exchange.

2.2-The Making of the KLSE

The Kuala Lumpur Stock Exchange (KLSE) is the only official stock exchange for Malaysia, although there is another stock exchange in existence in the country - the Bumiputera Stock Exchange[1]. The 'present' KLSE was formed on December 27, 1976 in conjunction with enforcement of the Securities Industry Act 1973.

A company limited by guarantee without a share capital and incorporated under the Companies Act 1966, the KLSE was established to serve investors and listed

[1]The Bumiputera Stock Exchange or the *Pasaran Saham Bumiputera*(PSB) as it is widely called, was established in February 1969 under the *Majlis Amanah Rakyat* Act 20, 1966. An exchange specially set up for *Bumiputera* companies, the PSB only admits public limited companies owned by the *Bumiputera* community (i.e., the Malay and other indigenous people), for listing. The main purpose in establishing this seperate exchange for *Bumiputera* companies is to encourage and assist the *Bumiputera* community in the commercial and industrial activities of this country. See Malaysia, Bank Negara (1989), p. 384.

companies: to provide a market place for raising new funds, and for trading outstanding shares by buyers and sellers who determine share prices freely and competitively. Entrusted to provide a fair and orderly market for investors, the functions of the KLSE as listed in the *Information Malaysia 1992/93 Yearbook* (p.270) are as follows[2]:

a) to provide a market place for the purchase and sale of listed securities;

b) to furnish information on the financial standing of listed companies;

c) to furnish quotations of stock prices and shares transacted on the Exchange;

d) to protect the interest of members and the investing public;

e) to provide investors with service and promote public interest in the securities market as a whole;

f) to work in close cooperation with relevant Government authorities.

To cater the need of investors and the general public for information, the Exchange provides an information service that includes daily bulletins, its monthly *Investors Digest*, statistical data and real-time on-line information. Its library, specialising in information on the capital markets, is open to the public. Moreover, the Exchange's subsidiary company known as RIIAM, concentrates on research and educational service that covers courses, training, seminars and investment expositions.

Prior to December 27, 1976, the Exchange was known as the Kuala Lumpur Stock Exchange Berhad (KLSEB). It was incorporated on July 2, 1973.

Actually, the KLSE was first established as the Malayan Stock Exchange in March 1960. Since then, the Exchange had evolved through various reorganisations:

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[2]For details of the objectives for which the KLSE is established, see the KLSE's *Memorandum of Association*, pp. 1 - 4.

From the Malayan Stock Exchange (1960), it became the Stock Exchange of Malaysia (1964) and the Stock Exchange of Malaysia and Singapore (1965). When it parted company from the Stock Exchange of Singapore (SES), the Exchange was reestablished as the Kuala Lumpur Stock Exchange Berhad (1973) and finally it is known as the Kuala Lumpur Stock Exchange (1976).

Historically, the origin of the KLSE can be traced back to 1930 when the Singapore Stock Brokers' Association was formed. Indeed, the securities industry in Malaysia is believed to have its roots in the late nineteenth century as an extension of the British corporate presence in the rubber and tin industries. During those early days

it was British corporate enterprise in Malaya (now Malaysia) that provided the catalyst for the emergence of the business of share trading in Singapore and Malaya, where stockbrokers performed a convenient and essential service for those who which to buy or sell shares of rubber and tin companies - companies which were operating in this region, incorporated locally or abroad [see Swee-Hock (1989); Drake (1969b)]. Drake (1969a), p. 210) put it as follows:

> "Stock and share brokers have operated in Malaya since the late nineteenth century, providing facilities for the purchase and sale of shares in companies operating in the area. The brokers came in the wake of British corporate investment in the extractive industries".

Clearly, the growth of corporate enterprises in the plantation and mining sectors was the impetus behind the early growth of securities industry and share trading in the country. This era witnessed the emergence of those early companies such as Boustead and Company Ltd. (1893), Malakof Plantation Company Ltd. (1897),

Inch Kenneth Rubber Ltd. (1897), Rahman Tin Company (early 1900) and Guthrie Company Ltd. (1905).

Table 2.2 shows the number of companies listed on the Exchange during the early years of its operations. Since those companies are classified by type and domicile, we can see clearly that:

- rubber and tin companies dominated the listed shares: they accounted for more than 60% of the share counters traded;
- about 55% of listed shares are from companies incorporated outside Malaya [mostly in London (Drake, 1969b) p. 76].

Late in the nineteenth century, the British started to penetrate and colonize Malaya or the Malay Peninsular (now Peninsular Malaysia). During the time of the British rule, Singapore (which was founded in 1819 by East Indian Compony) had played its role as the administrative and commercial centre for the region - providing port and financial services to the resource-rich interior. The same currency was used throughout the Malay Peninsular (i.e., the Malay States and the Straits Settlements of Penang and Malacca) and Singapore [see e.g., Seaward (1993), p. 144]. Due to this historical background, a study of the early development of securities industry and stock market in Malaysia cannot avoid mentioning the role played by Singapore. "Just as their political and economic history is intertwined, the histories of the stock exchange in Singapore and Malaysia are likewise connected" [Aron and Aron (1983), p. 17]. In fact, both of the stock exchanges in Malaysia and in Singapore had their origins as a single market until their separation in 1973.

When the Malayan Stock Exchange was formed in 1960, shares for companies registered in both Singapore and Malaya were traded through the Exchange. The

'stock market in Singapore' and the 'stock market in Malaya' continued to be closely linked in practice, despite the fact that the two territories did not enter into any political union until the formation of Malaysia in September 1963 [see Seaward (1993)]. Indeed, until December 31, 1989, the stock market and securities industry in Malaysia grew hand-in-hand with those of Singapore. The two stock markets were "tightly linked as runners in a three-legged race" [*Far Eastern Economic Review*, April 12, 1984, p. 57].

Even though securities trading in Malaysia can be traced far back to the late nineteenth century, the first formal organisation in this region was only established on June 23, 1930, with the formation of Singapore Stockbrokers' Association by 15 local brokers. The Association was formed with the objective of regulating the conduct of its own members and protecting the investing public [see Swee-Hock (1989)].

Brokerage business continued to expand; and by the late 1930s, Malaya had seen a fairly rapid growth of its own stockbroking activities [see Swee-Hock (1989)]. So, as share trading developed into a much more pan-Malayan than purely Singaporean activity, the Singapore Stockbrokers' Association was reregistered in 1937 under the new name: Malayan Share Brokers' Association. The association which had its own code of conduct was renamed to reflect its pan-Malayan membership.

The Malayan economic scene was more prosperous in the 1950s. The Korean War brought about a period of boom in both rubber and tin prices. With this postwar prosperity, a greater number of people were able to invest and the financial market was strengthened. Moreover, the achievement of independence by Malaya in 1957 and the increasing sophistication of its financial market as a result of the business and

industrial developments of the time, created the pressing need for a proper stock exchange. With some gentle encouragement from the Government, on the 21st. of March 1960, a group of stockbrokers throughout Malaya and Singapore reconstituted the Malayan Stockbrokers' Association into the Malayan Stock Exchange. In designing and implementing a trading system for the Exchange, the service of A.H.Urquhart, then Chairman of the Sydney Stock Exchange, was employed[3].

Public trading started on May 9, 1960 when four stockbrokers - Malayan Traders, Ariffin & Co., Hallam & Co. and Charles Bradburne & Co. - gathered together in the clearing house of the Central Bank in Kuala Lumpur to conduct their first afternoon 'call' and price marking. Subsequently, under the direction of and with clerical assistance and telephone facilities provided by the Central Bank, these four Kuala Lumpur brokers met regularly to 'call' shares and mark prices [see Malaysia, Bank Negara (1989), p. 374].

With the formation of the Malayan Stock Exchange, and the beginning of public trading for shares in 1960, a new era in the history the Malayan (Malaysian) securities industry began. The remaining years of the 1960s saw continuous improvements in the organisation and operations of the Exchange, including improvements in physical facilities.

Physical facilities for share trading were further improved with the introduction of a *Big Board* system similar to the one used in Sydney. By 1961 the Trading Post *Open-Cry System* (modelled after the Sydney Stock Exchange) was practised.

The fledgling Malayan Stock Exchange was established with two trading rooms: one in Kuala Lumpur and the other in Singapore - about 400 kilometres apart.

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[3]See e.g., Neoh (1985), p. 38; Aron and Aron (1983), p. 16.

By 1962, the trading room in Kuala Lumpur moved to a new premise in Mercantile Bank Building[4]. Direct telephone lines between the two trading rooms were installed to provide investors with the best and latest price available. Thus, such a link eliminated arbitraging, and effectively integrated the two trading rooms into a single pan-Malayan market [see e.g., Lin (1989), p. 228].

In 1963, on September the 16th., the federation of Malaysia was formed and Singapore became one of its member countries. The following year, on June 6, the trading rooms in Singapore and Kuala Lumpur were reconstituted to form a new joint exchange, under the name of the Stock Exchange of Malaysia (SEM).

In August 1965, in the wake of Singapore secession from Malaysia, this common stock exchange continued to function as a single entity for the two nations, but was given a new name: the Stock Exchange of Malaysia and Singapore (SEMS). This state of affairs continued for another eight years until May 1973, following the termination of the currency agreement between Malaysia and Singapore in March 1973.

On May 8, 1973, the Finance Minister of Malaysia announced in Parliament, that the joint Stock Exchange of Malaysia and Singapore was to be split. The reason Malaysia initiated this break was to increase the importance to the market in Malaysia, to speed up the development of financial institutions in Malaysia relative to Singapore, and to enable Malaysia to act independently in the stock exchange [Sheng-Yi (1974), p. 190]. The Malaysian authorities sought greater domestic control over the industry [see van Agtmael (1984), p. 74]. A separate stock exchange was considered

[4]The Kuala Lumpur trading room was moved to the Bangkok Bank building in 1967, and to Damansara Centre on the 12th. of March 1973. On the 26th. of March, 1987, the KLSE moved again to the present premises at the Bukit Naga Complex.

advantageous for Malaysia since the majority of shares listed on the joint Exchanges were those of companies incorporated in Malaysia[5].

In Singapore, the decision made by the Malaysian Government to split the SEMS, necessitated the incorporation of a new exchange - the Stock Exchange of Singapore (SES), on May 24, 1973. Its operations as a separate exchange - with a new set of Rules, Bye-Laws and Requirements, a Listing Manual and Corporate Disclosure Policy [see Swee-Hock (1989), p. 57] - commenced on June 4, 1973. On the Malaysian side, the action led to the setting up of the Kuala Lumpur Stock Exchange Berhad (KLSEB) under the Securities Industry Act 1973 and the Companies Act 1965, on the second of July, 1973.

Notwithstanding the fact that the two 'new' exchanges - the KLSEB and the SES - were deemed to be separate exchanges, all companies previously listed on the SEMS continued to be listed on both of them. In fact, it was reported that more trading in Malaysian stocks especially by foreign investors, took place in Singapore rather than in Kuala Lumpur. There was also active arbitrage between the two markets [see van Agtmael (1984), p. 74].

Another significant development in the making of the Kuala Lumpur Stock Exchange took place in 1976 with the bringing into force of the Securities Industry Act (SIA) 1973. On the same day, on the 27th. of December, 1976, a new company known as the Kuala Lumpur Stock Exchange (limited by guarantee and governed by the Companies Act, 1965), officially took over the functions of the KLSEB.

[7]At the time of the split announcement was made, of the 223 companies listed on the SEMS, 152 were Malaysian-incorporated with a combined issued capital of $1,549 million, versus the 71 Singapore-based companies which had a total paid-up capital of $1,318 million.

2.3-Developments and Changes in Legislation, Regulation and Organisation

Since its inception in 1960, various legislative, regulatory and organisational changes and improvements had been introduced to the Exchange, aimed at creating an orderly and harmonious share trading environment. Time, events and experience had proven that the legislative and regulatory framework needed to be changed and improved in order to ensure a steady and orderly growth of the stock exchange and the securities industry in the country.

Since the early years of its operations, in order to protect the investing public and to instil public confidence in the stock market, regulatory measures for the listing of and trading in shares on the Exchange were initiated. Standards (as embodied in the 'Official List Requirements') for the admission of companies' shares to the Exchange were also set [see Drake (1969b)].

A new listing manual was issued in 1964. On June the 21st. of the same year, New Rules and Bye-Laws were adopted. All these Rules and Listing Requirements were drawn up (after some redrafting) from the report and recommendations made by Mr. A.G.Wallace (from the Sydney Stock Exchange). He was commissioned by the Exchange to survey and report on matters relating to the Exchange and submit recommendations on the manner in which it should be developed so that it could function efficiently. These rules and requirements could be considered to be the first official attempt to regulate trading activities and to control companies seeking to achieve listing on the Exchange.

A more comprehensive legal framework in supervising the operations of companies in the country - the Malaysian Companies Act 1965 - came into force in August, 1965. With the objectives of ensuring the protection of investors as well as of promoting the growth of a well-informed and discriminating body of investors, the provision of the Act, for the first time, obliged public companies to certain standards of information disclosure. The Act also established certain rules governing the conduct of directors and insiders of public companies.

The latest major step that had been taken during the decade of sixties in supervising and controlling the development of the Malaysia capital market was the formation of Capital Issue Committee (CIC) by the Minister of Finance in 1968. With the formation of the Committee, the ad hoc arrangements set up in 1963 among the Central Bank, the Exchange and the Registrar of Companies in guiding and nurturing the development of the stock market, was formalised.

As a body that was established to supervise the issue of shares and other securities by companies applying for listing, the CIC's main functions include:

a) To examine the draft prospectuses or announcements of any company intending to make a new issue or to seek listing on the Exchange. This aspect of disclosure is important in ensuring that the public is provided with all pertinent information about the financial position of the companies concerned;

b) To regulate the timing of the various issues of shares to ensure the operation of an orderly market.

In the seventies, especially after the split of the Stock Exchange of Malaysia and Singapore, the Malaysian Government seemed to play an increasing role in moulding and nurturing the growth of the Malaysian stock market and securities

industry. Various direct and indirect measures were taken not only to create an environment where the stock market could function orderly and efficiently but also to achieve certain national goals.

In July 1973, the Securities Industry Act 1973 (SIA 1973) was enacted. The Act which provided for greater Government control of the securities industry, and greater protection of the investors [see e.g., Aron and Aron (1983)], came into force in December 1976. Under the Act, the Minister of Finance could, from time to time, consult the CIC on all matters relating to the securities industry; the Registrar of Companies could also consult with the CIC for the proper and effective implementation of the Act.

The SIA 1973, the implementation of which was the responsibility of the Registrar of Companies, provided the much needed legal authority for the Government to curb the unhealthy practices in the stock market such as excessive speculation, insider trading, share rigging and other forms of market manipulation. Indeed, in the Act, there were provisions for the licensing of share dealers to ensure that only persons of good character and high business integrity could become members of the Stock Exchange; there were also provisions for the proper and orderly conduct of listings and dealings in the market. The Act required that dealers, dealers' representatives, investment advisors and their representatives as well as financial journalists, to maintain proper records of their dealings in securities, which might be inspected by the Registrar of Companies. In general, the SIA 1973 was introduced to generate a more orderly conduct of the securities business in the country, to protect the interests of investors.

With the implementation of the SIA 1973 in 1976 and under the supervision

of the CIC, the Malaysian corporate securities market was provided with a somewhat healthy atmosphere for the steady growth in the remaining years of the 1970s.

The decade of the 1980s was an eventful period in the history of the country's securities industry. A number of significant reforms and advancements took place during the period. "While the equities market enjoyed rapid growth in the 1960s and 1970s, it was only in the 1980s that far-reaching changes were made that brought the KLSE to its current level of sophistication" [Lin (1993), p. 232].

In the eighties, trading in the stock market became more popular and widespread. At the same time, as the market for corporate securities grew into a more sophisticated one, excessive speculative activities and market manipulations were found to be practised in the Exchange; market rigging and instances of conflict of interests were also rife [Lin (1989), p. 239]. These unhealthy developments and negative market behaviour (particularly in 1981 and 1982) proved that the underlying principle of self-regulation which was the basis of the SIA 1973, did not produce the effects anticipated [see Aziz (1989), p. 32]. Recognising the inadequacy of the SIA 1973 in effectively checking the above state of affairs and in creating an orderly conduct of securities business in the country, the Government introduced a new Securities Industry Act which came into force in July 1983.

The Securities Industry Act 1983 (SIA 1983) which replaced the SIA 1973, contains legislation providing for more effective supervision and control of the securities industry in the country. It regulates the operations of dealers in order to prevent false trading and market rigging transactions, stock market manipulations and insider trading.

With the enforcement of the SIA 1983, the status and functions of the CIC

were also formalised. Prior to this, the CIC (which was charged with the responsibility to safeguard the interests of the investing public and to ensure a steady and orderly growth of the capital market) had functioned only informally.

Even though the Malaysian Government consistently recognises the principle of stock market self-regulation and the need for the KLSE to conduct its own affairs, it also has responsibility to oversee the Exchange in the interests of investors [see Section 2.6]. With regard to this matter, the SIA 1983 empowered the Minister of Finance to regulate the activities of the KLSE, particularly to initiate amendments to the Rules of the Exchange.

In the early years after the enforcement of the SIA 1983, the securities market in the country was dominated by bearish sentiments [see Malaysia, Bank Negara (1989), p. 377]. With the slowdown in the Malaysian economy in mid-eighties [see Table 2.1], trading activities on the KLSE were quite sluggish [see Table 2.5]. Further, the 'Pan-Electric crisis' in Singapore had caused an unprecedented closure of trading in the KLSE and the SES for three days from December 2 to 4, 1985.

Following the Pan-Electric crash, the authorities in both Malaysia and Singapore attempted a series of measures to remedy the consequential loss of confidence in their respective stock exchanges [see Aziz (1989), p. 34]. In Malaysia, one of those measures to revive the securities industry into a healthy state, was the move to amend the SIA 1983.

Amendments to the SIA 1983 came into force on October 1, 1987. It introduced the concept of corporatisation of stockbroking companies where only stockbroking companies rather than individuals, will be entitled to dealing licences. The objective behind this move were: to improve the financial strength of the industry

Table 2.1

MALAYSIA: ANNUAL GROWTH RATE OF GROSS DOMESTIC PRODUCT (GDP) AT CONSTANT PRICE (1960 - 1993)

YEAR	ANNUAL GROWTH RATE (%)	YEAR	ANNUAL GROWTH RATE (%)
1960	9.9	1977	7.8
1961	1.4	1978	6.7
1962	6.9	1979	9.3
1963	5.5	1980	7.4
1964	5.8	1981	6.9
1965	5.6	1982	6.0
1966	6.2	1983	6.2
1967	1.0	1984	7.8
1968	4.2	1985	-1.1
1969	10.4	1986	1.2
1970	5.0	1987	5.4
1971	10.0	1988	8.9
1972	9.4	1989	8.8
1973	11.7	1990	9.7
1974	8.3	1991	8.7
1975	0.8	1992	7.8
1976	11.6	1993	8.5

For 1960 (Peninsular Malaysia only), 1960 = 100
1960 - 1970: 1965 =100
1971 - 1980: 1970 =100
1981 - 1993: 1978 =100

Source: Bank Negara Malaysia Annual Report (various issues)

Table 2.2

COMPANIES LISTED ON MALAYA AND SINGAPORE STOCK EXCHANGE

(December 31, 1964)

CLASS OF COMPANY	DOMICILE				
	LOCAL			FOREIGN	GRAND TOTAL
	MALAYA	SINGAPORE	SUB-TOTAL		
1) Industrial and General	28	26	54	14	68
2) Property	5	7	12	1	13
3) Rubber	24	2	26	90	116
4) Rubber Investment	1	-	1	6	7
5) Tin	20	2	22	29	51
6) Mining Investment	1	-	1	3	4
7) Oil Palm and Coconut	3	-	3	7	10
TOTAL	82	37	119	150	269

Source: Drake (1969)

(to enable brokerage firms to handle larger volumes of business), to inject expertise and professionalism into the industry (so that it will be more competitive), and to generate greater international interest in dealing on the KLSE. It is hoped that through corporatisation, "we can also build the international image of our firms and enable them to increase their dealings with foreign brokers" [see *The New Straits Times*, August 15, 1987]. These 'corporations' are expected to take the lead in making the KLSE an international stock exchange through the enhancement of technical expertise, professionalism and widening of the network of operations [see *The New Straits Times*, July, 19, 1988].

Domestic banks, both commercial and merchant, as well as large domestic investment institutions were allowed to participate in the corporatisation of stock broking companies. In late 1987, new brokerage licences were issued to three largest domestic banks.

The Malaysian Government also has been quite active in encouraging reputable foreign stockbrokers to take up equity in local brokerage firms [see de Caires and Fletter (1990), p. 260]. An example of the Government's effort to encourage foreign stockbroking firms to participate in the country's securities industry - to expose the stockbroking industry to international market and technology - was in 1988. In July of that year, the Government decided to increase the maximum limit allowed for foreign corporate ownership of stockbroking firms from 30% equity interest to 49%, provided the foreign corporate shareholder is able to bring in a certain volume of foreign business [see See Lin (1993), p.233].

Other important changes and improvements introduced and initiated by the Government in the 1980s to promote efficiency in the market, would include the

following:-

a) The formalisation, in April 1986, of the set of guidelines on policies of the CIC. The guidelines, which stressed especially the need for timely as well as adequate corporate and financial disclosures, stated in clear terms the CIC criteria and standards to be complied by the public companies. For example, companies seeking public issues should include a full disclosure of information in their final prospectus, as required in the Companies Act 1965.

b) On April 1, 1987, the Malaysian Code on Takeovers and Mergers 1987, came into force. The purpose of the code is to establish the principles and procedures for takeovers and mergers, to ensure that all takeovers are conducted in an orderly manner, while at the same time the interest of minority shareholders are protected.

c) The introduction of a 'Code of Ethics: Guidelines on Share Trading' by the Central Bank, to ensure proper development of the stock market. Designed to prevent the occurrence of grey market and insider trading, these guidelines are particularly directed to the merchant banks. As corporate advisors and underwriters for share issues, these banks are privy to insider financial information of the companies concerned.

At the end of 1988, the Government took a drastic measure by changing the structure of the KLSE. Rules of the Exchange were amended and the Minister of Finance appointed a full time Executive Chairman and three Government representatives on the nine member-committee of the KLSE. Previously, the KLSE Committee comprised of only elected brokers and the Chairman was elected by the Committee. Although this move was considered controversial, it was felt that the new structure would project a more independent image and enhance the Exchange in the

eyes of foreign investors, who previously seemed to prefer to go through the Stock Exchange of Singapore to trade in Malaysian shares [see Creffield (?), p. 106].

Throughout the 1980s, to compliment the various measures taken by the Government, the management of the KLSE itself also effected various changes in the Exchange in their effort to upgrade and improve the operations and efficiency of the KLSE, so that it could be placed abreast with other international stock exchanges. The following were among those major changes and improvements:

a) The implementation of the first phase of a *computerised share scrips clearing system* in November 1983, with 20 selected counters (companies). The following year, the clearing house known as Securities Clearing Automated Network Services Sdn. Bhd. (SCANS) was established. By November of the same year (i.e., 1984), the entire clearing system was fully computerised.

b) The Incorporation of the Research Institute of Investment Analysts Malaysia (RIIAM) in May 1985. It was established with the objectives of educating the public, disseminating information and conducting research, so that the standard and quality of security analysis and research in the country could be enhanced. On the first of October 1985, RIIAM was admitted as a full member of the ASAC (Asian Securities Analysts Council).

c) On April 14, 1986, the Kuala Lumpur Stock Exchange Composite Index (KLSECOMP) was introduced to the public. Representing cross-sectoral components, this new index reflected more accurate movements in share prices on the KLSE, compared to the then existing six sectoral indices.

d) In addition to the computerisation of the entire clearing system in 1984, three years later, in 1987, automation was further expanded by the installation of a

real-time share price reporting system (MASA)[6] for brokers. The service, which is a joint venture with the official national news agency, *Bernama*, also announces corporate news and general economic news via computer terminals. So through MASA, brokers and investors are able to have the latest information on the market without any delay. The system was then upgraded to MASA II in 1990.

e) Learning from the 'Pan-Electric debacle', the Advanced Warning and Surveillance Unit (AWAS)[7] was formed in July 1987, to monitor the public listed companies and member firms. In other words, AWAS was established to alert the KLSE if any stockbroking firm or public listed company is facing problems.

f) In line with the growing sophistication of the Malaysian stock market and securities industry, in July 1987 the Exchange introduced its new Listing Manual. An entirely new section on corporate disclosure policies and penalties on errant companies was included. Through these new listing requirements investors are assured that all tradings of securities are conducted on a fair and open basis, allowing the public access wherever appropriate.

g) To cope with the buoyant activity in the economy and the rapid growth and expansion of companies, on november 11, 1988, the KLSE launched its *Second Board*. This new board was established to cater for listing of smaller and younger companies. With the launching of this Second Board, smaller companies (with a minimum paid-up capital of MR5 million but not exceeding MR20 million) which are viable and have

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[6]In Malay,'*masa*' means 'time'. However 'MASA' here is the acronym for '*maklumat saham*' (shares information).

[7]'*awas*', in Malay means 'caution'

strong growth potentials are able to tap additional capital from the market through their listing on the KLSE. Thus, the Board not only helps increase the variety of financial instruments (shares) available for trading on the Exchange, it also assists in the development of the economy in that smaller companies can now raise funds through the stock market for their development and expansion programmes.

h) With the rapid expansion in transactions and the dynamic changes that had taken place in overseas bourses, the need to modernise the KLSE arose. After one and a half years of hard work, in May 1989, the KLSE successfully made a leap into a new era of modern technology with the launching of an electronic trading system to replace the then existing open-outcry system. This new semi-automatic trading system known as 'System on Computerised Order Routing and Execution' (SCORE), was introduced on the 15th. of May, 1989. The SCORE which was designed to do away with the inefficiency of the open-outcry system in matching and executing orders, was implemented in stages started with 30 companies. Subsequently, the traditional open-outcry trading system came to an end on the 10th of November 1989 with all counters being traded through the SCORE. Since then, trading on the KLSE has been floorless. This has enabled the KLSE to handle much larger trading volumes with greater speed.

i) To expose investors to a greater choice of financial instruments, listing of warrants and transferable subscription rights (TSRs) have been allowed on the KLSE since December, 1989. For the first time, TSRs were listed on the KLSE in June 1990.

2.4-Recent Changes and Developments in the KLSE

With the growing differences in the philosophy, vision, aspirations and policies

of the securities industry in Malaysia and Singapore, it became clear that the 'final split' between the 'Siamese twin' markets of the KLSE and the SES was inevitable. On October 27, 1989, the Malaysian Finance Minister announced in his Budget Speech that Malaysian registered companies should *delist* themselves from the Stock Exchange of Singapore (SES).

In response to the above direction, the KLSE decided that Malaysian incorporated companies listed on the SES must be delisted from the SES by December 31, 1989. Consequently, the SES announced the reciprocal delisting of Singapore incorporated companies from the KLSE, also by the end of 1989.

So, the 'final split' between the KLSE and the SES took effect on the first of January, 1990, making the KLSE as the sole official market for Malaysian shares. With the split, 182 Malaysian companies were delisted from the SES. Similarly, 53 Singapore-based companies were delisted from the Official List of the KLSE.

The Malaysian Government decided to 'split' the two exchanges "as a matter of national policy" (see e.g., *New Straits Times*, October 14, 1989). Thus, the decision to establish the KLSE as an 'independent' exchange can be viewed as an effort to further the growth of Kuala Lumpur as a major financial centre in this region. By confining dealings on the Malaysian counters/companies to the local exchange, it would attract more international investors to trade on the Malaysian shares through the KLSE. The rationale for the Malaysian Government to take this move was also to reduce the market's vulnerability to unfavourable developments on the SES[8] [see

[8]For example, in December 1985, the collapse of the Pan-Electric Group (of 13 companies) in Singapore, forced the temporary closure (i.e. for three days) of both the SES and the KLSE. With this Pan-Electric debacle, Singapore's image as a financial centre was considerably damaged [see Sheng-Yi (1990), p. 94].

Public holidays for the two countries are also different. In his connection, an event on November 14, 1986, bore testament. On that date, a public holiday in Malaysia, the selling spate in Singapore led to

Malaysia, Bank Negara, *Annual Report 1989*, p. 150]. In addition, both exchanges were common only in respect to companies with dual listings, but the KLSE and the SES had their own rules and regulations.

With the split, it was hoped that, in the long run, the KLSE would develop into an internationally recognised independent exchange [see Lin (1993), p. 234]. However, the split brought about two immediate impacts on the Malaysian stock market:-

(i) On January 2, 1990, the number of counters fell by 53 to only 254 companies [see Table 2.3]. As a result, the market capitalisation of the KLSE declined from RM156.1 billion to RM110 billion - a reduction of RM46.1 billion or 29.5% [See Malaysia, Bank Negara (1994), p. 384; see also Table 2.4].

(ii) The emergence of a new 'over-the-counter' market known as the CLOB (Central Limit Order Book) International in Singapore on January 2, 1990. It listed 133 actively traded Malaysian stocks together with six other foreign stocks. However, the KLSE has declared the CLOB International as an unofficial market for the Malaysian shares because it was not bound by any corporate disclosure rules or listing requirements (see e.g., *New Straits Times*, September 18, 1990).

It is interesting to note here that the split between the KLSE and the SES had also given rise to the problem of misplaced scrips among the Malaysian stockbrokers, for some time. As the KLSE was getting part of the business that was previously done in the SES, the volume of trading on the KLSE increased very rapidly [see Tables 2.4 and 2.5]; see also de Caires and Fletter (1990), p. 260]. With this unprecedented surge in trading volume, a number of stockbroking firms were caught with the

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the plunging of prices on certain Malaysian counters to almost half their value [see Malaysia, Bank Negara (1994), p. 384].

Table 2.3
NUMBER OF COMPANIES LISTED ON THE KLSE BY COUNTRY OF INCORPORATION
(1973 - 1993)

YEAR	MAIN BOARD			SUB-TOTAL	SECOND BOARD	GRAND TOTAL
	MALAYSIA	SINGAPORE	OTHERS			
1973	155	69	38	262	-	262
1974	163	67	34	264	-	264
1975	167	67	34	268	-	268
1976	173	64	27	264	-	264
1977	177	59	20	256	-	256
1978	180	57	16	253	-	253
1979	185	56	12	253	-	253
1980	182	56	12	250	-	250
1981	187	55	11	253	-	253
1982	194	56	11	261	-	261
1983	204	56	11	271	-	271
1984	218	56	8	282	-	282
1985	222	56	6	284	-	284
1986	227	55	6	288	-	288
1987	232	54	5	291	-	291
1988	238	53	4	295	-	295
1989	249	53	3	305	2	307
1990	268	-	3	271	14	285
1991	289	-	3	292	32	324
1992	314	-	3	317	52	369
1993	326	-	3	329	84	413

Source: The KLSE

Table 2.4
THE KLSE: NOMINAL VALUE AND MARKET CAPITALISATION (1973 - 1993)

AS AT YEAR END	NOMINAL VALUE		MARKET CAPITALISATION	
	RM Billion	% Change	RM Billion	% Change
1973	3.8	-	13.3	-
1974	4.3	13.2	8.1	-39.1
1975	4.8	11.6	11.7	44.4
1976	5.0	4.2	12.7	8.5
1977	5.2	4.0	13.7	7.9
1978	5.9	13.5	18.5	33.6
1979	6.5	10.2	24.6	34.4
1980	7.9	21.5	43.1	75.2
1981	10.7	35.4	55.4	28.5
1982	13.6	27.1	52.9	-4.5
1983	16.3	19.9	80.3	51.8
1984	20.4	25.2	69.3	-13.7
1985	22.6	10.8	58.3	-15.9
1986	23.5	4.0	64.5	10.6
1987	26.6	13.2	73.9	14.6
1988	29.4	10.5	98.7	33.6
1989	34.3	16.7	156.1	58.2
1990	35.3	2.9	131.7	-15.6
1991	41.7	18.1	161.3	22.5
1992	53.2	27.6	245.8	52.4
1993	61.6	15.8	619.7	152.1

Source: The KLSE

problem of scrip processing and delivery as they had limited financial and administrative resources. Being unable to cope with the massive backlog of scrip deliveries, the problem of misplaced scrips arose among those stockbroking firms[9].

The aforementioned problem highlighted the various shortcomings among the local brokers. The incident had proved that it was time for stockbroking firms to improve their capacity, not only in terms of marketing and financial strength but also in terms of professionalism and technical expertise - to enable them to handle the rapidly increasing trading volume as well as to provide high standards of service to international clients. Capital adequacy is considered very important in ensuring the overall financial soundness and liquidity of the Malaysian stockbroking industry.

Recognizing the above situation and need, in its move to further enhance the financial strength and professionalism of the stockbroking industry, the Ministry of Finance decided that MR20 million should be the minimum paid-up capital for every stockbroking firm. At the same time, smaller broking firms were encouraged to merge among themselves or with institutional or foreign partners [see Malaysia, Bank Negara (1994), p. 384]. Accompanying this, the Exchange's Rules on minimum paid-up capital were amended. It then became mandatory for all stockbroking companies in all parts of the country to have a minimum paid-up capital of RM20 million by the end of 1991 [see e.g., ASAC (1992)]. Prior to that, in February 1990, to enable them to improve their financial strength, the CIC gave approval for stockbroking firms with a paid-up capital between RM5 million and 20 million to seek listing on the KLSE.

On the whole, however, the split between the KLSE and the SES did not bring much adverse effects on the growth and performance of the KLSE. O'Connor and

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[9]See *Investors Digest* (April 1990) and Malaysia, Bank Negara (1994), p. 384.

Table 2.5
THE KLSE: ANNUAL TRADING VOLUME AND VALUE (1973-1993)

YEAR	VOLUME (billion units)			VALUE (RM billion)		
	MAIN BOARD	SECOND BOARD	TOTAL	MAIN BOARD	SECOND BOARD	TOTAL
1973	0.5	-	0.5	2.0	-	2.0
1974	0.4	-	0.4	0.7	-	0.7
1975	0.6	-	0.6	1.3	-	1.3
1976	0.4	-	0.4	1.0	-	1.0
1977	0.6	-	0.6	1.0	-	1.0
1978	1.1	-	1.1	2.5	-	2.5
1979	0.6	-	0.6	1.6	-	1.6
1980	1.5	-	1.5	5.6	-	5.6
1981	1.6	-	1.6	8.1	-	8.1
1982	1.1	-	1.1	3.3	-	3.3
1983	2.3	-	2.3	7.9	-	7.9
1984	1.9	-	1.9	5.7	-	5.7
1985	2.9	-	2.9	6.2	-	6.2
1986	2.3	-	2.3	3.4	-	3.4
1987	5.3	-	5.3	10.1	-	10.1
1988	4.0	-	4.0	6.8	-	6.8
1989	10.18	0.02	10.2	18.4	0.06	18.5
1990	13.1	0.08	13.2	29.3	0.22	29.5
1991	12.1	0.28	12.3	29.2	0.85	30.1
1992	18.6	0.71	19.3	49.2	2.28	51.5
1993	105.0	2.74	107.74	372.6	14.6	387.2

Source: The KLSE

Smith (1991, p. 284) elucidate this fact in the following words [see also Tables 2.4 and 2.5]:

> "The separation has not unduly altered the scope and size of the KLSE. After the separation, there were 254 companies worth M$110 billion on the local bourse. Within one year, 30 new listings expanded the bourse to 284 companies valued at M$131.7 billion at the end of 1990".

The KLSE continued to expand rapidly in recent years despite the Pan-Electric Crash in 1985, the World Stock Market Crash in 1987 and the split with the SES in 1990. In their efforts to meet the new challenges of the nineties, to boost public confidence and to promote greater efficiency in the stock market, the Government and the authority of the Exchange have undertaken a host of improvement measures in recent years. With the rapid industrialisation of the Malaysian economy, and to keep up with world trends of the globalisation of financial markets, several measures were designed and implemented to improve the administration of the KLSE and to expose it to new technological advancements.

In January 1990, the Exchange introduced the 'daily netting system' for the broking firms, whereby all outstanding sales and purchases of stocks transacted will be netted out on the day of the contract. The system was introduced with the objective of reducing physical movement of shares between broking firms and the securities clearing house.

In February 1990, the Fixed Delivery and Settlement System (FDSS) was implemented by the KLSE, with the objective of developing a more organised and efficient system of scrip delivery and payment. It was hoped that the FDSS would help to enhance the management of cash flow among stockbroking firms. With the

new system, broking houses would be in a better position to plan their funding requirements more efficiently. Before the introduction of the FDSS, there was a trading period system whereby sellers of shares during a particular week were given, up till Wednesday the following week to deliver their scrips; making it difficult for the buying broking house to predict when the scrips will be delivered.

On the 14th. of April 1990, as a step to further improve the settlement system of the Exchange - a move towards introducing scripless trading (in tandem with trends in developed markets) - the Malaysian Central Depository Sendirian Berhad (MCD), an associate company of the KLSE, was incorporated. This company (which has been accepted as an eligible foreign custodian under the United States Investment Company Act, 1940) was charged with the responsibility to implement the establishment of the Central Depository System (CDS) that will do away with the present physical movement and delivery of scrips.

The CDS is effectively a 'scripless' trading system - a system of securities trading without involving share certificates or scrips changing hands. Under the system, ownership of shares is transferred through a computerised book entry instead of by physical delivery. So, to trade in shares under the CDS, an investor needs to open a CDS account with the Malaysian Central Depository Sdn. Bhd. (the company that manages the CDS) through its agents (i.e., stockbroking firms).

A CDS account has all the security features of a bank account. Indeed, the CDS is to shares what a bank is to cash. When an investor buys a share, his or her account will be credited; similarly it will be debited when a share is sold.

The Act which provides for the regulation of the CDS - the Securities Industry Act (Central Depository System) 1991 - was passed in Parliament, in February 1991.

The opening of the CDS accounts by investors was launched in November 1992. Since then, the CDS accounts can be opened with the stockbroking firms which are appointed as the ADAs (Authorised Depository Agents). However, trading under the CDS system only commenced on March 2, 1993, with an existing second board counter (company), Autoways Holdings Berhad, to be the first counter brought into the system. By end-1993, all the 84 companies listed on the Second Board had been prescribed into the system, while prescribing of counters from the Main Board only commenced in 1994.

When the CDS is fully operational, the KLSE is expected to be able to handle a greater volume of trading than currently possible. Moreover, the CDS will not only help to reduce the cost of trading (as all scrips will be unmobilised), but also reduce financial losses arising from problems related to scrips such as forgeries, stolen certificates, tampering and misplaced certificates, and delays in share registration.

In addition to the changes and advancements discussed above, the following are among other changes and improvements initiated and implemented by the management of the KLSE in recent years:-

- The establishment of the Market Development Unit in April, 1990, to monitor developments in the domestic and foreign securities markets.

- To enhance its price reporting efficiency, the KLSE upgraded its real time price dissemination system (MASA) with MASA II. It provides additional information to users.

- The launching of the Second Board Index in January 1991, to provide investors with an indicator of the performance of stocks listed on the Second Board. With the implementation of this index, smaller companies become more attractive to

institutional investors since there is a better track of price movements for those shares (see Malaysia, Ministry of Finance, *Economic Report 1991/92*, p. 204).

- In early 1991 also, with the cooperation of Telekom Malaysia, the Exchange launched the *telestock service*. Through this service, information on counters listed on the KLSE such as the selling and buying prices of shares and total volume traded can be obtained via telephone.

- On October 17, 1991, the Exchange launched the Kuala Lumpur Stock Exchange Main Board All-Shares Index known as EMAS Index. Consisting all shares listed on the Main Board, the Index supplements the Composite Index in gauging the performance of the KLSE.

- Commencing from the 19th. of October 1992, matching of orders under the SCORE is automatic. However, the automation was implemented in stages. By end of November 1992, measures to facilitate full automation of the former semi-automatic trading system in the KLSE were completed and all listed stocks were automatically matched. This would enhance the efficiency of the KLSE and investors should benefit from the increased transparency.

- In November 1992, the KLSE launched the Real-time Analysis Stock Information Service (RASIS). With this service, further up-to-date information is available for investors.

- Shares listed on the KLSE were previously grouped into eight sectors namely, Industrial, Finance, Property, Palm Oil, Rubber, Hotels, Tin and Property Trust. Nevertheless, with effect from the first of September 1993, to better reflect businesses of companies listed on the Exchange, to help investors focus on a particular sector more accurately, the KLSE reorganised and reclassified its Main Board sectors.

Consequently:

(i) four new sectors were introduced to replace the then existing Industrial Sector of the Main Board which was getting too big. The new sectors are known as Consumer Products, Industrial Products, Construction and Trading/Services;

(ii) the Loan Sector comprising loan stocks/notes and bonds was also launched;

(iii) both Palm Oil and Rubber Sectors were merged and known as Plantation sector;

(iv) the Tin Sector was renamed as the Mining Sector.

On the same date, new indices to represent the above sectors were also introduced.

- The SCANS formed an alliance with Dow Jones/Telerate - the Telerate Scans - to provide a customised real-time equity and international markets information service, for the exclusive use by member companies of the KLSE. The Telerate Scans was formed with the objective of providing financial information on regional and global markets. With this, beside easy access to information on a particular exchange that the international capital market will have, perhaps further international interest on the KLSE could also be generated.

In February 1992, the CIC made another revision to its listing guidelines to tighten the requirements for new listings; and also set additional criteria for rights issue proposal [see e.g., Malaysia, Bank Negara, *Annual Report 1993*, p. 23]. After this date, it was decided that applications to the CIC for listing on the KLSE would be subjected to this new listing requirement guidelines. Listed below are among the salient features of the new listing guidelines:

(i) For companies seeking listing on the Main Board, an average pre-tax profit of not less than MR4 million per annum (compared with only MR2 million

previously) must be made for the past three years to five years. A pre-tax profit of at least MR2 million per annum is also required to be made for each of the past three years to five years.

(ii) For listing on the Second Board, a company is required to make an average pre-tax profit of not less than MR2 million per annum (compared with MR1 million previously) for the past three years. In addition, a pre-tax profit of at least MR1 million per annum must be obtained for the past three years.

Besides, the KLSE itself amended its listing requirements in August 1993. This move was consistent with the commitment of the KLSE to encourage high standard of corporate disclosure and protect the investing public [see Malaysia, Bank Negara (1994), p. 390]. The following are among the major additional requirements:

(i) To help reduce nepotism and thus minimise influences of interested parties in the administration of a company, all listed companies are required to set up audit committees whose composition of members have to meet certain requirements. All listed companies were given a year, from August 1993, to set up an audit committee. Similarly, all companies which are seeking a listing must also meet the requirement of having an audit committee.

The functions of the audit committee are, among others, to review the audit plan and reports; also to evaluate the system of internal accounting control. In this respect, all listed companies are required to include in their annual reports, their audit committees' report disclosure.

(ii) Public listed companies which are required by the KLSE must report within 48 hours from the date of the query. This move will help to protect investors from extreme price fluctuations in cases where information may be price sensitive.

On the regulatory ground, the establishment of the Securities Commission (SC) commencing operations on March 1, 1993 (with the coming into force of the Securities Commission Act 1993), marked a milestone in the development of the domestic capital market. The SC was established with a statutory role in ensuring law and order in the capital market .

The SC, which absorbed the functions of three agencies, namely, the Capital Issues Committee (CIC), the Panel on Take-overs and Mergers and some of the functions of the Registrar of Companies, is responsible for the enforcement of the Securities Commission Act 1993 (SCA 1993). Together with the Registrar of Companies (ROC), the SC is also responsible for the enforcement of the Securities Industry Act 1983 and the Securities Industry (Central Depositories) Act 1991.

As the Malaysian capital market grew in size, complexity and sophistication, regulation was felt to be an urgent issue (see *New Straits Times*, October 23, 1992). The time had come for the country to establish a single regulatory body - the SC - to supervise and regulate the securities industry to see its orderly development so that an environment for fair play in Malaysian capital market could be provided.

In tabling the Securities Commission Bill 1992 in Parliament, the Minister of Finance was reported to stress that, even though some quarters claimed that the market mechanism could regulate itself, the confidence in the so-called self-regulated market had more often than not, been disappointing. "The Government cannot afford to gamble away the interests of the national economy and the investing public with an unregulated market". In supporting the need for a regulatory body to ensure the integrity of a capital market and the protection of investors, he added, "Well-known international exchanges have also encountered crisis after crisis as a result of the greed

of individual market manipulators" [see *New Straits Times*, October 22, 1992].

2.5-Legislations and Regulatory Bodies

In Malaysia, supervision of the securities industry comes under the purview of the Ministry of Finance [see Figures 2.1a and 2.1b]. Listed below are laws that govern the administration of securities industry in Malaysia. In general, these acts seek to provide for the development and management of a healthy capital market and securities industry and to ensure that the investing public are protected:

(a) Securities Commission Act 1993;

(b) Securities Industry Act 1983;

(c) Securities Industry (Central Depositories) Act 1991;

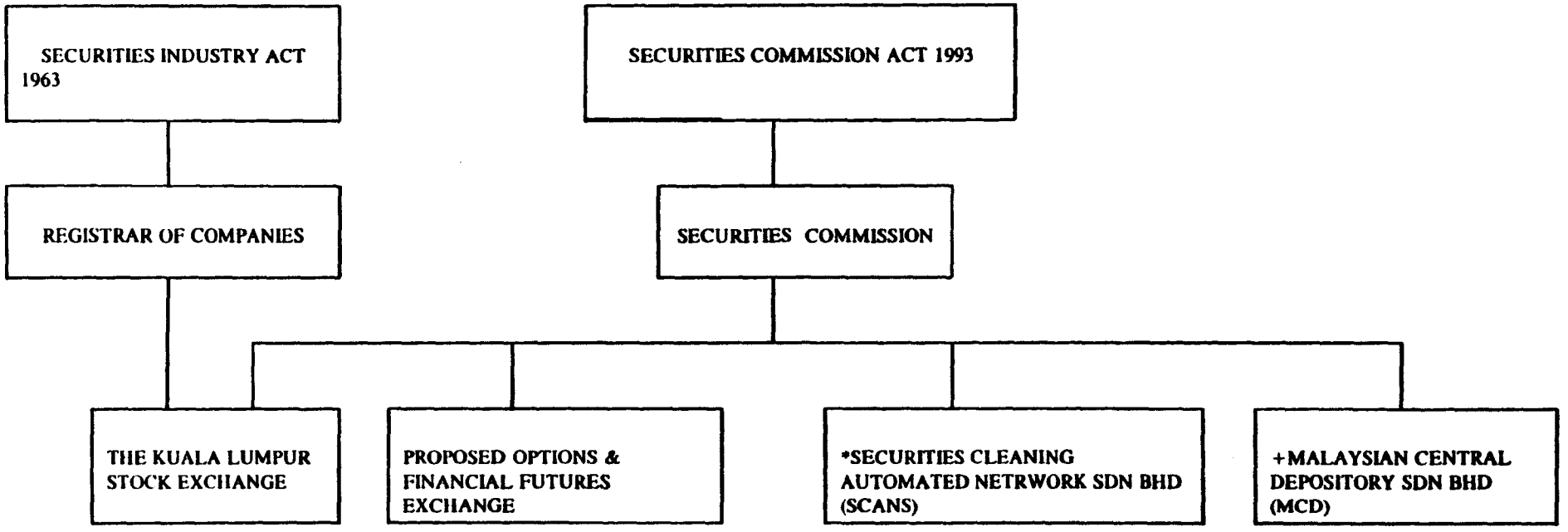
(D) Companies Act 1965.

Currently, there are two key regulatory agencies in the Malaysian financial system: the Central Bank (*Bank Negara*) and the Securities Commission. While the Central Bank supervises and regulates the banking system (including the money market), the Securities Commission (SC) which concentrates on the broad capital market, is responsible specifically, for the regulation and development of the securities industry, financial futures and options markets, unit trust and property trust schemes and the takeover and merger of companies.

Despite the fact that the SC was established to entrust the governance, regulation and supervision of the securities industry within one central body, more than one authority still monitor, manage and admonish the capital market. Apart from the SC, there are effectively four other regulatory organisations responsible for the

Figure 2.1a

REGULATORY STRUCTURE OF THE SECURITIES AND FINANCIAL FUTURES INDUSTRY: SUPERVISORY AND MONITORING



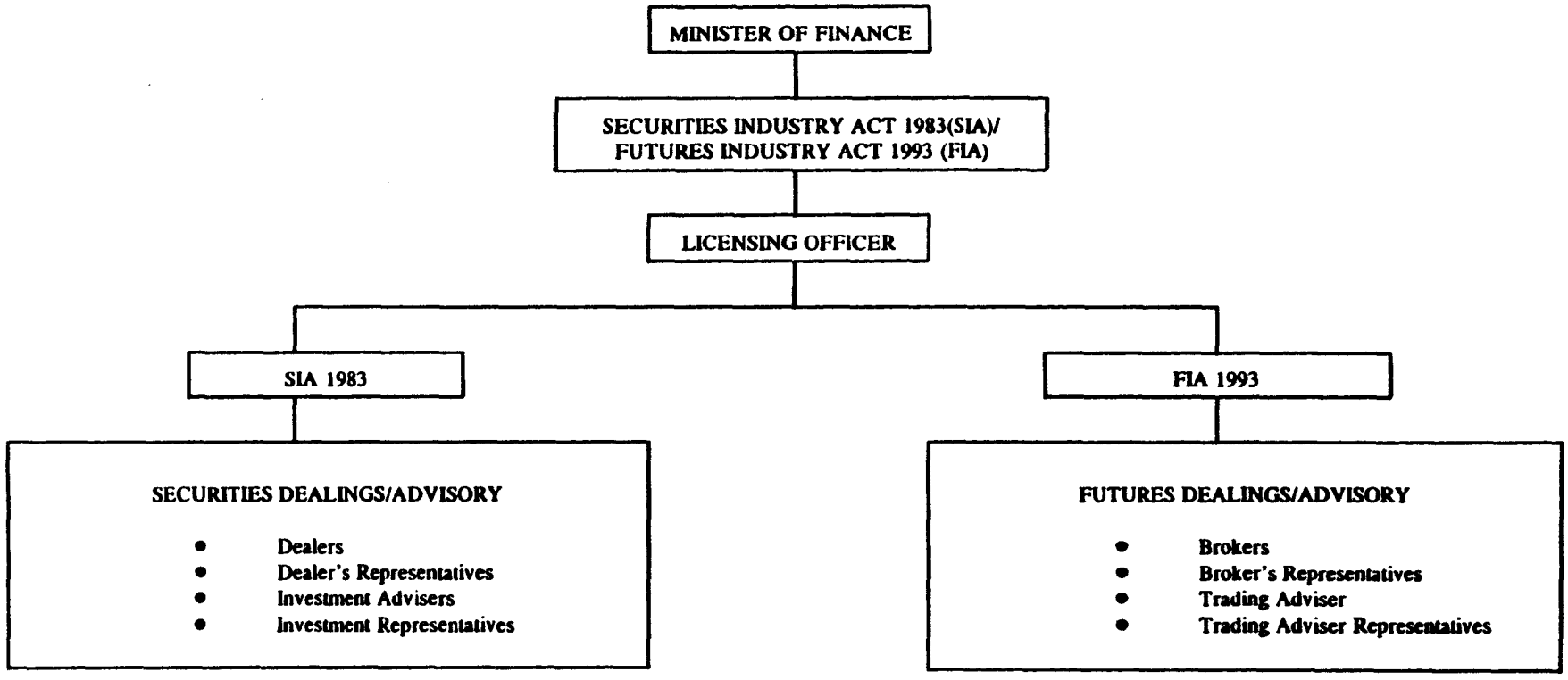
* SCANS operates as the clearing house for The KLSE and is its wholly owned subsidiary.

+ MCD is a subsidiary of The KLSE and operates the Central Depository System pursuant to the Securities Industry (Central Depositories) Act 1991.

Source: The KLSE

Figure 2.1b

REGULATORY STRUCTURE OF THE SECURITIES AND FINANCIAL FUTURES INDUSTRY: LICENSING



Source: The KLSE

supervision and management of the stock market in particular and the securities industry in general [see Figures 2.1a and 2.1b] . The bodies are, the Registrar of Companies (ROC), the Licensing Officer (Securities/Futures Trading) of the Ministry of Finance (LO), the Foreign Investment Committee (FIC), and the KLSE itself. With the exception of the KLSE which is basically a self-regulatory body run and managed by the private sector, the other three bodies are Government agencies.

The major functions and responsibilities entrusted to the five regulatory authorities mentioned above are briefly elucidated below:

a) The Securities Commission (SC)

The SC was established under the Securities Commission Act 1993 as a watchdog organisation to centralise powers governing the regulation and supervision of the securities industry within one authority from the previously fragmented system of several regulatory agencies[10]. The SC's functions, as stipulated in the Securities Commission Act 1993 (Act 498, p. 13) are listed below:

(i) to advise the Minister of Finance on all matters relating to securities and futures contract industries;

(ii) to regulate the issue of securities;

(iii) to regulate the designation of futures contracts;

(iv) to regulate the take-overs and mergers of companies;

(v) to regulate all matters relating to unit trust schemes;

[10]Previously, as we have already examined, the watching and warning, the supervision and regulation, of the capital market, rested with six major bodies: the Registrar of Companies, the Capital Issue Committee, the Panel of Takeovers and Mergers, the Foreign Investment Committee, the Central Bank and the KLSE.

(vi) to be responsible for supervising and monitoring the activities of any exchange, clearing house and central depository;

(vii) to take all responsible measures to safeguard the interest of persons dealing in securities or trading in futures contracts;

(viii) to promote and encourage proper conduct amongst members of the exchange and all related persons;

(ix) to suppress illegal, dishonourable and improper practices in dealings in securities and trading in futures contracts and the provision of investment advice or other services relating to securities or futures contracts;

(x) to consider and suggest reforms of the law relating to securities or futures contracts including changes to the constitution, rules and regulations of any exchange and its clearing house;

(xi) to encourage the development of securities and futures market in Malaysia; and

(xii) to perform any function conferred by or under any other act.

b) The Registrar of Companies (ROC)

Established as the overseer of thousands of companies - public and private - the ROC administers the Companies Act 1965. It also administers and regulates the relevant provisions of the Securities Industry Act, 1983 (with regard to both listed and unlisted companies and their officers). The ROC is responsible to supervise the behaviour of the 400-over companies listed on the local bourse.

c) The Licensing Officer (Securities/Futures Trading)

The office of the Licensing Officer (LO) was established together with the setting up of the SC. The LO which is appointed by the Minister of Finance, is responsible for the issuance of the relevant licences under the Securities Industry Act 1983 (previously under the purview of the ROC) and the Futures Industry Act 1993. Working within the Ministry of Finance and under both acts, the LO is endowed with the authority to issue permits to trade or deal in securities, futures and options.

d) The Kuala Lumpur Stock Exchange

As a formal stock exchange for the country, the KLSE not only provides a market place for the trading of securities but also responsible for the surveillance of the market place. This self-regulatory organisation with its own Memorandum and Articles of Association as well as a set of Rules, governs the conduct of its members and stockbroking companies in securities dealings. Besides, the KLSE is also responsible for the enforcement of its Listing Requirements which spell out the criteria for listing, disclosure requirements and standards to be maintained by public listed companies[11]

e) The Foreign Investment Committee (FIC)

Formed in 1974, the FIC is concerned with the distribution of equity ownership consistent with the *New Economic Policy*[12]. Its main role is to implement the

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[11]See the KLSE, *Investing in the Stock Market in Malaysia*, PP 6812/2/93, p. D4.

[12]*The New Economic Policy* (1970 - 1990) spelled out twin objectives of socio-economic development for national unity. These two-pronged objectives are:

(i) the eradication of poverty irrespective of race; and

(ii) the restructuring of society to eliminate racial economic dominance: to eventaully eliminate the

Government's guidelines on regulation of acquisition of assets or interests, mergers or takeovers of companies and business. In addition, the FIC is also charged with responsibility for major issues pertaining to foreign investment.

To summarise, there are three major arms of the Government that regulate and supervise the trading of securities or shares in Malaysia: the LO that has power to license, the SC which is authorised to regulate and the ROC which has the mandate to prosecute contradiction of the law. The duties and functions of these bodies are supported and complemented by the KLSE - a private sector organisation - which has its own set of rules, regulations and requirements to be enforced.

2.6-Organisational Structure of the KLSE

In Malaysia, the establishment of a stock exchange requires the approval of the Ministry of Finance. The Kuala Lumpur Stock Exchange (KLSE) is the only body approved by the Minister of Finance, under the provisions of the Securities Industry Act 1983 (SIA 1983) as the stock exchange in the country.

As a public company limited by guarantee, the KLSE has no shareholders and no share capital. It only has members who must be shareholders in any stockbroking company (or the KLSE member company, as it is often referred to) that is recognised by the Exchange.

Membership is confined to individuals and corporations (including foreign corporations) who are licensed under the SIA 1983 to deal in securities. Put

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identification of race within economic functions.

differently, the members of the KLSE can be either natural persons or corporations who shall be the shareholders of the stockbroking companies[13] [see *Articles of Association of the Kuala Lumpur Stock Exchange*, p. 8]. The maximum number of members allowed by the Exchange's Articles of Association is 250 (i.e., 200 natural persons and 50 corporations).

A stockbroking company is not directly a member of the KLSE however. This is because, a corporate member must be represented on the Exchange only by a corporate nominee. A corporate nominee, whose acts and defaults shall be deemed to be those of the corporate member, is required by law to hold a dealer's representative licence.

Following the British model [see van Agtmael (1984)], the KLSE is a self-regulatory organisation, conducting its own affairs in the securities industry. However, the Exchange is closely monitored by the Ministry of Finance. The Malaysian Government, acutely aware of the importance of a properly regulated equity market in economic development, has proclaimed its desire to avoid market excesses [see Aron and Aron (1983)].

As a self-regulatory body, the KLSE is administered by a committee, monitoring shares trading and stock broking operations. The Exchange also establishes listing requirements.

Like any other company, the KLSE has its own Memorandum and Articles of Association (M&A). In addition, to govern the conduct of its members in securities dealings, the Exchange has two sets of rules, namely, Rules Relating to Member

[13]The business of dealing in securities in Malaysia is crried out by stockbroking companies with limited liabilities. Stockbroking business in the form of partnership or sole proprietership is not allowed.

Companies and Rules for Trading by Member Companies.

The Exchange's M&A as well as its Rules can be amended by the members of the KLSE. Under the provisions of the SIA 1983, the Minister of Finance also can amend the Exchange's M&A and Rules, after consulting the Securities Commission and the KLSE Committee.

The affairs of the Exchange are managed and regulated by a Committee of nine members. The current nine member Committee consists of four members elected from individual members, four independent members including the Executive Chairman who are appointed by the Minister of Finance and one elected corporate nominee. The maximum number of corporate nominees allowed to be represented on the Committee is two.

The day-to-day management and administration of the Exchange are handled by the Executive Chairman and a management team, all of whom are answerable to the KLSE Committee. The General Manager (appointed by the KLSE Committee) who heads the day-to-day operations of the Exchange, is assisted by a team of executive personnels heading various departments.

The organisational structure of the KLSE is exhibited in Figure 2.2.

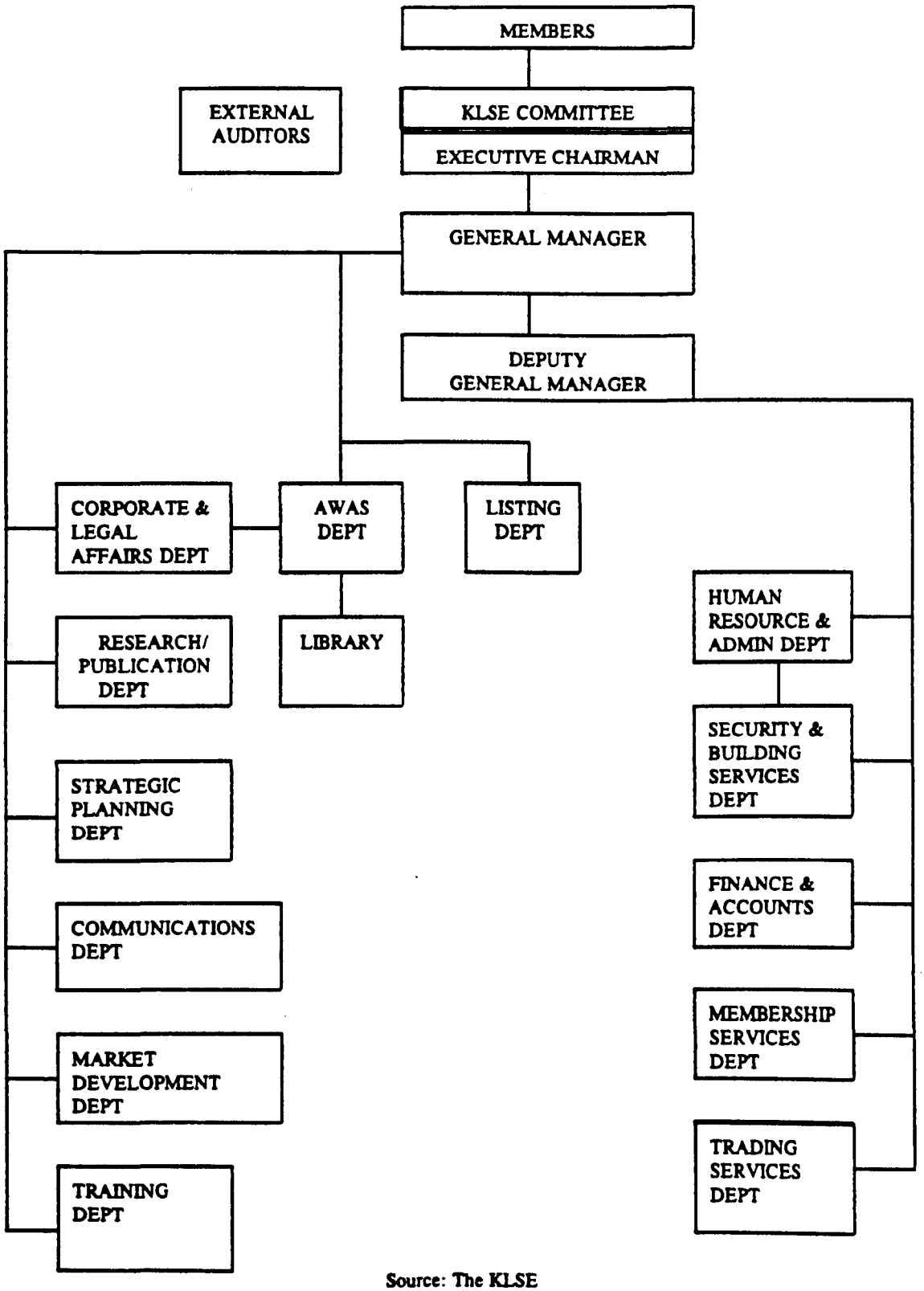
2.7-Trading Systems and Practices

The KLSE operates on the basis of a five-day week (i.e., Monday to Friday). Trading begins at 9.30 a.m. and finishes at 12.30 p.m. for the morning session. The afternoon session begins at 2.30 p.m. and ends at 5.00 p.m.

Activities and practices of trading on the Exchange are defined, regulated and

Figure 2.2

STRUCTURE OF THE KUALA LUMPUR STOCK EXCHANGE



Source: The KLSE

governed, primarily by the Exchange's *Rules for Trading by Member Companies.*

2.7.1-Execution of Orders: The Open Outcry and the SCORE

As has been mentioned, the open outcry was the method of trading previously practised by the KLSE. Under this scoreboard system which had been in existence since 1961, trading clerks of the member companies did the trading on the floor of the Exchange's trading room. Bids and offers received by the Exchange's clerks from the trading clerks through voice or hand signals would be entered on the board. Transactions were based on individual auction, with a recognition of preference for time and price. A transaction could only occur when a bid and an offer matched.

Under the currently existing automatic trading system - the SCORE which was developed with the professional and manpower help from the Taiwan Stock Exchange Corporation [see *Investors Digest*, April 1990, p. 38] - the brokers directly key in clients' orders on the SCORE terminals at their offices which in turn are routed to the KLSE's matching room. In this case, the stockbroker concerned is fully responsible for the accuracy of the details of orders entered.

As noted earlier, the SCORE started as a semi-automatic trading system. Under this semi-automated trading system, orders were matched and executed (by the KLSE staff) in the matching room under strict rules and surveillance. However, by November 30, 1992, the matching was fully automated. So, under the currently existing trading system, there is no more human intervention in the matching process.

As soon as an order is matched, the stockbroking company concerned will get the information which is relayed to the broking company's office via a matched information order printer located at the broking company's office. Details of the

information would include the quantity matched, the price and the identity of the selling/buying broker.

2.7.2-Settling and Clearing: The SCANS and the FDSS

The Securities Clearing Automated Network Services Sdn. Berhad or the SCANS, a subsidiary of the KLSE established in 1984, is the clearing house for the KLSE. It effects the settlement of all business done through the SCORE. In other words, all matters relating to the delivery and settlement of trades and scrips come under the purview of the SCANS. As a clearing house, the SCANS is also responsible for settling payments and claims between clearing members.

However, only domestic contracts of all securities listed by the KLSE are cleared by the SCANS. It does not provide clearing facilities for cross-border trades.

Under the 'daily netting system' the amount to be settled daily between the SCANS and each clearing member is the difference between the values of scrips delivered to the SCANS and collected from the SCANS by the clearing members. To selling members, the SCANS will have to issue cheques, and on the other hand, buying members will have to issue cheques in favour of the SCANS and credit its account at the clearing bank.

The SCANS maintains clearing accounts with Malayan Banking Berhad (MBB) and all clearing members have to open an account with the MBB. At the end of each trading day, the MBB produces its daily statement of all clearing accounts for the SCANS. From this statement, the SCANS can detect any default clearing members and thus, appropriate action can be taken against them.

Transactions on the KLSE can be classified into three types of bargains:

immediate or *prompt contract*, *ready contract* or *ready bargain* and *settlement contract* or *time bargain*. However, the bulk of trading is on a ready basis [see e.g., van Agtmael (1984)].

Ready contract requires delivery of scrips and transfer documents between three to seven market days after the day of contract. For immediate contract on the other hand, delivery would have to be done no later than 3.00 p.m. on the first market day following the day of contract. A transaction on a settlement or time basis, can be settled within a month; i.e., it requires delivery after four week following the day of contract.

The present settlement system known as FDSS (Fixed Delivery Settlement System) which was introduced in 1990, determines the exact dates for the delivery of share certificates and settlement (as opposed to the previous system where dates were not fixed). The dates of delivery and settlement are all based on a specific number of market days from the date of transaction or contract, usually denoted as T day.

For a contract on a ready basis, under the FDSS, a selling client must deliver share certificates to his or her broker by 12.30 p.m. on the fourth market day after the date of the trade (i.e., T+4), while the selling broker must deliver the certificates to the SCANS on the fifth market day after the transaction (T+5). The SCANS then will have to deliver the scrips to the buying broker on the sixth market day (T+6).

In the event that the selling broker is unable to deliver the scrips to the SCANS by 4.00 p.m. on day T+5 (because the selling client fails to deliver the scrips to the selling broker on the due date), the KLSE will institute automatic *buying-in*[14](i.e., it will repurchase the shares) against the broker concerned, on the market

[14]See the *KLSE Rules for Trading by Member Companies (Rule 8, p. 108)*

day following the due date to the SCANS. Further, by 12.30 p.m. on day T+7 the buying broker is required to deliver the scrips to the buying client.

In the process of settlement, payment to the selling client must be made by the selling broker on the sixth market day following the transaction day (T+6), latest by 4.00 p.m. The SCANS in turn, is required to make payment to the net selling broker by 11.30 a.m. on day T+6. Similarly, the net buying broker is responsible to pay the SCANS by 11.30 a.m. on day T+6.

Buying clients are given any time up to 12.30 p.m. on day T+7, to pay for their scrips. In case, by the due date, there is a buying client who still does not make payment to his broker, then the broker is entitled to institute the *selling-out* on day T+8. The broker concerned may, at any time thereafter sue such a client for the difference and all losses and expenses that resulted from the *selling-out*.

The KLSE has imposed its settlement terms rigorously. With the surge in the volume of transactions since early 1991, the KLSE has decided to apply its *buying-in* rules strictly. A hefty *buying-in* price is fixed: 10 bids higher than the last-done prices. A further five bids will be added to the 10 bids, for shares not attained on the first day.

Buying-in takes place every market day at 9.30 a.m. and 2.30 p.m.

2.7.3-Types of Transaction

There are two types of trading commonly practised by investors trading on the KLSE. They are, the cash transaction and the margin transaction.

Cash transactions refer to trades in which the financing of the purchase of shares is entirely borne by the buyer. Settlement for cash transactions must be made

within the time period as specified in the settlement rules of the Exchange (see Section 2.7.2).

With the margin transaction, a buyer is required to place certain acceptable forms of collateral when buying securities. The sum of collateral and securities bought must not be less than 150% of his or her outstanding balance.

Under the Securities Industry Act 1983, short selling is forbidden, except under certain circumstances. In the event that a short sale was made, under the allowed circumstances, the documents evidencing the sale must be endorsed with a statement to this effect.

2.7.4-Types of Orders

As noted in the KLSE's (PP6 6812/93) *Investing In the Stock Market in Malaysia* (p. H2), the types of orders most frequently used by the KLSE investors are *limit orders* and *market orders*. Limit order is defined as an order which is to be executed at a price entered into the system, or better. A market order on the other hand, refers to an order which is to be executed at the matching price.

2.7.5-Trading Lot

The minimum unit of trading known as 'board lot', is usually 1,000 shares. In other words, every bid and offer should represent a minimum of one board lot (or also known as even lot). Marketable parcels or board lots for a stock with a market price of RM10.00 or less comprise 1,000 units of shares. If the market price of a stock is above RM10.00, a board lot may comprise 100 shares , 500 shares or 1,000 shares.

Quotations on stocks of less than board lot may be put on the Special Lots

Board or transacted by private negotiation.

2.7.6-Transaction Costs

For transactions on Malaysian equities, both buyers and sellers are charged brokerage commissions[15] . These commission charges are fixed by the KLSE and they are not open for negotiation [see Seaward (1993)].

Transaction costs involved in investing on the KLSE, as specified in the KLSE's *Fact Sheet*, January 1995, are as follows:

(i) **Brokerage rates:** For shares priced at less than MR0.50, the commission is fixed at MR0.05 per share. For shares priced between MR0.50 and MR0.99, the commission is raised to MR0.1 for ready contracts and MR0.15 for other contracts.

If shares are traded at MR1 and above, the commission is 1% of the value, for ready contracts, and 1.5% for other contracts. Commissions for shares quoted in foreign currencies are fixed at 1% of the value if they are transacted under ready contracts and 1.5% for other contracts.

(ii) **Clearing fees:** Each party to the transaction is also required to pay a clearing fee of 0.05% of transacted value. For the issuance of share certificates, payment to the company registrar must be made at the rate of MR3.00 per share certificate.

(iii) **Stamp duty:** Share transactions are subject to contract stamp tax as well as transfer stamp. The contract stamp tax for both purchases and sales is fixed at RM1.50 for MR1,000 or fractional part of value of securities. The transfer stamp

[15]For details, see the *KLSE Rules for Trading by Member Companies* (Rule 6, pp. 105 - 107b). See also the KLSE *Fact Sheet*, January 1994.

which is MR3.00 per MR1,000 or MR0.30 per MR100 value of securities, on the other hand, is payable by the buyer if he or she wants to register.

(iv) **Taxation:** In Malaysia, interest and dividend income on corporate securities are subject to income tax. However, there is no tax on capital gains.

2.7.7-Policy and Regulation Regarding Stock Price Fluctuations

Under the open outcry trading system, there had been no specific regulation for controlling fluctuations in share prices. However, as a matter of policy and practice, when there was a move in the price or volume of a particular company's shares by a substantial percentage within a day or a week, the Exchange would normally query the company concerned.

Under the present, computerised system - the SCORE - there is a limit imposed on the highest and the lowest price that a stock can be traded for each trading session of the day. At present, share prices must be confined within a range of ±30% relative to the closing price of the previous trading session[16]

2.8-The Main Board and the Second Board

Shares traded on the KLSE are listed on two boards: the Main Board and the Second Board. The Main Board is for shares from big companies, whereas the Second Board is meant for companies which are smaller in size and younger in age.

The launching of the Second Board in 1988, coincided with the raising of the

[16]See the KLSE, *Investing in the Stock Market in Malaysia*, PP 6812/93 p. H2.

minimum paid-up capital required for companies seeking a listing, from RM5 million to RM20 million. As a result of this increment, without the existence of the Second Board, smaller companies (with a paid-up capital of less than RM20 million) would be disqualified from taping additional capital in the capital market through a listing on the KLSE. Therefore, the establishment of the Second Board, provides access for such small companies to equity financing.

Listing requirements for the Second Board are essentially the same as the Main Board's[17]. The Second Board companies still have to comply with all corporate disclosure rules as those of the Main Board companies. However, they are given certain concessions in addition to the lower paid-up capital requirement. The prelisting requirement for these smaller companies is a profit track record of only two-to-three years, compared with the Main Board requirement of five years unbroken profitability. Another concession given to the Second Board companies is that they are not required to print full prospectuses as advertisements in two local newspapers prior to the public offer: they need only to print summaries of their prospectuses [see e.g., Seaward (1993)].

2.9-Share Price Indices: the KLSEMAS and the KLSECOMP

The general movement of the stock market is usually measured by a stock

[17]For the details of listing requirements for both the Main Board and the Second Board, see the KLSE, *Investing in the Stock in Malaysia*, PP 6812/2/93, pp. J1 - J2. See also *New Straits Times*, September 27, 1990

market average or index consisting of a group of securities that is supposed to reflect the entire market [Amling (1984)]. In general, a share price index is a yardstick that measures the changes in the market value of shares which make up a stock market over time. Thus, a well-formulated share price index or stock market index can be used as an indicator of the performance of the underlying economy, and as a useful summary measure of the current expectations of future economic (and political) outlook.

In Malaysia, there are several share price indices available for investors and market observers to gauge the performance of the KLSE. Beside the KLSE itself, *New Straits Tines* and *Business Times* also have their own set of share price indices.

Since 1973, the KLSE has been computing sectoral indices - the Industrial, Finance, Property, Plantation and Tin indices - for its listed shares.This was followed in 1996, with the introduction of a single broad-based index known as the KLSE Composite Index (KLSECOMP). To assist investors and fund managers in evaluating the performance of the Second Board, an all-share index for the Second Board was launched in January 1991. To complement this move, in October 1991, the Exchange's Main Board All-Share (EMAS) Index was launched.

Lastly, as mentioned earlier, when the KLSE Main Board was revamped in September 1993, four new sectoral indices, namely, Consumer Products, Industrial Products, Construction and Trading/Services were launched. Thus, to date, there are 12 share price indices available from the KLSE. In order to provide an 'updated' indication of the market's performance during a trading session, beginning from January 1990, all of these indices were calculated by the Exchange every 15

minutes[18].

However, as reported in the *New Straits Times* (April 11, 1995), effective from April 18, 1995, the KLSE indices are computed on a minute-by-minute basis, "in line with the local bourse's objective to increase the transparency of the market and give investors more timely information". These indices, are made available to stockbroking firms immediately through their MASA terminals.

Among the various share price indices mentioned above, the KLSE Composite Index (KLSECOMP) and the EMAS Index (KLSEMAS) seem to be the most widely followed and used.

The KLSECOMP which was formulated by a special committee comprising representatives from various agencies, has the following objectives [see the *KLSE Composite Index* (1986), p. i]:

(i) to effectively reflect the performance of shares listed on the KLSE;

(ii) to be sensitive to investors' expectations;

(iii) to be indicative of Government policy changes;

(iv) to be responsive to underlying changes in the economy.

To ensure that the Index meet the aforementioned objectives, stringent criteria were used in the selection of the KLSECOMP components. The following are among the criteria used in the selection of the stocks to be included as the KLSECOMP components [see the *KLSE Composite Index* (1986), p. ii]:

(i) the company selected must have its major business in Malaysia;

(ii) the stock must be actively traded in the KLSE;

(iii) to avoid multiple counting, both parent and subsidiary companies are not

[18]Previously, the indices were calculated twice daily.

included together in the component stock.

The KLSECOMP is calculated by the weighted average method, using the number of shares outstanding (i.e., aggregate market value) as weight. Each component stock price is weighted by the number of the ordinary shares listed, to reflect its relative market importance. The base year for the calculation of the Index is 1977. As reported in the *New Straits Times* (April 11, 1995), effective from April 18, 1995, the number of component stocks in the KLSECOMP was increased to 100 (from the previous 86).

On October 16, 1991, as previously mentioned, the KLSE announced the creation of a new index known as the EMAS Index (KLSEMAS). It is the second Main Board all-share index for the Exchange; the first being the *Business Times'* (BT) Ordinary Index launched in 1990. 'EMAS'[19] Index is actually the acronym for the KLSE Main Board All-Share Index

Similar to other KLSE indices, the EMAS Index is calculated by the weighted average method, using the number of shares outstanding (or aggregate market value) as the weight. The base year used for the calculation of the Index is 1984.

Like other KLSE indices also, the KLSEMAS is calculated electronically every minute, and is displayed on the MASA terminal. The opening and closing indices for the day are computed at 10.00 a.m. and 4.00 p.m. respectively.

As an index that comprises all shares listed on the Main Board, the KLSEMAS essentially reflects the performance of the entire Main Board of the KLSE. Then, this should prove to be very useful for fund managers and individual investors alike, since it could provide a more accurate picture of the overall market sentiment, and hence

[19]In Malay, *emas* means *gold.*

the average market activities.

2.10-Growth and Performance of the KLSE

From its modest beginnings as a group comprising only four brokers in 1960, the KLSE has grown and transformed itself into one of the largest and most modern bourses in the developing world [see Table 2.7]. From a simple structure, within some thirty years of its establishment, the Exchange has evolved steadily to reach a reasonable level of maturity and sophistication. In recent years, the Exchange has grown remarkably in size owing not only to the performance of traded equities but also to the process of privatization [see Table 2.6].

Consonant with the dynamic and steady growth of the Malaysian economy [see Table 2.1], since its inception in 1960, the Exchange has recorded impressive achievements and development. Even though borrowings from the banking system still represent an important source of finance in the economy, businessmen and entrepreneurs have increasingly begun to turn towards equity financing as an alternative source for their growth and expansions [see Malaysia, Bank Negara, *Annual Report 1992*, p. 173]. The privatisation of the Government-owned departments/corporations since the late 1989, has added substantial impact on the growth of equity financing and thus the equity market. Nevertheless, the contribution of the stock market in financing private investment in the country was still small: it amounted to only 27% of total private investment in 1992 [see Malaysia, Bank Negara, *Annual Report 1992*, P. 173].

An unforgettable event in the history of the KLSE took place in 1987. Like

Table 2.6
MALAYSIA: MARKET CAPITALISATION OF PRIVATISED COMPANIES
(As At End 1993)

COMPANIES	RM MILLION
1) Tenaga National	58,194.7
2) Telekom	43,884.9
3) MISC	7,263.8
4) Proton	6,152.9
5) Malaysia Airline System (MAS)	5,460.0
6) EON	3,743.2
7) Sports TOTO (Berjaya Leisure)	1,969.7
8) Kedayah Cement	1,482.4
9) CIMA	1,319.2
10) Pernas International Hotel (PIHP)	1,019.0
11) KCT	975.0
12) Tradewinds	854.0
13) TV 3	653.4
14) Cement Manufacturing Sarawak Bhd (CMS)	576.0
15) Far East Holding (FEHB)	375.2
TOTAL	133,923.2
PERCENTAGE (of the KLSE total market capitalisation)	21.6

Source: *Investors Digest*, Mid-January 1994. (adapted)

Table 2.7

TOP THIRTY STOCK MARKETS OF THE WORLD:

Market Capitalisation, Value Traded and Number of Listed Companies, 1993

RANK	MARKET	TOTAL MARKET CAP. (US $m)	RANK	MARKET	TOTAL VALUE TRADED (US $m)	RANK	MARKET	NUMBER OF LISTED DOMESTIC COMPANIES
1	U.S	5,223,768	1	U.S.	3,507,223	1	U.S	7,607
2	Japan	2,999,756	2	Japan	954,341	2	India	6,800
3	U.K.	1,151,646	3	U.K.	423,526	3	Japan	2,155
4	Germany	463,476	4	Taiwan	346,487	4	U.K.	1,646
5	France	456,111	5	Germany	302,985	5	Canada	1,124
6	Hong Kong	385,247	6	Korea	211,710	6	Australia	1,070
7	Canada	326,524	7	France	174,283	7	Korea	693
8	Switzerland	271,713	8	Switzerland	167,880	8	Pakistan	653
9	Malaysia	220,328	9	Malaysia	153,661	9	South Africa	647
10	South Africa	217,110	10	Canada	142,222	10	Israel	558
11	Australia	203,964	11	Hong Kong	131,550	11	Brazil	550
12	Mexico	200,671	12	Thailand	86,934	12	France	472
13	Taiwan	195,198	13	Singapore	81,623	13	Hong Kong	450
14	Netherlands	181,876	14	Australia	67,711	14	Germany	426
15	Korea	139,420	15	Netherlands	67,185	15	Malaysia	410
16	Italy	136,153	16	Italy	65,770	16	Spain	376
17	Singapore	132,742	17	Mexico	62,454	17	Thailand	347
18	Thailand	130,510	18	Brazil	57,409	18	Taiwan	285
19	Spain	119,264	19	Spain	47,156	19	Chile	263
20	Sweden	107,376	20	Sweden	43,593	20	Denmark	257
21	Brazil	99,430	21	China	43,395	21	Netherlands	245
22	India	97,976	22	Israel	30,327	22	Peru	233
23	Belgium	78,067	23	Turkey	23,242	23	Switzerland	215
24	Israel	50,773	24	India	21,879	24	Italy	210
25	Chile	44,622	25	Denmark	20,989	25	Sri Lanka	200
26	Argentina	43,967	26	South Africa	13,049	26	Mexico	190
27	Denmark	41,785	27	Belgium	11,199	27	China	183
28	China	40,567	28	Argentina	10,339	28	Portugal	183
29	Philippines	40,327	29	Indonesia	9,158	29	Argentina	180
30	Turkey	37,496	30	Norway	8,751	30	Philippines	180

Source: *Emerging Markets Factbook 1994*, International Finance Corporation (IFC), Washington, D.C.

other stock exchanges, the KLSE was adversely affected by the global stock market crash of October 1987. While, on Monday, October 19, 1987, the Dow Jones Industrial Index was reported to plummet by 508 points or 23% within the day, in London the Financial Times Stock Exchange Index, closed 11% down and the Tokyo market, on October 20, declined by 12%, the impact of the Crash on the KLSE can be summarised as follows[20]:

♦ Due to heavy selling pressure, during the week following the Crash, the KLSE Composite Index fell by about 25%.

♦ During the period between October 19 to October 28, 1987, the KLSE Composite Index fell by 173 points or 42%.

♦ To prevent short selling, on October 20, 1987, the Exchange had to place trading on an immediate delivery basis.

♦ The market deteriorated further in November, though it started to revive moderately in late December 1987.

♦ At the end of 1987, the KLSE Composite Index was reported to close at 261 points, which was 44.4% lower than the peak for the whole of 1987 (recorded on August 10, 1987).

♦ Market capitalisation of the Exchange was reduced to RM70.9 billion on October 28, 1987, from RM110.8 billion on October 15, 1987 - a loss of 36%.

There were two other international events in the 1990s which had affected the Exchange quite significantly [see Malaysia, Ministry of Finance, *Economic Report* 1992/93, p. 265; see also O'Connor and Smith (1991), p. 285]:

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[20]See Malaysia, Ministry of Finance, *Economic Report 1988/89*, p. 143; *Economic Report 1992/93*, p. 261.

(i) The Gulf Crisis (Kuwait Invasion/Desert Storm Operation) which started in August 1990, was accompanied by reduced trading on the Exchange [For comparison, see *The Economist*, January 19, 1991, p. 91]. The Gulf War caused the KLSE Composite Index to decline to 505.9 points at the end of 1990, a drop of 20% from the highest level of the year (i.e., 632.22 points recorded on August 1, 1990). For comparison, the KLSE Composite Index stood at 562 points at the end of 1989.

(ii) Following the outbreak of brokerage scandal in Tokyo and weak overseas bourses, prices on the KLSE weakened towards mid-1991 but then recovered moderately towards the end of 1991.

From Table 2.5 [see also Table 2.4], we find that the volume of trading has increased remarkably since the 1989. Even though the Gulf War had affected the trading on the Exchange considerably, the volume of trading in general continued to rise steadily. This rise, according to O'Connor and Smith (1991), p. 285] was encouraged by the following factors:

- the delisting of Malaysian incorporated companies from the SES;
- the full conversion of trading to the computerised SCORE system;
- the robust economic fundamentals;
- a steady inflow of funds from overseas;
- the good performance of companies and fairly lively corporate activity.

Today, in terms of market capitalisation, the KLSE has emerged as the largest stock exchange in South-east Asia [see Table 2.7]. In Asia, it was ranked fourth (in 1993) after Tokyo, Osaka and Hong Kong [see Malaysia, Bank Negara, *Annual Report 1993*, p. 194]. In terms of price performance in 1992, the KLSE was one of the best ten stock markets of the world [see IFC, *Emerging Stock Markets Factbook 1993*, p.

9].

Market capitalisation of the KLSE, which amounted to only RM8 billion or 35% of the GNP at the end of 1974, expanded by 763% to RM69 billion at the end of 1984 and further to RM246 billion or 176% of the GNP in 1992. The figure at the end of 1993 was recorded to reach RM620 billion or four times the size of the nation's GNP. Put differently, in 1993, the market capitalisation of the KLSE increased by 152% over the figure of the previous year, and this outstanding growth placed the Exchange among the 15 largest stock markets in the world[21].

The profile of the Malaysian stock market was further enhanced when, beginning May 1, 1993, a leading United States fund manager, Morgan Stanley, incorporated 68 selected Malaysian stocks into its widely followed indices: the EAFE (the Europe, Australia-Asia and the Far East) Index and the World Index [see e.g., *Investors Digest*, May 1993, p. 47]. The KLSE was the only emerging market to be included in both the World Index and the EAFE Index[22].

Overall, the number of companies listed on the KLSE has also grown rapidly [see Table 2.3]. At the end of 1961, there were only 138 companies listed on the Exchange with a nominal paid up capital of RM708 million. The figure rose to 262 in 1973 and further to 369 in 1992. At the end of 1993, the number of companies listed on the KLSE was 413 (with a total nominal value of RM61.6 billion) - an increase of 12% over the figure of the previous year[23]

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[21]See Malaysia, Bank Negara, *Annual Report 1993*, p. 194; see also Table A2.7.

[22]See Malaysia, Bank Negara (1994); see also Malaysia, Ministry of Finance, *Economic Report 1993/94*, p. 230.

[23]See the KLSE, *Investing in the Stock Market in Malaysia*, pp 6812/2/93.

To sum up, the KLSE's history of over thirty years has witnessed the Government's commitment and role in introducing and effecting various regulatory, legislative as well as institutional changes and reforms with the objectives of moulding, promoting and developing the Exchange into an orderly, well-organised, more efficient and strong bourse. Complimentary to the Government's 'catalytic role', various improvements and advances have been and being introduced and accomplished by KLSE authority itself with the objective of strengthening and modernising the Exchange to enhance its professional and international image and to instil greater confidence to enable it to compete with other bourses in the region. In addition, the robustness of the country's economy, strong corporate results, price and political stability, ample liquidity in the economy as well as the presence of a reasonable level of speculative activities [see Malaysia, Bank Negara *Annual Report 1993*, pp. 192 & 193], was the combination of factors that continued to attract investors into the Exchange and paved the way for the KLSE to chart a remarkable growth and outstanding performance.

2.11-The KLSE and Other Exchanges: A Brief Comparison

In the previous sections we have examined several aspects of the KLSE as an individual exchange. The purpose of this section is to take a glance at the KLSE from the comparative perspective.

As an emerging equity market which was established just in 1960, the KLSE

is very young and far from being mature compared to the well-established exchanges of the world such as the London Stock Exchange which was named 'the Stock Exchange' in 1773 [see London Stock Exchange, *Fact Book 1994*, p. 10], the New York stock Exchange which celebrated its bicentennial in 1992 [*Euromoney*, May 1993, p. 108], and the Tokyo Stock Exchange which was established in 1878 [see George (1991), p. 30].

Even though the KLSE is relatively a very young and less complicated market, in some aspects it is a more advanced and successful exchange compared to some developed bourses. For example, in coping with the advancements in modern technology, the KLSE has successfully implemented its electronic trading system, whereas the London Stock Exchange (LSE) has to incur a loss of many millions of pounds with the failure of its ambitious Taurus Project and has to start with a new project - the Crest Project [see e.g., *The Times*, March 12, 1993; *The Economist*, April 2nd., 1994, p. 85; June 12th., 1993, P.118].

Being an emerging market, no doubt, the KLSE is a relatively thinly traded exchange. In terms of market capitalisation, the number of listed companies and the volume of trading, the KLSE is a very small exchange compared to, for example [see Table 2.7], the New York Stock Exchange which is the largest stock exchange in the world [*Euromoney*, May 1993, p. 108], the London Stock Exchange which is the third[24] largest exchange in the world [*Euromoney*, May 1993, p. 57] and the Tokyo Stock Exchange which ranks third as the world's most active stock exchange[25]

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[24]As shown in Table A2.7, the Tokyo Stock Exchange is in the second place after the New York Stock Exchange.

[25]The New York Stock Exchange is the world's most active stock exchange, followed by the NASDAQ (National Association of Securities Dealers Automated Quotations) exchange, which is also in New York.

[*Euromoney*, May 1993, p. 78].

The KLSE's shares are relatively quite expensive. According to the FIC calculations[26], the price-earnings (P/E) ratio for Malaysian shares at the end of 1992 was 21.84 (an increase by 2.29% from the ratio for 1991) compared with the ratio for the United States and the United Kingdom which was 22.70 and 19.70 respectively. While the ratio for Japan was the highest in 1992 (i.e., 38.90), the P/E ratio for South Korea, Taiwan and Thailand was respectively 21.43, 16.57 and 13.93.

Euromoney (December 1993, pp. 68 - 70) has made an attempt to measure and compare the 'maturity' and 'efficiency' of emerging equity markets worldwide. The 'study' involves two approaches or stages:-

- 'Objective approach': Under this approach, emerging equity markets are compared using the following 'objective criteria':

(a) Market size:

(i) market capitalisation;

(ii) number of listed stocks.

(b) Liquidity:

(i) value traded;

(ii) ratio of value traded to market capitalisation;

(iii) weekly trading hours.

(c) Concentration:

(i) percentage of market capitalisation of ten largest stocks;

(ii) percentage of value traded of ten largest stocks.

(d) Transaction costs which include brokerage commissions, stamp duty,

[26]See IFC (1993), *Emerging Markets Factbook 1993*.

stock exchange registration or handling fees and taxes such as VAT.

(e) Settlement:

(i) settlement period;

(ii) degree of automation.

(f) Hedgeability (measured by the availability of derivatives).

(g) Openness:

(i) degree of openness;

(ii) withholding tax (%);

(iii) capital gains tax;

(iv) repatriation controls.

The aforementioned criteria are used to measure the level of 'maturity' and 'efficiency' of emerging equity markets in fifty countries. Among these markets, with a total score of 158.89, Malaysia is in the third place after Taiwan (164.14) and Korea (161.52).

- 'Subjective approach': By polling institutional investors and equity researchers, asking them to give their opinion on countries of which they have experience. Under this method, the scores are listed under the following headings:

(a) quality of accounting/legal infrastructure;

(b) reliability of settlement;

(c) liquidity;

(d) prevalence of insider-trading;

(e) international brokers;

(f) domestic brokers;

(g) quality of research.

For this 'subjective approach' thirty eight emerging equity markets are compared. The total poll score obtained by Malaysia is 53.03, ranking it second after Mexico which obtained 57.06.

Clearly, from both of these 'objective' and 'subjective' approaches, the scores secured by Malaysia are among the highest. Thus, these results indicate that among emerging equity markets, the KLSE is one of the most 'mature' and 'efficient' exchanges.

2.12-A World-Class Stock Exchange?

The KLSE is a very ambitious stock exchange [see e.g., Lin (1993); Salleh Majid (1994)]. The authority of the Exchange has made no secret of its vision and aspiration to develop the KLSE into a world-class stock exchange for investors: "The KLSE is committed to becoming a world-class stock exchange, offering unique investment opportunities in a fast developing capital market within the industrialising Malaysian economy". In trying to transform this aspiration into a reality and to forge the KLSE ahead of its rival bourses especially within the region, the following are among the targets that have been set [see The KLSE, *World-Class Exchange for Investors*; see also Lin (1993)]:

★ To have a trading and settlement infrastructure, information system, skilled resources, accessibility, and a fair and orderly market place that ranks with the best in the world.

★ To offer a wide range of diverse and exclusive quality stocks, coupled with a growing number of market instruments, making the Exchange attractive for both

domestic and foreign investors.

Consonant with its aim of transforming the Exchange into a world-class stock market, to strengthen investors confidence and to upgrade the trading infrastructure, the KLSE was reported to have implemented a number of projects in the past few years [see Malaysia, Ministry of Finance, *Economic Report 1994/95*, p. 205]:

a) The setting up of the Exchange's Dealing Facility (EDF) site, that is, an on-site full disaster back-up system within the KLSE premises and the building of an off-site disaster computer recovery centre in Petaling Jaya. The purpose of both projects is the creation of a 100% disaster recovery environment to prevent any disruption of the operations of the Exchange. The EDF site became operational in March 1994.

b) A new information technology system known as the WinScore or Broker Front End (BFE) System for stockbroking companies. With the BFE, trading, monitoring real-time market information (MASA II) and checking order status will be integrated within one single terminal. This BFE project is initiated to facilitate more efficient and secure trading operations, to cope with the tremendous increase in the volume of transactions. The BFE began operations on a pilot basis at three stockbroking firms in June 1994.

c) The introduction of an electronic surveillance system, also by mid-1994. The purpose of this project is to enhance the market surveillance of the stockbroking and public listed companies, to replace the present AWAS (Advanced Warning and Surveillance) system which is operated manually.

Lastly, given the rapid growth and development of the Malaysian economy[27]

[27]As reported in *Fortune*, October 30, 1995, the World Bank forecasts that for the next decade, Asia's developing econimies will be growing 8% ayear, on average - roughly three times the pace of gross domestic oproduct (GDP) growth in the U.S., Europe and Japan [see also Morgan (1993/94)]. Malaysia is

in an environment of the present trend of capital market globalisation, the question at this juncture is, when might the KLSE's vision become a reality?

2.13-Conclusion

Based on the facts and figures that we have already examined, it is clear that the KLSE is a fast growing exchange. Within about thirty years of its existence, the Exchange has undergone various stages and levels of changes, transformations and advances to attain its present stature (as an emerging market). In this successful context we have also seen that the Exchange has improved its level of operational efficiency considerably. It would be reasonable to suppose that the KLSE has improved its level of efficiency in pricing shares as well, but this is an empirical question. If the KLSE is price/informationally efficient, then we might expect prices of shares traded on this emerging stock exchange to behave similarly to the prices of those traded in the so-called developed stock exchanges.

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considered as one of the world's fastest growing economies. See e.g. *World Link* (September/October 1992), p. 77), *Fortune* (June 27, 1994), p. 87); *Far Eastern Economic Review*, (June 23, 1994), p. 1); *BusinessWeek* (July 10, 1995, p. 82).

CHAPTER THREE

EFFICIENCY OF THE STOCK MARKETS

A Review of Theory and Empirical Evidence

3.1-Introduction

The concept of market efficiency is the foundation for much of the theoretical and empirical research in financial economics. The proposition that capital markets are efficient - a proposition that has come to be known as the Efficient Market Hypothesis (EMH) - is a concept which, according to Jensen (1978), progressed from the state of curiosity taken seriously by only a few scientists in the economics and finance communities, to that of a dominant paradigm in finance and the basis of an emerging revolution in macroeconomics (where the principle is generally known as *rational expectations*).

The proposition that capital markets are efficient - an important doctrine which was reborn in the late 1950s and early 1960s under the rubric of the 'theory of random walks' in the finance literature and 'rational expectations theory' in the mainstream economics literature [Jensen (1978), p. 96] - is likely to continue (at least for some time) becoming one of the most rooted beliefs in economics and finance. Indeed, market efficiency was the first area of finance that matured into a science [Ross (1989), p. 1].

'Efficiency' is a term which has many connotations. More precisely, in economics and finance, 'efficiency' is a crucial concept which has a variety of related but distinct meanings. As far as stock markets are concerned, there are three concepts of efficiency that can be found widely discussed in the literature; namely, *informational* or *pricing (external) efficiency*, *operational (internal) efficiency* and *allocational efficiency*[1]. Since the concern of the present study is with the behaviour of share prices, our focus will only be on price efficiency. Accordingly, throughout the thesis, the phrase 'efficient market' or 'efficient stock market' is used to refer to *price efficiency* or *informational efficiency* (unless stated otherwise).

A capital market is said to be informationally efficient if it utilizes all of the available information in setting the prices of assets [Ross (1989), p. 2]. A market is said to be efficient with respect to some information set, if asset prices would be unaffected by revealing that information to all participants [Malkiel (1989), p. 127]. In Fama's (1976a) words, in an informationally efficient market, "the market correctly uses all available information" in determining security prices.

In an efficient market, information flows swiftly throughout the market and investors react immediately. Their decisions to buy or to sell securities drive the price

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[1]West (1975) distinguished market efficiency into two types: *informational* (or *outside*) *efficiency* and *operational* (or *inside*) *efficiency*. Whereas outside efficiency refers to the performance of a market as an information processor and a price setter, inside efficiency refers to the performance of a market as an exchange system [see Hawawini (1988).

Tinic and West (1979, p. 92) define an *operationally efficient market* as one in which buyers and sellers can purchase transactions services at prices that are as low as possible, given the costs associated with having these services provided. So, lower the transactions costs are, the more operationally efficient a market can be.

A market on the other hand, is said to be *allocationally efficient*, as defined by Copeland and Weston (1988, p. 330), when prices are determined in a way that equates the marginal rates of return (adjusted for risk) for producers and savers. Thus, in an allocationally efficient market, scarce savings are optimally allocated to productive uses in a way that benefits everyone.

quickly to the fundamental values - the 'true prices'. In such a market, securities are priced so quickly and fairly that investors, on average, cannot expect to earn abnormal profits. With prices reflecting forecasts of expected benefits from owning future cash flows discounted at appropriate discount rates, the net present value of expected returns in an efficient market would be zero [see e.g., Franks *et.al.* (1985)]. Investing in an efficient market can then be viewed as a 'fair game' since all participants have an equal opportunity for gains [see Fama (1970); Tinic and West (1979)].

In contrast, if information disseminates rather slowly throughout the market, and if investors take time in analyzing the information and reacting, and possibly overreacting to it, prices may deviate from values based on careful analysis of all relevant information; then such a market could be characterised as being relatively inefficient [see Haugen (1990)]. If a market were *inefficient* in its response to new information, the delay in discounting through price adjustments, would present investors with opportunities to profit from such relevant information. Then, in a market of this nature, diligent investors could possibly garner abnormal profits by practising active investment strategies (as opposed to passive investment strategies often advocated by proponents of the EMH).

In a nutshell, market efficiency, as pointed out by Beaver (1981), can be viewed as a property of an equilibrium mechanism or process by which security prices are formed. Having said this, understanding the issue of market efficiency - an issue which has long been perceived as the cornerstone of modern finance theory [Keane (1991)] - is crucial for investors in visualizing the general behaviour of security prices so that appropriate approaches could be employed in making investment decisions. As stressed by Boldt and Arbit (1984), each investor's beliefs regarding market efficiency

are implicit in his investment philosophy, decision-making process and perhaps, most fundamentally, in his assessment of his unique competitive skills and how best to exploit those skills.

"Since market efficiency and equilibrium-pricing issues are inseparable" [Fama (1991)], this chapter attempts to provide a discussion on stock market efficiency in some detail: the concept and the evidence. In substance, some theory and empirical results regarding the way in which security prices tend to behave over time are reviewed. Our discussion here is also addressed to the theoretical and practical meaning and implications of the EMH and its evidence, for investors. The chapter thus serves as a stepping stone for our further investigation into the behaviour of share prices in the chapters that follow.

The present chapter is divided into seven sections. We begin, in Section 3.2, with a brief historical perspective of the development of the efficient market doctrine: examining the early ideas concerning the process of price formation that preceded the birth of the EMH. A discussion on the formal presentation of the EMH can be found in Section 3.3.

It is common in the literature that the informational efficiency of a stock market is distinguished into three levels or forms. A review of theory and evidence on these three forms of the EMH is provided in Section 3.4.

While most evidence supporting the EMH are drawn from various studies based on the highly developed and well-established exchanges, in Section 3.5 we provide a review on a number of studies investigating the validity of the EMH when applied to the small, less-developed and less-active markets.

Perhaps no other hypothesis in either finance or economics has been studied

and tested more extensively than the EMH. Consequently, it is not surprising if, along with the predominance of evidence that supports the EMH, there have been scattered findings that contradict the hypothesis. We examine this so-called anomalous evidence in Section 3.6 before we conclude the chapter in Section 3.7.

3.2-Early Ideas: The Random Walk and the Fair Game

In an efficient market, prices adjust rapidly to new relevant information. Since the flow of information into the market appears to be random [see e.g. Smidt (1968)] - unpredictable by definition - the period-to-period changes in securities prices are believed to be random or statistically independent of one another. Since security prices are "typically very sensitive, responsive to all events, both real and imagined" [Cootner (1964, p. 1)], random events are likely to affect those prices positively and negatively. Movements in share prices under such conditions, describe what statisticians call a *random walk*[2] and physicists call *Brownian motion*[3]. "A Brownian walk, like the walk of a drunken sailor, wanders indefinitely far, lifting the with wind" [Samuelson (1965), p. 785].

[2]It is believed that the term "random walk" was first used by Karl Pearson in a 1905 issue of *Nature* Magazine to describe the path of a drunk left to wander on an open field [see Blume and Siegel (1992). According to Schwartz (1991b), a random walk in stock price is not caused by the pattern of information arrival, but rather by investor responses to information.

[3]In his article published in 1959, Osborne (1959) compared changes in stock prices with the random movement of microscopic particles suspended in a solution, known to physicists as *Brownian motion*. *Brownian motion* is named after the Scottish botanist who first identified the phenomenon in the nineteenth century, from his observation of the movement of pollen grains in water [see Griffiths (1990)].

Share prices are said to follow a random walk when their changes are independent of each other. There are no clear trends or patterns in their movements - much the way molecules move in a solution (Brownian motion).

The idea that security prices in an organised market might follow a random walk was first put forward by Louis Bachelier, a French mathematician, in his doctoral thesis, *Théorie de le Spéculation*, in 1900. Although the mathematical properties of the random walk were rediscovered five years later by Albert Einstein, the importance of Bachelier's work had been little noticed by economists. Bachelier's work was virtually ignored by economists for over half a century [Granger and Morgenstern (1970)].

While the earliest empirical work on 'random walk theory' was performed by Bachelier (1900), in the finance literature, major interest in the theory primarily started with the papers by Kendall (1953), Roberts (1959) and Osborne (1959). Osborne (1959) who reintroduced the random walk model [Granger (1968)] for example, found that stock price movements were very similar to the random Brownian motion of physical particles - that the logarithms of price changes were independent of each other.

Subsequently, Samuelson (1965) and Mandelbrot (1966) pioneered the *fair game* approach to the theory of price formation and market efficiency. They proved that, in a speculative market where there are no transaction costs, where information is freely available to all market participants and where all investors share the same expectations over a common time period, prices would change instantaneously to reflect new information.

Fama (1970) argues that the random walk model can be viewed as an extension of the general expected return or 'fair game' model. The EMH is basically an

elaboration of the fair game or "fair market" hypothesis [see Boldt and Arbit (1984)]. Moreover, from the theory of stochastic processes, the process and principle of random walk implies a *martingale* [see e.g., Rubinstein (1975)]. Correspondingly, in the literature of time series behaviour of stock market prices, three types of related models can be identified; namely, *the fair game model, the martingale* and *submartingale models* and *the random walk model:*

a) <u>The Fair Game Model</u>

The fair game concept of market efficiency states that, a market is efficient if there is no trading strategy that yields a consistent abnormal return [Dyckman and Morse (1986)]. This model which is based only on the behaviour of average returns (rather than the entire probability distribution of returns) can mathematically be expressed as follows [see Copeland and Weston (1988, p. 346)]:

$$X_{j,t+1} = \frac{P_{j,t+1} - P_{jt}}{P_{jt}} - \frac{E(P_{j,t+1}|\Phi_t) - P_{jt}}{P_{jt}}$$

$$= \frac{P_{j,t+1} - E(P_{j,t+1}|\Phi_t)}{P_{jt}} \qquad (3.1)$$

where

P_{jt} = the actual price of security j at time t;

$P_{j,t+1}$ = the actual price of security j at time t+1;

$E(P_{j,t+1}|\Phi_t)$ = the expected price of security j at time t+1, given the current information set, Φ_t;

$X_{j,t+1}$ = the difference between the actual and expected (or theoretical) returns. In other words, this is the return at time t+1 in excess of the equilibrium expected price projected at time t.

The one-period return on security j at time t+1 is defined as

$$R_{j,t+1} = \frac{P_{j,t+1} - P_{jt}}{P_{jt}} \tag{3.2}$$

Then, equation (3.1) may be rewritten as

$$X_{j,t=1} = R_{j,t+1} - E(R_{j,t+1}|\Phi_t) \tag{3.3}$$

In an efficient market, the information set, Φ_t, is fully utilized by the market in forming the equilibrium expected returns. In an efficient market, where price at any point in time represents the best estimate of a security's 'intrinsic value' (or equilibrium price), the expected difference between the realized return and the expected return will be zero [Tinic and West (1979), p. 95]. In equation (3.3), $X_{j,t+1}$ is the excess return on security *j* when the *ex-post* return, R, exceeds the *ex-ante* return E(R). Since in a fair game this is zero by definition, equation (3.3) may be rewritten as

$$E(X_{j,t+1}) = E[R_{j,t+1} - E(R_{j,t+1}|\Phi_t)] = 0 \tag{3.4}$$

A fair game model of price formation implies that the market provides equal opportunity for all investors. On average, and across a large number of samples, the

expected return on a security equals its actual return [Copeland and Weston (1988), p. 347]. Therefore, in an efficient market, investing is a fair game in the sense that no investor possessing today's information has an advantage over any other investor. Nobody can beat the market consistently if the market is a fair game.

b) <u>The Martingale and Submartingale Models</u>

If a price series follow a martingale, the expected value of future prices is the most recently observed price [Pinches (1970)]. A martingale model states that, given information set Φ_t, the next period's price is expected to be the same as today's price. Notationally,

$$E(P_{j,t+1}|\Phi_t) = P_{jt} \tag{3.5}$$

A martingale, which is a fair game, is based on the assumption that expected returns and price changes are equal to zero. Thus, in returns form, equation (3.2) can be rewritten as follows:

$$\frac{E(P_{j,t+1}|\Phi_t) - P_{jt}}{P_{jt}} = E(R_{j,t+1}|\Phi_t) = 0 \tag{3.6}$$

A *submartingale* is a version of the martingale model which is modified to deal with either or both of the following [Frankfurter and Lamoureux (1988), p. 386]:

(i) the fact that stocks are risky assets and investors are risk averse; and

(ii) the notion of time preference or the time value of money, in a risk neutral environment.

A sequence of prices is said to follow a stochastic process known as a *submartingale* when the expected value of price in one period is equal or greater than the price in the previous period [see Tinic and West (1979)]. Stated differently, in a submartingale (which is also a fair game) the expected value of the variable is at least its most recent realization: tomorrow's price is expected to be greater or equal to today's price. Mathematically, a submartingale is defined by the following relationship:

$$E(P_{j,t+1}|\Phi_t) \geq P_{jt} \tag{3.7}$$

or equivalently,

$$\frac{E(P_{j,t+1}|\Phi_t) - P_{jt}}{P_{jt}} = E(R_{j,t+1}|\Phi_t) \geq 0 \tag{3.8}$$

which merely states that the expected return on security *j* in time period t+1 subject to information set, Φ_t - available at in period t - is greater than or equal to zero. This assumption is a reasonable one since we could not expect people to invest without an expectation of a positive return. Price changes are expected to exhibit upward drift because risk averse investors demand a positive expected return [Schwartz (1991b)].

Following from the assumption that information is impounded in prices at any point in time and that expected returns are nonnegative, a submartingale in stock market prices has an important implication for investors. Investors who are making decisions based on information, Φ_t, available at time t, , cannot expect to earn more by 'trading' a security than they can expect from buying and holding it [Tinic and

West (1979); see also Fama (1970)].

In an efficient submartingale market, prices are expected to increase over time. Thus, comparison with a buy-and-hold control portfolio must be made when testing for abnormal returns on an experimental portfolio [see Copeland and Weston (1989)]. The performance of both portfolios should be the same: they will have a positive mean return, and the difference between their mean returns will not be significantly different from zero.

To recapitulate, following Granger (1975, p. 4), a stochastic process Y_t is said to be a submartingale if

$$Y_t \leq E(Y_{t+1}|Y_{t-j,\, j \geq 0}) \tag{3.9}$$

The process of Y_t is said to form a martingale if the inequality ($\leq$) in equation (3.9) is replaced by equality. Then, using this definition, the sequence of share prices P_t is a martingale if

$$P_t = E(P_{t+1}|P_{t-j;\, j \geq 0}) \tag{3.10}$$

The martingale, a model which only places restrictions on the first moment, is less restrictive than the random walk. As defined by Frankfurter and Lamoureux (1988, p. 386), a stochastic process (Y_t; t = 1, 2, ...) is a martingale if:

$$E|Y_t| < \infty \text{ ; and} \tag{3.11}$$

$$E(Y_{t+1}|Y_1, ..., Y_t) = Y_t \tag{3.12}$$

c)<u>The Random Walk Model</u>

Random walk is a term which has both a mathematical and statistical meaning. A random walk involves a less general process than the martingale model.

As applied in the stock market literature, the term generally refers to the unpredictability of share price changes: they wandered aimlessly over time. Statistically, there would be no correlation - technically, either linear or nonlinear [Jacob and Pettit (1984)] - between subsequent price changes.

A concept which predated the popularity of the 'efficient market' terminology, the random walk is one of the oldest models of stock market price behaviour and formation. Perhaps no other subject in the area of investment analysis and selection has received more attention than the idea of randomness of stock prices: the theory or hypothesis of random walk [see Pinches (1970)]. Perhaps the primary reason for the interest in the random walk theory is its relation to the EMH [see Hagerman and Richmond (1973)]: that the random properties of security returns had been fundamental to the development of the EMH [Blume and Siegel (1992)].

The random walk theory - an hypothesis which has cast serious doubt on many other methods for describing and predicting stock price behaviour [Fama (1965b) appeared to be disputed and not well understood by practitioners and market professionals [see e.g. Levy (1967), Fama and Blume (1966)]. "The random-walk hypothesis was almost universally derided in the financial community as implying that the market was senseless or irrational; but, properly understood, the random behaviour of stock prices is a consequence of intense competition between a large number of competent and avaricious investors" [Lorie and Brealey (1978), p. 102].

Being a relatively old and popular model, the random walk has been

interpreted in various ways by statisticians, economists and financial analysts. In fact, the random walk model "is almost certainly the simplest model found in the field of economics and is probably by now also the most over-tested and most over-misinterpreted model within the field" [Granger (1975), p. 3].

In statistical terms, the random walk hypothesis can be modeled in many ways. In the original work of Bachelier (1900), a random walk hypothesis implies that price changes have independent and identical normal distributions [see Taylor (1986; Allen (1985)]. Fama (1965a,) however, dropped the assumption of normal distributions[4].

According to Fama (1965a, pp. 35 & 40), the theory of random walk in stock prices is actually based on two hypotheses:

(i) successive price changes for an individual security are independent, and;

(ii) the price changes conform to some probability distribution.

Fama (1965a) further stressed that of the two hypotheses, independence is the most important: "In the general theory of random walks the form or shape of distribution need not be specified" (p. 41).

Godfrey *et al.* (1964) as well as Granger and Morgenstern (1970) argue that, to follow a random walk, price changes need not be identically distributed, but all of the distributions must have zero mean values. Taylor (1986) suggests that for practical purposes, zero correlation will be sufficient "to ensure that out-of-date prices are irrelevant when forecasting" (p. 9).

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[4]Fama's (1965a) study on the distribution of share price changes has led him to reject the normality assumption. See also Mandelbrot (1966), Praetz (1969). Frankfurter and Lamoureux (1988, p. 387) define a return generating process as following a random walk if successive returns are independent, identically distributed (iid). Referring to equations (3.11) and (3.12), for t = 1,2,..., a stochastic process is said to follow a random walk if $f(Y_{t+1}) = f(Y_t)$. However, Yalawar (1988, p. 75) suggests that the condition that successive price changes be 'identically distributed' is difficult to be satisfied owing to the evolution of economy, markets and corporations over time.

The sequence of random variables (Y_t; t = 1, 2,...) can be considered as following a random walk process if the increments

$$Y_t - Y_{t-1} = \varepsilon_t \tag{3.13}$$

are independently distributed.

Rewriting (3.13), a random walk model for stock price series can be represented as

$$P_t = P_{t-1} + \varepsilon_t \tag{3.14}$$

where P_t is the price at time t; ε_t is a random disturbance having zero mean[5], finite variance and distributed so that the covariance between ε_t and ε_{t-s} is zero for all non-zero values of s. The property of the residual or error series may be stated formally as

$$E[\varepsilon_t] = 0$$

$$E[\varepsilon_t^2] = \sigma_t^2$$

$$E[\varepsilon_t, \varepsilon_{t-s}] = 0 \text{ for all } s \neq 0 \tag{3.15}$$

The random walk is a special case of the martingale because it has more restrictions than the martingale. According to LeRoy (1982), every random walk is a

[5]According to Conrad and Jüttner (1973, p. 578) zero mean is not necessary because "positive or negative expected price changes are also consistent with this theory".

martingale but the reverse is not true because higher-order dependencies among ε_t may exist without impairing the martingale property.

A random walk model of equation (3.14) implies that, the price of any particular share in any period, will be equal to the price of that same security in the immediately preceding period plus some value randomly chosen. Simply put, the model states that changes in the price of shares cannot be predicted from the sequence of historical prices. Past price changes provide no clues to future changes: that the probability of a change in price of any magnitude, Q, is independent of the previous history of such changes. So, in a random walk market, the conditional probability of a change in price, Q, at time t, will not be different from the unconditional probability:

$$\text{Prob } [\Delta P_t = Q | \Delta P_{t-1}, \Delta P_{t-2}, \ldots] = \text{Prob } [\Delta P_t = Q] \tag{3.16}$$

By applying the expectation operator to equation (3.14), we can obtain the following equation (see equation 3.12):

$$E(P_t | P_{t-1}) = P_{t-1}, \tag{3.17}$$

which implies that the best predictor of tomorrow's price, given today's price, is today's price.

The random walk hypothesis which is put forward as an explanation of speculative price changes, according to Godfrey *et al.* (1964), is not intended to explain long term trends in price series. Praetz (1969) contends that the random walk hypothesis is essentially a short-term hypothesis, as the intervals between prices in

most tests have not been large. "This is confirmed by spectral analysis, where short-term components fit the hypothesis well but long-term components do not" [Praetz (1969), p. 137].

The most obvious and important implication of the random walk hypothesis for investors is that, the past values of the random walk contain no information useful for prediction of future values [Godfrey *et al.* (1964),]. If the random walk hypothesis is correct, then there is no trading rule based on past prices that will garner economic profits. As nobody can use today's information to beat the market, investing in a market of this type is a fair game.

Despite the overwhelming acceptance in the academic community that the random walk is a good approximation of share price behaviour, predictive systems based on historical data appear to continue in widespread use in every stock market around the world. Thus, empirical investigations of the random walk hypothesis are of considerable practical as well academic, interest.

Empirical work employing several procedures to assess the validity of the random walk hypothesis have taken place since around the middle of the 1950s. *Serial correlations tests*, *runs tests*, *spectral analyses* and *filter tests* are among the methods popularly applied by the random walk researchers[6].

Kendall (1953) was among the earliest to employ the **serial correlation**[7] approach in investigating statistical dependence between share price changes[8]. Testing

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[6]All these methods are discussed in some detail in Taylor (1986) and also in Fama (1965a).

[7]Granger and Morgenstern (1970, p. 72) point out that the correlation coefficient is only a measure of the degree to which two random variables are *linearly* related: "Complete independence is impossible to prove statistically although one can go some way toward it".

[8]In fact, Kendall was notable in that he was the first person (after Bachelier) to introduce the concept of the random walk into financial market research.

the United Kingdom (U.K.) data, he found that there was not enough statistical dependence present to permit prediction of price movements by using past history of their changes. Similar empirical works using British data were performed, among others, by Dryden (1970a, b), Brealey (1970) and Cunningham (1973).

In the United States (U.S.), an enormous growth in serial correlation testing has taken place since the 1960s. Among the major ones are by Moore (1964), Fama (1965a) and Hagerman and Richmond (1973). Fama for example, found a very small amount of positive dependence in price changes - an average serial correlation not statistically different from zero.

Other serial correlation tests of dependence, to name a few, were conducted by Praetz (1969) for Australian data, Solnik (1973) for Europe, Conrad and Jüttner (1973) for German, Jenergren and Korsvold (1974) for Norway and Sweden, Ang and Pohlman (1978) and Hong (1978) for Japan and Cooper (1982) for many countries.

A number of researchers, including Godfrey et.al.(1964), Praetz (1972, 1973), Sharma and Kennedy (1977) and Cooper (1982), used spectral analysis[9] techniques pioneered by Granger and Morgenstern (1963). The results of spectral studies on American shares by Granger and Morgenstern (1963) and Godfrey et.al. (1964) support the random walk hypothesis very well for short-term price movements, although for the long-term movements, there exist deviations from the random walk hypothesis.

[9]Spectral analysis which provides a powerful method of testing for independence of price changes [see Praetz (1969), Malkiel (1989)], analyzes the characteristics of a series of price changes through the frequency domain as opposed to the time domain and can detect the presence, if any, of long-term dependence as well as oscillatory in the data [Hawawini and Michel (1984)]. For details, see e.g, Granger and Morgenstern (1970).

The **analysis of runs**[10] in the data is another method which is commonly applied in the testing for the randomness in stock price movements. Being non-parametric, a runs test may be preferable for testing the random walk hypothesis since it is easy to perform and is independent of the normality and constant variance in the data [see Praetz (1969); Taylor (1986)].

Roberts (1959), Alexander (1961), Fama (1965a), Praetz(1969) and Jennergren and Korsvold (1974) are among the early researchers who applied runs tests in their studies. In his careful study of daily log price changes of thirty U.S. companies, Fama found some small positive dependence between price changes, but such dependence was too small to be of any importance either from an investment or from a statistical point of view.

The interrelationships of price changes may be so complicated that standard statistical tools such as serial correlations might not find them and might provide misleading measures of the degree of dependence in the data [see Granger & Morgenstern (1970); Fama and Blume (1966)]. An alternative way of testing the random walk hypothesis which is considered capable of meeting some of the objections to the use of standard statistical tests is by examining the profitability of applying mechanical trading rules (such filter rules, point-and-figure charts, moving averages and relative strength rules) to the price series [see e.g. Dryden (1970b), Hawawini and Michel (1984)].

Filter rules or filter tests were advocated and used by Alexander (1961, 1964) in his early tests of the random walk hypothesis. Later, this procedure was also applied by (inter alios) Fama and Blume (1966) and Beaver and Landsman (1981) for

[10]A run, as defined by Fama (1965a, p. 74) is a sequence of price changes of the same sign.

U.S. data, Dryden (1970a, 1970b) for U.K. data and Jennergren (1975) for Swedish data. In general, these tests arrived at the conclusion that filter rules are not profitable in comparison to a buy-and-hold strategy. Firth (1972) in his survey, reported that: "None of the research has shown that any of the technical rules investigated could consistently beat the buy and hold policy".

In summary, empirical tests of the random walk hypothesis, applying various techniques, have been undertaken on almost all major stock markets around the world. With relatively few exceptions, the results of most studies conducted essentially around the 1960s and the 1970s, indicated that for the particular samples and time periods studied, prices in major stock markets fluctuate randomly [see e.g. Bicksler (1977); Hawawini and Michel (1984)].

Even though many empirical tests do indicate some dependencies in successive price changes, such dependencies are considered to be too small to provide the basis profitable treading rules. Malkiel (1989, p. 127) contends that while empirical data are remarkably consistent in their general finding of randomness, equity markets do not perfectly conform to the statistician's ideal of a random walk [see also Copeland and Weston (1988), p. 349]: "The probability distributions of stock prices may be a submartingale rather than a random walk" [see also Fama and Blume (1966); Dryden (1969)]. Moreover, for prices in the smaller and less developed markets, deviations from the independence assumption of the random walk are often reported[11]. In consequence, we conclude our discussion on the random walk theory of share prices with a statement made by Granger (1975, p. 11):

[11]See e.g., Theil and Leenders (1965), Praetz(1969), Conrad and Jüttner (1973), Solnik (1973), Jennergren and Korsvold (1974), Jennergren (1975), Cooper (1982) and Keane (1983, p. 48). See also Section 3.7.

"Although there are some exceptions, the majority of studies find the random walk hypothesis, in one form or another, to give at least an extremely good approximation to whatever may be the truth. It is, however, clearly only an 'average' kind of law, and may not hold true for all securities at all times".

3.3-Formal Presentation of the EMH

As noted earlier, the EMH linking the concepts of information, prices and economic returns in a specific way, occupies the centre stage in financial theory and research. The EMH which is a more comprehensive model of share price behaviour than the random walk theory [Rutterford (1993)] has emerged not only as an obviously significant issue for individual investors and security analysts, but also for firms and for the economy as a whole. If a market is efficient, security analysts would face difficulty in providing stock recommendations that would outperform the market.

Individual investors would like to be sure that they have paid 'fair' prices for the securities they bought[12] . Similarly, firms that issued securities to finance their operations are equally interested that their securities are 'fairly' priced in the market. When a market is efficient, shareholders of successful companies can enjoy higher prices and at the same time, the managements of the companies can use the more valuable shares to finance expansions or acquisitions.

[12]Prices in an informationally inefficient market are considered to be 'unfair' because:

(i) when the information is favourable but not reflected the price, the seller of the share would be harmed;

(ii) when the information is unfavourable but not reflected in the price, the buyer of the share would be harmed.

For the economy as a whole, when its equity market is efficient, prices which may be described as fair indicators of economic values, would provide accurate signals for the efficient allocation of resources.

In an informationally efficient capital market, prices communicate information to participants [Ross (1989, p. 7)]: information which includes what is knowable and relevant for judging securities is very rapidly reflected in security prices. Then, in such a market, the available information set cannot be exploited so as to yield abnormally high returns - the economic or supernormal profits. Other than by chance, investors are not expected to outperform the market: they cannot expect to earn extra profits other than as a reward for bearing risks. In order to reduce the risk caused by the future price adjustments, investors can diversify their stock portfolios.

In sum, given an efficient capital market, investors can expect a fair return, and firms can expect a realistic and reasonable cost of capital. Given an economy with a healthy, active and efficient securities market, the allocation of savings and investments towards a more optimum national economic development can be expected.

The concept of market efficiency owes much of its articulation to Fama (1970) in his landmark article. Beside providing a review of the previous work concerning market efficiency, Fama also produced a common set of terminology, a more unified theoretical basis for future research and a fairly standardized set of methods. This article is viewed as the galvanizing force behind the EMH [see Mandell & O'brien (1992)]: it may be taken as marking the watershed of the EMH research. However, as previously noted, Samuelson (1965) should get the credit for becoming the first economist to enunciate the theory that price changes will be random if they rationally reflect available economic information.

According to Fama (1976a), market efficiency requires that in setting the price of securities at time t-1, the market correctly uses all available information. The process of price formation in an efficient market can be described as follows: Let Φ_{t-1} be the set of all information available at time t-1, and let Φ^m_{t-1} be the set of information actually used by the market in the determination of security prices at time t-1. In addition, assume that the prices of securities at t-1 depend only on the characteristics of the joint distribution of prices to be set at time t. If the market is efficient in pricing the securities at time t-1, then all available information is correctly used to assess the joint distribution of prices at time t. Therefore, in an informationally efficient market

$$f(P_{1t}, \ldots, P_{nt}|\Phi_{t-1}) = f_m(P_{1t}, \ldots, P_{nt}|\Phi^m_{t-1}) \tag{3.18}$$

where $f_m(P_{1t}, \ldots, P_{nt}|\Phi^m_{t-1})$ is the joint distribution of security prices $P_{1t}, \ldots, P_{nt}$ at time t assessed by the market at time t-1 on the basis of the information set Φ^m_{t-1}; while $f(P_{1t}, \ldots, P_{nt} /\Phi_{t-1})$ is the joint distribution of security prices at time t, as implied by the information set Φ_{t-1}.

Hess and Reinganum (1979, p. 3) alternatively, formulate the process of price formation in a market where current security prices 'fully reflect ' all relevant and available information, in the following way [see also Allen (1985, p. 133)]:

$$p^e_t = \psi(\Phi_t) \text{ and } p^e_t = \psi(\Phi^m_t), \tag{3.19}$$

or

$$p^e_t = \psi(\Phi_t) = \psi(\Phi^m_t) \tag{3.20}$$

where

p^e_t = N-dimensional vector of equilibrium security prices at time t;

Φ_t = the set of information available at time t;

Φ^m_t = the set of information actually used by investors in the determination of security prices at time t;

$\psi(.) = \psi: A \rightarrow R^N$. Here, ψ maps A, the set of all potential information, into R^N, the security price space. From the economic point of view, ψ is the model of equilibrium that links a particular information set with equilibrium prices.

Expression (3.18) and equivalently expression (3.20) state that, equilibrium prices determined based on the information set investors actually used, are identical to the equilibrium prices implied by the set of all available information. Consequently, in an uncertain world, if the EMH were true, no investor should expect to earn returns in excess of those normally associated with a risky portfolio by predicting asset prices from the set of available information [Hess and Reinganum (1979), p. 4].

If expression (3.18) or expression (3.20) does not hold, then the EMH must be rejected. Nevertheless, the description of an efficient market given by either the expression (3.18) or the expression (3.20), is still too general to be testable. They are just formal notations for the statement that prices in an efficient market fully reflect available information.

Referring to the expression (3.18), one still cannot directly make a decision to reject or to accept the EMH since $f_m(P_{1t}, \ldots, P_{nt} / \Phi^m_{t-1})$ cannot be observed. A more detailed specification of the link between $f^m(P_{1t}, \ldots, P_{nt} / \Phi^m_{t-1})$ and $P_{1,t-1}, \ldots, P_{n,t-1}$ is needed. Put differently, we need to specify how equilibrium or market-clearing prices at time t-1 are related to the market assessed joint distribution of prices for time

t. Hence, in testing the EMH, some model of market equilibrium is required[13].

In terms of the expression (3.20), ideally, verification of the EMH would simply be a matter of substituting Φ^m_t and Φ_t into the specified $\psi(.)$ function to check that the equilibrium prices implied by both information sets corresponded to the equilibrium prices, p^e_t, actually observed. The hypothesis would be rejected if

$$p^e_t = \psi(\Phi^m_t) \text{ but } p^e_t \neq \psi(\Phi_t) \tag{3.21}$$

In reality however, the functional form of $\psi(.)$ is not known a priori and thus, has to be estimated. We can only obtain an estimate of p^e_t via the estimated function, $\psi^*(.)$. In this connection, according to Hess and Reinganum, the observable prices can be decomposed into an estimated part plus an error term:

$$p^e_t = \psi^*(\Phi^m_t) + u_t \tag{3.22}$$

where

$\psi^*(\Phi^m_t) \equiv$ the estimated equilibrium prices implied by the information set used by investors;

u = error term.

Since some model of market equilibrium is required in testing the EMH, any empirical test of the EMH is actually a test of the joint hypothesis that [see Fama (1976a), p. 143; (1976b), p. 137]:

(i) security prices 'fully reflect' all available information; and

[13]Models of market equilibrium are discussed in Chapter Four.

(ii) the model of market equilibrium is correctly specified.

Said differently, any test of the EMH is a test of at least two distinct hypotheses: that the market is efficient; and the manner by which securities are (efficiently) priced [Frankfurter and Lamoureux (1988)]. It follows that, if the result of a test cannot reject the EMH, then simultaneously, the assumptions about the nature of market equilibrium also cannot be rejected. On the contrary, any rejection of the EMH can be due to a misspecified model or an inefficient market, or both.

As Fama (1976b) points out, the usual general assumption is that the conditions of market equilibrium can be stated in terms of expected returns. The characteristics of the market assessed distribution, $f_m(P_{1t}, \ldots, P_{nt}|\Phi^m_{t-1})$, determine the equilibrium expected returns on securities. Simultaneously, the market sets the prices of securities at time t-1 so that it perceives expected returns to be equal to their equilibrium values. More specifically, if $P_{j,t-1}$ is the price of security j at time t-1; if $E_m(R_{jt}|\Phi^m_{t-1})$ is the equilibrium expected return on security j implied by $f_m(P_{1t}, \ldots, P_{nt}|\Phi^m_{t-1})$ and if $E_m(P_{jt}|\Phi^m_{t-1})$ is the market assessed expected value of the price of security j at time t, then the market sets the price of security j at time t-1 such that

$$P_{j,t-1} = \frac{E_m(P_{jt}|\Phi^m_{t-1})}{1+E_m(R_{jt}|\Phi^m_{t-1})} \tag{3.23}$$

The price, P_{jt}, of security j, will however, be drawn from the true distribution of prices $f(P_{1t}, \ldots, P_{nt}|\Phi_{t-1})$. If $E(P_{jt}|\Phi_{t-1})$ is the true expected price of security j implied by the true joint distribution $f(P_{1t}, \ldots, P_{jt}|\Phi_{t-1})$ and if $E(R_{jt}|\Phi_{t-1})$ is the true expected return implied by $E(P_{jt}|\Phi_{t-1})$ and $P_{j,t-1}$, then the market is efficient [i.e.,

expression (3.18) holds) if

$$E(P_{jt}|\Phi_{t-1}) = E_m(P_{jt}|\Phi^m{}_{t-1}) \tag{3.24}$$

and

$$E(R_{jt}|\Phi_{t-1}) = E_m(R_{jt}|\Phi^m{}_{t-1}) \tag{3.25}$$

That is, when a market is efficient, it correctly uses all available information to assess the distribution of future prices and its assessment of the expected future price of any security is the true expected price. Furthermore, when the correct prices are set, the market's assessment of the expected return on any security is also equal to the true expected return.

In an inefficient market on the other hand, in setting prices at time t-1, the market may neglect some of the information in Φ_{t-1}, or it may analyse and use the information incorrectly in assessing the distribution of future prices. In such a case, the equality of equations (3.24) and (3.25) may not hold.

Ross (1989) relates the concept of capital market efficiency to the neoclassical equilibrium theory of efficiency in economics: *Pareto efficiency*[14]. He argues that, when prices depend on information available to the economy, it is not unreasonable to think of the efficient market definition of finance as being a requirement for a competitive economy to be Pareto efficient. "If a capital market is competitive and efficient, then neoclassical reasoning implies that the return that an investor expects

[14]*Pareto efficiency*, a fundamental concept in welfare economics, refers to an economy where resources are allocated in such a way that no-one can be made better off without others becoming worse off [see Vickers (1995), p. 1]. In other words, an economic system is defined to be Pareto efficient if there is no way to improve the well-being of any one individual without making someone worse off.

to get on an investment in an asset will be equal to the opportunity cost of using the funds".

Representing the opportunity cost by the riskless rate of interest, r - according to Ross, the EMH asserts that

$$E(R_t|\Phi_t) = (1+r_t) \tag{3.26}$$

where R_t is the total return (i.e., capital gains as well as payouts) on the asset over a holding period from t to t+1. E is the expectation taken with respect to a given information set, Φ_t (including r_t), that is available at time t.

In terms of price

$$R_t \equiv P_{t+1}/P_t \tag{3.27}$$

From equation (3.27), equation (3.26) can be rewritten as

$$E(P_{t+1}|\Phi_t) = (1+r_t)P_t \tag{3.28}$$

Equivalently, P_t may be written as discounted price which follows a martingale:

$$P_t = \frac{1}{(1+r_t)} E(P_{t+1}|\Phi_t) \tag{3.29}$$

This means that, when the market is weak-form efficient; that is, the current

price of a security embodies all of the information contained in the past prices

$$E(P_{t+1}|P_{t-1}, \ldots) = (1+r_t)P_t \tag{3.30}$$

or, in returns form

$$E(R_t|R_{t-1}, R_{t-2}, \ldots) = (1+r_t) \tag{3.31}$$

Equation (3.31) implies that, when a market is weak-form efficient, an investment decision which simply uses the 'technical' information of past prices, can only expect to earn a return of the opportunity cost $(1+r_t)$. (3.34)

3.4-Levels of Market Efficiency

In an ideal setting, a market can be said to be informationally efficient if it is 'fully informed'. A securities market is informationally efficient when security prices reflect all available information. The basic empirical issue therefore is, whether the information set used by the market in pricing securities includes all available information. Nonetheless, given the fact that the universe of relevant information is extremely vast, in the real world, the conditions for full efficiency are unlikely to exist.

Whilst the definition of 'information set' is partially a philosophical matter [Hess & Reinganum (1979)], the question of market efficiency has emerged as an issue of degree rather than merely black or white. By definition, there is no market

which is perfectly efficient or strictly inefficient.

Given the fact that real life social phenomena are seldom so clear-cut and that individuals would apparently differ in their views as to how much the available information the price of a security reflects, there appears to be no quantitative way in which the EMH can be adequately tested [see Firth (1977)]. One way of measuring the level of efficiency of a market is by asking the types of information, encompassed by the total set of available information, that are reflected in security prices[15] [see Haugen (1990)].

Based on Roberts's (1959) suggestion, Fama (1970) distinguished three types of information sets by which the efficient market model could be appraised and tested: past prices (i.e., the historical sequence of prices), publicly available information and all information including private information. Since then, it is customary to classify the level or form of market efficiency into three: the weak-form (price-information or predictability) efficiency, the semi-strong form (or public information) efficiency and the strong-form (private or inside information) efficiency[16].

The three levels of market efficiency, form a hierarchy: a market will not be efficient in the strong-form unless the semi-strong form of efficiency exists. Likewise, the presence of semi-strong form efficiency must ipso facto imply that the market is also efficient at the weak level.

The weak-form efficiency which is at the bottom of the ladder of the efficiency hierarchy, requires only that the current and past price history be

[15]However, the exact mechanism by which prices incorporate information, as Ross (1989) points out, is still a mystery and an attendant theory of volume is simply missing.

[16]Keane (1983) proposed further classification. For practical purposes, he distinguished three potential degrees of efficiency; namely, perfect efficiency, near efficiency and inefficiency.

incorporated in the information set. If a market is weak-form efficient, current prices will fully reflect all past market information, future prices will be independent of past price changes and price changes from one period to another can be approximated by a random walk.

Consequently, if a market is weak-form efficient, investors cannot devise an investment strategy on the basis of past price changes or past market information to yield abnormal profits. Trading rules (*technical analysis*) using 'past price patterns' to predict future changes, should have little economic value because any information from such an approach will have already been impounded in current market prices.

Major tests of the validity of the weak-form of the EMH were tests for randomness in successive price changes. In general, these tests can be grouped into two:

(i) statistical testing of the independence of price changes; and

(ii) testing the efficacy of the various mechanical trading rules (which are based only on prior price performance) used by *chartists* and technical analysts.

Early tests of the EMH were tests of the weak-form efficiency. Such tests have been performed as early as the 1950s by Kendall (1953), Robert (1959) and Osborne (1959). As we have examined in the foregoing section, in general, empirical tests present strong evidence in favour of the weak-form EMH[17]: that no discernible predictable patterns of price changes that speculators or investors can exploit. Even though "the random walk hypothesis is not strictly upheld, the departures from randomness that do exist are not large enough to leave unexploited investment

[17]Hawawini and Michel (1984) in their review of the evidence of price behaviour and efficiency of the European Equity Markets for example, concluded that: "In general, European Equity Markets regardless of their size, are efficient in the weak form" (p. 25).

opportunities" [Malkiel (1989), p. 127].

A market is **efficient in the semi-strong sense** if it uses all of the publicly available information in pricing securities. The value of information (i.e., current as well as past publicly available information) is rapidly discounted in share prices.

When a market is efficient (in the semi-strong-form), only new or shock information will cause prices to change; but new information cannot be predicted: A continuous stream of information is becoming public knowledge randomly, and then the affected share prices, in respond, will be 'walking' randomly [see Tarascio (1984)]. This implies that the semi-strong-form efficiency of a market is consistent with the weak-form efficiency.

Hence, in a market which is efficient in the semi-strong sense, current prices reflect not only the information contained in the sequence of past prices, but all available published information. Consequently, investment decisions based on either technical analysis (which focuses on stock price patterns) or fundamental analysis (which focuses on the determinants of the underlying value of the firms), will not yield abnormal economic profits. Since both approaches are based on publicly available information, neither would be able to beat the market.

Tests of the semi-strong-form of the EMH attempt to establish whether share prices adjust precisely and rapidly to new items of information. The general approach involved in these studies has been to take an economic event (hence event studies[18]) and measure its impact on the share price (and returns). A classic example of the so-called event study, was the one conducted by Fama, Fisher, Jensen and Roll [FFJR

[18]In his recent paper, Fama (1991) has even proposed the change of the "semi-strong-form tests of the adjustment of prices to public announcement" to a new common title: *event studies*

(1969)] - a study that set the fashion and technique for most of the subsequent tests of the semi-strong form of the EMH. In their study, the authors investigated the reaction of stock prices to the event of stock split announcements.

Even though the splits themselves provide no economic benefit, stock splits are usually accompanied by dividend increases. Thus, stock splits are often interpreted as implicitly conveying favourable information to the market - information about management's confidence about the future progress of the enterprise. While splits usually are associated with higher share prices, when the market is efficient, prices will fully and immediately adjust to the information.

In their study, FFJR (1969) divided their sample into two: companies that increased their dividends after the splits, and companies that did not. They found that, while substantial abnormal returns were observed prior to the split announcement, there was no evidence of abnormal returns after the public announcement. For the firms that did not increase their dividends following the splits, the market reduced the price of the shares because the anticipated dividend increase did not materialise. Firms that raised their dividends as expected, exhibited only very little additional gain. FFJR (1969) concluded that their study provided evidence in support of semi-strong-form efficiency of the New York Stock Exchange. The evidence provided by the study does not contradict the hypothesis that current prices already reflect all publicly available information relevant to the value of a company's stock.

A similar study using U.K. data on scrip issues was implemented by Firth (1977). Results of the study revealed a considerable increase in the price in the week prior to the announcement, but no systematic price movement in the month after the announcement.

The variety of economic events or new items of information that have been used by researchers to test the semi-strong level of the EMH, include the following:

* Analyst's information/recommendations: Diefenbach (1972) for the U.S. and Firth (1972) for the U.K.;

* capitalisation issues - stock splits and/or dividends): Fama et.al (1969); Charest (1978) and Reilly and Dryzcmski (1981) for American data; Firth (1977) for the U.K. and Ball, Brown and Finn (1977) for Australia;

* dividend announcements: Petit (1972) and Watt (1973);

* earnings announcement: Ball and Brown (1968); Aharony and Swary (1980); Morse (1981) and Hans, Wild and Ramesh (1989);

* earnings estimates made by company officials: Foster (1973);

* issuance of new shares of an existing security: Hess and Frost (1982);

* large blocks of shares being bought or sold: Kraus and Stoll (1972); Dodd and Ruback (1977); Dann, Mayers and Raab (1977) and Carey (1977);

* macroeconomic factors: e.g., discount rate changes [Waud (1970)]; monetary growth [Rozeff (1974)]; money and other key macroeconomic variables [Darrat and Mukherjee (1987)]; and

* merger bid announcements: Franks, Broyles and Hecht (1977); Firth (1976).

Although there are some exceptions, the vast majority of these studies support the semi-strong version of the EMH. While most evidence is consistent with the existence of the semi-strong form market efficiency, there has also been some evidence that suggested that stock markets tended to overreact or underreact to the value implications of published piece of information [see e.g., Charest (1978), Latane and Jones (1979)].

The strong form of the EMH, as its name implies, takes the notion of market efficiency (with respect to information) to the ultimate extreme. A market is said to be strong-form efficient if it exhibits prices that not only reflect public information but also private information. Then, in a market which is efficient in this sense, prices are liable to reflect not only everything that is known but also everything that is knowable [Lorie & Brealey (1978)].

Even though this form of market efficiency is so extreme that "few people have ever treated as anything other than a logical completion of the set of possible hypothesis" [Jensen (1978)], and "we would not, of course, expect this model to be an exact description of reality" [Fama (1970), p. 409], there are mechanisms that could lead to strong-form market efficiency. For example, competition among privately informed investors might be sufficient to produce prices that reflect private information [Dyckman & Morse (1986)]. Malkiel (1989, p. 131) even maintains that there is considerable evidence that "the market" comes reasonably close to strong-form efficiency. Blume and Siegel (1992), however, argue that since the set of relevant information is theoretically infinite, it is unreasonable to expect that the market would literally incorporate all information into stock prices at every point in time.

As all available information - public as well as private - is rapidly impounded in securities prices, it would be impossible for any investor to garner superior returns consistently. As such, in testing for strong-form market efficiency, researchers are concerned with whether company insiders or other privileged groups possess special or inside information which can be used to make above average profits. In Fama's (1970, p. 409) words, tests of the strong-form of the efficient market model are "concerned with whether all available information is fully reflected in prices in the

sense that no individual has higher expected profits than others because he has monopolistic access to some information". Thus, finding that the 'better informed' do not make excess profits would be evidence in support the strong-form of the EMH.

The problem with testing strong-form market efficiency is that the existence of nonpublic or private information in the market cannot be directly observed. Consequently, indirect approaches are used by investigators. In general, we can roughly group the strong-form tests of the EMH into two major subclasses [see e.g., Elton & Gruber (1991), p. 425]: The first type of tests attempt to examine the performance of major market participants or institutional investors. The second type of tests involve investigating the investment performance of individuals or groups who can be identified as in a position of possessing nonpublic information - the insiders - such as directors, managers and owners of at least 10% of the shares of a company.

If stock markets are found to be strong-form efficient, then any day is as good as any other day to buy any stock. Nonetheless, in general, empirical evidence appears to refute market efficiency of this form. Indications that markets are probably not strong-form efficient are documented, among others, by Lorie & Niederhoffer (1968), Jaffe (1974), Penman (1982), and Dimson & Marsh (1984).

In a more recent study, Seyhun (1986) provides evidence indicating that insiders can predict abnormal future price changes. He concluded that the evidence was consistent with (the semi-strong-form) market efficiency because outside investors were found to be unable to use the publicly available information about insiders' transactions to earn abnormal profits.

To generalise, empirical evidence suggests that most matured securities markets are efficient at the semi-strong level, but they may not be efficient in the strong-form

sense. Alternatively stated, major exchanges are believed to be efficient to the general public and to their agents such as fund managers, but they might not be efficient to the company insiders.

3.5-Evidence From the Small and Less Developed Exchanges

Empirical studies and evidence on stock market efficiency are voluminous. Collections and excellent summaries of empirical tests and findings on the EMH for the developed markets can be found, inter alia, in Cootner (1964), Fama (1970, 1991), Lorie and Hamilton (1973), Firth (1977), Cooper (1982), Keane (1983), Hawawini (1984), Hawawini and Michel (1984), Dyckman and Morse (1986), Copeland and Weston (1988) and Elton and Gruber (1991). The general consensus of a large number of these studies is that the world's major exchanges are efficient in the weak and semi-strong form. While the 'matured' exchanges are generally accepted as being both weak-form and semi-strong form efficient, it is an interesting empirical question whether, and to what extent, that the small and developing stock markets are also efficient.

Research tradition for the developing capital markets, is relatively young and yet, steadily growing. Interest in investigating the price behaviour and efficiency of these relatively young exchanges has increased rapidly, particularly since the publication of Fama's (1970) seminal work.

The findings of studies using data from the smaller, less complicated and thinly

traded exchanges are less obvious and generally mixed. They appear to be inconclusive. Some of these researches provide evidence supporting market efficiency, while others do not. To name a few, studies were conducted by Roux and Gilbertson (1978) for South Africa (Johannesburg); Palacios (1975) for Spain; Ang and Pohlman (1978) for the Far Eastern Countries; Darrat and Mukherjee (1987), Sharma (1983), Kapur (1988) and Yalawar (1988) for India (Bombay); Hong (1978) and D'Ambrosio (1980) for Singapore; Gandhi *et al.*(1980) for Kuwait; Dawson (1982, 1984) and Wong and Mak (1982) for Hong Kong; Al-Hmoud (1987) for Jordan; Buttler and Malaikah (1992) for Saudi Arabia and Kuwait and Khilji (1993) for Pakistan.

Errunza and Losq (1985a) investigate the behaviour of stock prices for "a group of well established and newly emerging" securities markets in Argentina, Brazil, Chile, Greece, India, Jordan, Korea, Mexico, Thailand and Zimbabwe. The data used in the study covers the period from December 1975 through April 1981. One of the conclusions of the study is that, these markets, even though not as efficient as major the markets in developed countries, they "are quite comparable to the smaller European markets" (p. 574).

Empirical research on the efficiency the Kuala Lumpur Stock Exchange (KLSE) was initiated some time in the early 1980s. Studies performed by M. Nasir Lanjong (1983), Neoh (1985), Barnes (1986) and Laurence (1986) provide some early indications of the weak-form efficiency of the Exchange.

M. Nasir Lanjong (1983) conducted serial correlation and runs tests on monthly returns of 104 KLSE companies, from January 1974 to June 1980. He found that successive returns of those shares are randomly distributed and thus confirming the weak-form efficiency of the market.

Various aspects of the Malaysian stock market, including its efficiency, were studied by Neoh (1985). By applying Beaver's (1981) concept of "signal efficiency" rather than Fama's concept of "form efficiency", seven type of signals, organised into two categories were tested:

(i) Transaction information: price periodicity, price moving average and relative strength. Under this category, he found that the Malaysian market was less efficient than the U.S. market. However "when applied to all stocks over the long term, the test methods do not yield much inefficiency" (p. 321).

(ii) Accounting information: dividend yield, dividend growth, stock split and earnings forecast error. He concluded that "overall, the Malaysian market is much less efficient with regard to accounting information" (p. 326).

Barnes (1986) examined the weak-form efficiency of the KLSE using the data consisting of thirty companies and six sectoral indices for the six years ended 30th June 1980. Based on serial correlation and runs tests, he found that there was very little departure from the random walk hypothesis within confidence intervals of two and three standard errors. Using spectral analysis, he further found that "this technique confirmed that the KLSE is fairly efficient in the weak form" (p. 614). Barnes then concluded that "although there were certain departures from the hypothesis, the KLSE overall exhibited a surprisingly high degree of efficiency, in view of thinness and its age as a stock exchange" (p. 616).

Laurence (1986) studied the weak-form efficiency of the KLSE and the Singapore Stock Exchange (SES) using serial correlation and runs tests. His conclusion was that the two independence tests manifested mixed behaviour: "Some sample stocks exhibit random behaviour while others - particularly many of those

from the SES - appear to deviate from a random walk" (p. 444).

One of the earliest work investigating the efficiency of the KLSE was carried out by Dawson (1981), whereas the most recent ones were accomplished, inter alios, by Othman Yong(1987), Mansor Md Isa (1989), Annuar Md Nasir (1990) and Rokiah (1992). Dawson (1981) analysed the returns earned by investors who bought the stocks recommended by analysts: 'stock of the month' published in the *Malaysian Business* (a monthly trade journal) from January 1973 through March 1980. The purpose of the study was to see whether those recommended stocks (i.e. 85 stocks of the month in the sample) did better than the market. Those stocks were found to rise on average in value over the following year, and over a six month period they outperformed the market. " These results suggest that the KLSE is not yet an efficient market although it may be closer than many observers think since the stocks of the month did not finish well above the market" (p. 72).

Othman Yong (1987) conducted a study (using runs tests and serial correlation tests) on weekly data of 170 stocks (from January 1977 to May 1985) to investigate whether or not the KLSE conforms to the weak-form of the EMH. Overall "this study provides evidence that a small and thinly traded stock market is less efficient in the weak-form sense of the EMH compared to larger stock markets in the United States" (p. 71). Price changes for all stocks on the KLSE were also found to be non-normal, using Kolmogorov-Smirnov test for normality.

From his examination of the behaviour of Malaysian stock prices, Mansor Md Isa (1989) detected, inter alia, the following:

(i) The KLSE stock returns were not normally distributed. (He further inferred that the KLSE stock prices followed a stable Paretian distribution).

(ii) "Since the random walk model requires independence, it is not therefore a good description of Malaysian stock prices" (p. 18).

Using monthly data in a period from 1975 to 1986, Annuar Md Nasir (1990) tested the three levels of the EMH in the KLSE. Despite apparent minor inefficiencies, on the whole, he concluded that the market conformed well to the behaviour predicted in a weak-form EMH. The study also reached to the conclusion that the market appeared to be near efficient in the semi-strong form, with respect to the adjustment process of share prices to announcements of earnings and dividends. In testing for strong-form efficiency of the Exchange, the researcher analysed the performance of 'stock of the month' recommendations published by *Malaysian Business*. The result indicated that the KLSE was not strong-form efficient.

Rokiah (1992) examined price performance and aftermarket efficiency of the unseasoned new equity issues in Malaysia. According to the researcher, "...it would suffice to conclude that the market is only near efficient in the semi-strong form" (p. 317).

Similar to many other developing stock exchanges, empirical studies on the efficiency of the KLSE do not provide clear-cut results. On the whole, however, the previous researches (as we have examined above) have shown that the Exchange is efficient in the weak form. Investigations into the semi-strong-form efficiency of the KLSE are few and the results appear to indicate that the market may not be efficient in this sense.

3.6-Some Anomalies: Evidence of Market Inefficiencies?

Tests of the EMH are legion. While a plethora of empirical evidence has been supportive, there are some findings which are not in favour of the EMH.

Probably, the EMH is the most controversial topic in finance, and possibly in economics in general. Although early evidence in support of the EMH appeared very strong, the validity of the hypothesis has increasingly been challenged. "Why do many economists refuse to be convinced by twenty years of successful empirical testing?" asked James Tobin [Tobin (1987), p. 126]. Perhaps recent developments in empirical work that provide evidence which casts doubt on the validity of the EMH could partly be explained by the fact that new studies can always benefit from improved techniques to challenge the results of the previous ones.

The more recent evidence suggesting that stock markets might not be as efficient as most academics once believed, falls in two parts. First, the evidence that appears directly to challenge the EMH; and secondly, the so-called 'anomalous' evidence.

The incidence of stock market crash in October 1987 (also known colourfully as "October meltdown") is often cited by efficient market sceptics as a serious blow on the EMH. The October "meltdown", as Rao (1992) points out, immediately provided a forum for vigorous attacks against the EMH. For example, *BusinessWeek* of October 22, 1988 even expressed the view that, "Efficient market theory is useless in explaining the biggest stock market calamity in 58 years".

While the stock market crash of October 1987 can be considered as a special case in the EMH controversy, the so-called *market anomalies* had been in existence - detected and reported - many years before the October "meltdown". They are, de facto, not new; some of them have existed as market folklore for many years [see Bowers and Dimson (1988)]. 'Certain Observations in Seasonal Movements in Stock Prices' have been reported as early as 1942 by Wachtel (1942).

In the 1970s, empirical regularities appeared in the work of a number of authors. Officer (1975) observed monthly stock return seasonalities in Australia. Early indications of seasonality in the US capital market can be found in the work of Rozeff and Kinney (1976), whereas the early case of seasonalities in the UK and other European markets was reported by Richards (1978). Contravening the random walk model which implies that stock returns are time invariant, Rozeff and Kinney (1976) for instance, observed that in the US, stock returns for January were significantly larger than the returns for other months. During the time however, anomalies were not 'in fashion' and therefore, the evidence reported did not attract much attention [see Constantinides (1988)].

Today, some of the most persuasive evidence against the EMH, is believed to come from the "anomaly"[19] literature [see Blume and Siegel (1992)]. Several unusual patterns in the price behaviour of shares that appear to be contrary to the efficient market concept can be found in this anomaly literature.

Fundamental analysis, an investment approach which uses much wider information than does technical analysis (see Chapter Four) in creating portfolios, has

[19]*Anomaly* is a term used by Thomas Kuhn (1970), a scientific historian, to refer to the evidence of departure from conventional theory.

revealed evidence that seems inconsistent with the EMH [see Bodie *et al.*(1989); Ball (1978)]. Such 'unexplained empirical results' are often referred to as *market anomalies* because economists cannot (perhaps for the time being) really 'understand' and hence cannot offer 'satisfactory' reasons and explanations for their existence [see e.g., Elton and Gruber (1991); Tinic and Barone-adesi (1988); Schwertz (1983)].

Market anomalies, according to Bowers and Dimson (1988), takes the form of observed capital market regularities that are not explained by theory or institutional practice. The existence of market regularities could be interpreted as implying informational inefficiency because market participants could, by devising certain trading strategies, exploit such regularities to earn above normal profits.

In 1977, Sanjay Basu [Basu (1977)] published his study on the price-to-earnings (PE) ratio which was conducted in a risk-adjusted framework. Basu's results which became known as the **PE effect** or the **PE anomaly** - an anomaly that had long been popularised by practitioners[20] - provided dramatic contradiction to the semi-strong form of the EMH. Basu (1977 & 1983) found that stocks with low PE ratios have higher average risk-adjusted returns than stocks with high PE multiples. Basu's findings imply that an investor who purchase shares with low PE ratios, will find that the historical performance in terms of returns is higher, and risk in terms of *betas* is lower. Clearly, Basu's results challenged the concept of a positive trade-off between risk and return and hence, the concept that risk-averse behaviour was reflected in security prices [see Mandell and O'brien (1992)].

[20]It has become a market folklore for some time that shares of companies with low PE ratios may be undervalued. According to Keim (1988), earnings related strategies have a long tradition in the investment community. 'Buying shares that sell at low earnings multiples' which is the most popular of such strategies, can be traced at least to Graham and Dodd (1934).

Reinganum (1981) confirmed and extended Basu's results. Examining the relationship between the size of the firm and the PE ratio, he found that it was the size of the firm and not the PE ratio that was the important discriminator.

The so-called **small-firm-effect** or **size effect**[21] appeared to be one of the most important anomalies or empirical regularities so far observed, with respect to the EMH. The tendency towards the size effect in stock returns - that the risk-adjusted stock returns are a monotonically decreasing function of firm size - was first noted by Banz (1981). He discovered that stocks of small capitalisation firms earn, on average, higher risk-adjusted returns than those of large firms.

Results of studies by both Reinganum (1981) and Banz (1981) indicate that the difference in returns between small and large firms cannot be explained by the Capital Asset Pricing Model (CAPM). Differently stated, both studies have shown the tendency of small firms to yield returns greater than those predicted by the traditional CAPM. Almost similar results are provided by Dimson and Marsh (1984) for the U.K., Brown *et al.* (1983) for Australia, Berges *et al.*(1984) for Canada and Kato and Schallheim (1985) for Japan.

The fact that the small-firm-effect is a world-wide phenomenon, has also been documented by Keim (1988). His analysis of stock returns in four major stock exchanges in Australia, Canada, Japan and United Kingdom revealed that there was an inverse relation between stock returns and market capitalisation in each of those countries. A size effect on the London Stock Exchange was also found in a more recent study covering the period from April 1961 to March 1985, by Levis (1989).

[21]For the survey of various attempts to explain the size effect, see e.g., Keim (1988). Some explanations of the size effect and January effect are also discussed in some detail by Chen (1988). Brown *et al.*(1983) accentuate and show that the size effect has even manifested itself beyond academic circles.

Some studies nonetheless, have found that the small-firm-effect is virtually a **small-firm-in-January effect.** Among others, studies by Keim (1983), Reinganum (1983) and Blume and Stambaugh (1983) demonstrated that excess returns on small firms' shares (in the U.S.) concentrated in January, particularly during the first few days of January.

Much literature has been produced, supplying evidence of a tendency for share prices to fall towards the end of the year and rise during the month of January: the **January effect** or the **turn-of-the-year effect**. While Rozeff and Kinney (1976) conducted the first rigorous study which confirmed the existence of the January effect in the US, Berges *et al.*(1984) and Tinic and Barone-adesi (1988) demonstrated a January seasonal in Canada. Gultekin and Gultekin (1983) empirically examined stock market seasonality in major industrial countries. The study revealed that the January effect was even stronger in many other countries than in the United States. The January effect has also been documented by numerous other studies which, among the most recent ones, were accomplished by DeBondt and Thaler (1985), Gultekin and Gultekin (1987), Cohay *et al.*(1988) and Lakonishok and Smidt (1988). Lee (1992) provides evidence of seasonalities in Japan, Korea, Taiwan, Hong Kong and Singapore.

In addition to the January effect, several studies have also documented empirical regularities that are related to the time of the month or the day of the week (i.e, the **day-of-the-week effect**). Gibbons and Hess (1981) for example, reported that the U.S. market exhibited negative returns on Monday and large positive returns on Wednesday and Friday. For other evidence of the day-of-the-week effect, see Keim and Satambaugh (1984), Jaffe and Westerfield (1985), and Lakonishok and Smidt

(1988), to name a few.

Analysing stock returns drawn from seven national equity markets; namely, New York, Sydney, Toronto, London, Tokyo, Paris and Singapore, Condoyanni *et al.*(1988) identified that the weekend effects were the norm rather than being U.S. specific. Based on these results they concluded that the "weekend effect is a pervasive feature of capital markets around the world" [p. 61].

For the well-established stock markets essentially, there are many investment advisory services selling advice that predicts the performance of various types of securities. The Value Line Investor Survey is one of the largest and most consistently successful investment advisory services in the United States. The Value Line predictions and recommendations which are believed to be based on historical data such as earnings-related information [see Keim (1988)], have been the subjected of many academic studies [see e.g., Kaplan and Weil (1973) and Holloway (1981)].

Several investigations of the Value Line system of ranking securities conducted by, inter alios, Black (1973), Copeland and Mayers (1982) and Stickel (1985), have demonstrated that the service could be used to produce abnormal profits. Value Line's apparent success in predicting stock performance, which has become known as the **Value Line Enigma**, is as puzzling as the size and PE effects: "predetermined variables are used to construct portfolios that have abnormal returns relative to the CAPM" [Keim (1988), p. 26]. The Value Line significant performance, which would be a violation of the semi-strong version of the EMH (or of the CAPM as a joint hypothesis), is considered an enigma.

Consonant with the growing literature on market anomalies and other empirical evidence that contradict the EMH; and with the scattered resistance to the EMH in

place in the 1980s, there appears to be a growing body of 'new schools of thought' suggesting that equity markets are inefficient. They include, the revival of the idea of market psychology, the issue of noise trading, the overreaction hypothesis, mean reversion in share prices, noisy rational expectations model and the uncertainty information hypothesis. These contemporary developments in stock market theory which represent serious attacks on the validity of the EMH, have been advanced in the recent academic literature. These issues are to be reviewed in Chapter Four.

At this stage, a number of questions concerning market efficiency might be asked: Once anomalous evidence suggesting profit opportunity has been published, would not investors react quickly to this information and thus, arbitrage away the reported 'inefficiencies'?[22] Could such inconsistencies be viewed as evidence of market inefficiencies or "evidence that we don't yet completely understand equilibrium" [Elton and Gruber (1991), p. 431]? Could such anomalies and empirical regularities be considered as manifestations of "the fact that there are inadequacies in our current state of knowledge" [Jensen (1978), p. 100] and hence the imperfections in research methodology? Could all those evidence, issues and developments that question the validity of the EMH highlighted in this section, be judged as reflections of the fact that we are in some stage of advancement in knowledge and with "the advancement in knowledge, it is the fate of all theory to be encompassed, superseded or outright rejected in the long run" [Merton (1987), p. 97]?

Reinganum (1984, p. 839) in his 'discussion' entitled "What the anomalies mean" has written:

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[22]For example, if small company shares are identified as superior investments, why not the market bids up their prices until they reach a level at which risk-adjusted returns to future investors would merely be normal? [see Seligman (1983)].

"They mean that the theories of capital asset pricing (at least as they pertain to equity markets) have been toppled. They mean that the most interesting insights into the pricing behaviour of stocks are being discovered by tedious and painstakingly thorough examination of data. They mean that, in the constant ebb and flow between theory and empirics, empirics currently holds the upper hand".

As was implicitly noted, one basic problem that empirical researchers of the EMH have to confront is that, tests of the EMH are tests of the joint hypothesis: choice has to be made between rejecting the EMH or rejecting the testing procedure. By opting to reject the procedure, researchers are left with no conclusion about market efficiency[23].

A model of market equilibrium needs to be specified in testing the joint hypothesis of the EMH. Such a model serves the benchmark in verifying whether abnormal profits can be earned by exploiting the available information. In this case, model misspecification might lead to misleading results and conclusions. For example, the Capital Asset Pricing Model (CAPM) which enjoys widespread use in the testing of the EMH, has been identified as having a number of weaknesses [see e.g., Roll (1977), Blume and Siegal (1992). See also Chapter Four].

In essence, the growth or rather, the explosion of anomalous evidence and literature regarding market efficiency that has taken place in the recent past - "a coming mini-revolution in the field" as described by Jensen (1978) - provides a challenge to both the theorist and empiricist. To the empirical researchers, as stressed

[23]For example, Banz (1981) and Reinganum (1981) who find persistent abnormal returns in their tests and being unwilling to reject market efficiency, have to suggest that their results might be due to the misspecification of the CAPM rather than to market inefficiency.

by Bowers and Dimson (1988), the challenge not only lies in the realm of identifying anomalies and testing possible explanations for them: "There is also a serious question mark posed about the integrity of much of the methodology of financial research" [p. 13][24].

3.7-Summary and Concluding Comments

Efficiency of the securities markets is a concept that refers to the tendency of security prices to reflect economic information rapidly and accurately; i.e., everything known about the prospects of individual companies and the economy as a whole. When a market is efficient in that observed security prices reflect fundamental economic values, it is efficient in performing its role of allocating capital resources among the society's alternative uses of capital [see Mandell and O'brien (1992); Copeland and Weston (1988)]. Due to its fundamental importance in the theory of finance, the efficient market doctrine has permeated almost every part of modern financial theory and has become the mainstay of much of financial research.

The speed by which security prices adjust to fundamental information or new information is influenced by the efficiency of the market as an 'information processor'. Under the EMH, a capital market is viewed as an efficient information processor.

In an informationally efficient market, information is rapidly disseminated and

[24]Some of the methodological problems in testing the EMH are discussed by Merton (1987). See also Schwertz (1983).

reflected in prices. In a *perfectly* efficient capital market, as defined by Sharpe (1985) every security's price equals its investment value (or fundamental value) at all times. Prices are accurate signals of true values.

If stock markets are perfectly efficient, the following will be the major implications for investors:

(i) Since prices reflect all available information, the only reason for prices to change is the arrival of new (unanticipated) information. Since new information is as likely to be favourable as unfavourable, movements in security prices are as likely to be upward and downward: unpredictable.

(ii) Since prices reflect all available information, there will be no method of analysis -technical or fundamental - that will produce abnormal profit over and above the expected reward for the bearing of risk. Being efficient, the markets and their prices can be said to be fair in that every investor is given the same chance of making profits and losses on their investments.

(iii) In an efficient market, there are no rewards for taking on risks which can be avoided. *Specific risks* or *unsystematic risks* can be avoided by diversification; and rewards are only offered for bearing *market risk* or *systematic risk* which cannot be avoided.

(iv) Since prices reflect all available information, and changes in security prices are random and unpredictable, all one can hope to do is to buy and hold a well-diversified portfolio of shares which is expected to grow with the economy. In the absence credible evidence of a realistic prospect of achieving superior performance, buying and holding an internationally diversified portfolio with minimum costs, as suggested by Keane (1991), would be the optimal strategy for most investors.

Employing an active trading strategy on the contrary, would only increase brokerage costs without increasing the expected returns. Switching investments will only incur transaction costs and the possibility of taxation [Dobbins *et al.*(1994).

If a market is weak-form efficient, share price changes will be statistically random. Price history cannot be expected to repeat itself. Then, the foundation underlying technical analysis becomes vacuous because 'technical information' is no longer effective in detecting profitable trends.

If an equity market is semi-strong-form efficient, all publicly available information will be useless in predicting future prices. Investors cannot profit abnormally by acting on such information.

If a stock market is strong-form efficient, not only experts, analysts and professional investors will be unable to exhibit distinctive performance, but also *insiders* will be unsuccessful in trying to beat the market.

It is obvious then, that the issue of market efficiency is central to investor behaviour. The question is, however, do we really know that stock markets in general are efficient?

In the 1970s, the evidence summarised in Fama (1970, 1976b) led to widespread acceptance as a scientific fact that stock markets are efficient. Nonetheless, since about the second half of the 1980s, the subject of stock market efficiency has developed into a polemic in academia. Along with a huge body of evidence providing evidence consistent with stock markets being efficient (essentially in the semi-strong sense), there has also been a growing body of hypotheses and evidence suggesting that equity markets are, to some extent, inefficient.

Whilst, since the 1980s, the number of proponents for the EMH has been

extremely large, the number of opponents to the hypothesis has also been rapidly increasing. In 1979, a staunch proponent of the EMH and the eventual Nobel price winner, Franco Modigliani [Modigliani and Cohn (1979)] argued that in the late 1970s, because of inflation-induced errors, investors had systematically undervalued the stock market by 50%. He then admitted that "our conclusion is indeed hard to swallow - and especially hard for those of us who have been preaching the gospel of efficient markets" (p. 35). Robert Shiller [Shiller (1979, 1981a, 1981b, 1991)], a Yale economist and one of the leaders of the revolt against the EMH, suggested that financial markets display excess volatility and overreact to new information. Similarly, Summers (1986) showed that the strength of existing evidence confirming the hypothesis of market efficiency has been exaggerated. Tobin (1987) also does not believe that stock prices are rational estimates of fundamental values.

At this juncture, after considering and comparing the views and evidence provided by both sides of the debate on the EMH, we incline towards a stance expressed by Haugen (1990) that the stock markets are not *strictly* efficient with respect to any of the so-called levels of efficiency [see also Seligman (1983); Beckers (1988)]. While the evidence indicates that a great deal of information available at all levels, at any given time, is reflected in share prices; while the evidence indicates that the stock markets in general may not be easily beaten, 'the market' "appears to be beatable, at least if you are willing to work at it" [Haugen (1990), p. 666].

Notwithstanding that some minor or temporary inefficiencies may exist even in the well-established exchanges, such inefficiencies need not significantly affect the stock market's function in allocating capital resources. This suggests that, instead of asking a qualitative question of "are markets efficient?" we ought rather ask the more

quantitative question of "how efficient are markets?" As noted by Keane (1991, p. 31), the issue raised by the new evidence is not whether it makes the market inefficient, but whether it reduces its efficiency to a level that has significant economic consequences.

To date, although tests of the EMH have not yielded unanimous results, the balance appears to lie in favour of the EMH. Although the proliferation of anomalies and other new issues in stock market theory in recent years has perhaps put the EMH into the status more tentative or in the state of needing some updating, the efficient market paradigm still remains the dominant 'explanation' of stock price determination among academic researchers [see Tarascio (1984)].The important question, and perhaps the most relevant issue is, whether the EMH is sufficiently correct to provide useful insights into market behaviour [see Lorie and Brealey (1978)]

Correspondingly, whatever view one may hold about the EMH debate, as Keane (1991, p. 30) emphasises, it is beyond dispute that the its status is central to fundamental policies of investment practice, corporate financial management and corporate financial reporting. As there currently appears to be no promising candidate to supersede the efficient market paradigm, it is likely that the EMH will continue guiding a large body of theoretical and empirical work in modern finance and investment.

Given published evidence to date, and with the belief that the debate on this controversial issue of market efficiency is still far from being closed, we conclude the chapter with a statement made by Ross (1989) concerning the efficient market paradigm, as follows:

"Its usefulness is beyond question, but its fine structure is not" (p. 8).

CHAPTER FOUR

EQUITY PRICING, INEFFICIENCIES AND PREDICTABILITY OF THE STOCK MARKETS

A Review of Theory, Evidence and Practice

4.1-Introduction

The process of equity price formation under the assumption that markets are efficient, has been discussed in Chapter Three. As an extension to the foregoing chapter, the focus of the present chapter is on the various theories and investment approaches that provide alternative explanations to stock market behaviour and price formation. For the sake of comparison besides concentrating on those theories and models that appear to be in contradiction to the idea of market efficiency, theories or models that seems to be complementary to, or in accord with, the efficient market hypothesis (EMH), are also reviewed.

The chapter is structured as follows. We begin in Section 4.2 by reviewing the view of John Maynard Keynes - the noted British economist who was also known for his ability to make substantial profits (as well as losses) in the stock market - regarding stock market operations and behaviour. The philosophy and procedures of

technical analysis - the one which is believed to be the oldest investment approach - is discussed in Section 4.3.

So-called fundamental analysis is another investment approach which is believed to be widely followed and employed by stock market investors. The rationale behind the theory and practices of fundamental analysis is examined and analysed in Section 4.4. Comparison between technical analysis and fundamental analysis is also made in this section.

Early empirical studies of share price behaviour revealed that share price movements are essentially random. This apparent random character in share price changes, led to the development of the EMH. Since it was difficult, if not impossible, to 'beat' an efficient markets, investors were advocated to relate their investment returns expectations to risk; and to reduce risk, they should diversify portfolio. This led to the development of two elegent models of equilibrium asset pricing, known as the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT). Prior to the development of CAPM, there had been a 'statitical' model known as the Market Model (MM). These models are diasucssed in Section 4.5

In more recent years, stock market theory and evidence have witnessed a number of new results and developments that seriously question the notion of market efficiency and investor rationality. Some of these contemporary issues in stock market theory and evidence are surveyed in Section 4.6. Section 4.6 offers summary and conclusion for the chapter.

4.2-The Beauty Contest and the Castle-in-the-Air Theory

In a market, information is the input that drives trading, and security prices are an input of the system [Schwartz (1991b)]. While information can be classified into two broad categories - floor information and fundamental information -there is disagreement among theorists about what information will be utilized by investors in making their investment decisions[1]. Regarding this matter, Forsythe *et.al* (1982) identified four different hypotheses or 'models', one of which is termed by Copeland and Weston (1988) as the **speculative equilibrium hypothesis**. This hypothesis is based on Lord Keynes's (1936) famous 'beauty contest' metaphor, that the successful investors must base their investments on their expectations of others' expectations of value - on "what average opinion believes average opinion to be" [Keynes (1936), p. 159] - rather than solely on their own estimates of value [see e.g, Flood and Hodrick (1990)].

Analysing the operations of stock markets in his well-known book, *The General Theory of Employment, Interest and Money*, Keynes (1936)[2] drew an analogy between stock selection and a beauty contest (p. 156):

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[1]While we are interested in understanding how an investor's decision-making process, given the receipt of information, is reflected in the market prices of assets, this is not easy because it is impossible to observe the quantity and quality of information or the timing of its receipt in the real world [see Copeland and Weston (1988), p. 339].

[2]John Maynard Lord Keynes, the famous British economist and variously successful investor, devoted an whole chapter (Chapter Twelve) of *The General Theory* to discuss stock market and the importance of investor expectations. *The General Theory* was first published in 1936, the aftermath of the 1929 stock market crash and the worldwide recession that followed.

"..., professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole; so that each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one's judgement, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees".

Although we might debate about what Keynes really meant [Copeland and Weston (1988)], his analogy suggests one way of relating share prices to expectations [Schwartz (1991b)]. Investors are said to base their investment decisions entirely on their anticipation of the behaviour of market participants without any necessary reference to the actual payoffs expected from the assets[3] . Even though investors are able to make objective assessment of the assets, their decisions are more influenced by psychological factors. Being unwilling to lose out, investors tend to buy when others buy and sell when others sell. If an investor anticipates that other investors will

[3]According to Malkiel (1973, p. 23), Keynes applied psychological principles - mass psychology - rather than financial evaluation in his study of the stock market, that "any price will do as long as others may be willing to pay"; that it is "perfectly all right to pay three times what a stock is worth as long as later on you can find some innocent to pay five times what it's worth".

anticipate a price increase, he or she will buy the share. If there is a preponderance of investors in the market who have the same anticipation, buying pressure will increase the current market price of that particular share: the anticipation turns into a reality. This phenomenon of the stock market was described by Keynes (1936, p. 154) in the following eloquent terms:

> "A conventional valuation which is established as the outcome of the mass psychology of a large number of ignorant individuals is liable to change violently as the result of a sudden fluctuation of opinion due to factors which do not really make much difference to the prospective yield; ...".

This psychological approach to stock market investments which is based on the premise that stock prices are guided by emotion rather than reason [Chandra (1993], enunciated most lucidly by Keynes in 1936, has been described vividly by Burton G. Malkiel [Malkiel (1973)] as the **castle-in-the-air theory**. According to Malkiel (1973, p. 22), it was Keynes's opinion that professional investors prefer to devote their energies to an analysis of how the crowd of investors is likely to behave in the future and how during periods of optimism they tend to build their hopes into castles in the air.

The castle-in-the-air school of thought suggests that the value or price of a stock depends entirely on the psychology of the investing crowd and has nothing to do with the intrinsic value or market fundamentals [see Sivalingam (1990); Malkiel (1973)]. In other words, in order to understand and anticipate share price movements and hence, to make investment positions - to make the "buying before the crowd" [Malkiel (1973), p. 22] - advocates of the castle-in-the-air theory ignore intrinsic values and just look to the interpretation and prediction of investor sentiments and

actions [see Maturi (1994)]. The theory just "concentrates on psychic values" [Malkiel (1973), p. 22], propounding that the price of a stock depends on what the next person in the market is willing to pay for it.

As 'irrational animals', investors are believed to be overly optimistic or pessimistic: they tend to build 'castles in the air' and push prices up when they are optimistic; they sell shares in panic when they are pessimistic, pushing the price down. Under this school of thought, an investor is advocated to read and understand the mind of the market, so that he/she can buy just as the crowd starts to buy, and conversely, sell as the crowd starts selling.

It is believed that market psychology and herd instinct often play a leading role if not major role, in the determination of stock prices and market direction [see Maturi (1994]. Thus, studying and understanding how the crowd thinks and reacts, both in normal circumstances as well as in panic situations are considered central, so that proper investment moves could be taken.

Pratten (1993) has accomplished a study to assess the contemporary relevance of Keynes's writings about the stock market. In his concluding remarks, he writes:

> "The conclusion of this study is that Keynes did provide important insights which apply to the operation of the contemporary stock market, and to the explanation of the erratic movement of asset prices. Uncertainty about the future, which was the focus of Keynes's analysis, and the reaction of agents to that uncertainty also undermine the apparent virtuosity of the finance theory that Professor Brealey finds so convincing" (p. 186).

4.3-Technical Analysis

Technical analysis is, perhaps, the oldest approach to stock market investment. Probably, it is also one of the most controversial aspects of investment management.

Technical analysis is an approach to predicting stock price behaviour based on the premise that the value of a stock depends primarily on supply and demand and may have very little relationship to intrinsic value[4]. It refers to the study of stock market actions both in aggregate and for individual securities [Maturi (1994); see also NYIF Grouop (1989)]; it refers to the study of price movements of the immediate past for telltale indications of movements in the immediate future [see Firth (1972), p. 39].

Glydon (1995) defines a technical analyst as one who studies market action, primarily through the use of graphs, for the purpose of forecasting future prices. Technical analysts believe that because people make markets, and people change little, they will repeat their previous actions under similar conditions [Teweles *et.al* (1992)]. Technical analysts who agree with the 'castle-in-the-air' perspective [Sivalingam (1990)], believe that market operators as creatures of habit, under similar situations, tend to behave in the same predictable manner. Based on this belief, technical analysts contend that[5] [see Teweles *et.al* (1992), p. 438]:

(i) the study of statistics involving transactions can forecast the direction of future prices - that past price behaviour (and other market indicators) contain useful

[4]See Pinches (1970, p. 105); Fischer and Jordan (1987, p. 512); NYIF Group (1989, p. 3) and Levy (1967).

[5]These contentions are clearly in contrast with the EMH which asserts that the travel of information in a market is random and unpredictable and hence, share price changes are random, independent and unpredictable.

information that can be harnessed to predict future price levels and movements;

(ii) the market has so much nonrandom and predictable elements in it that studying its actions and behaviour is profitable over time[6].

In general, technical investment analysis involves two approaches:

(i) the qualitative techniques which rely on the interpretation of some typical configuration of the ups and downs of price movements (such as head and shoulders, bottom and top and Elliott Wave formations); and

(ii) the quantitative techniques which try to isolate runs from non-directional movements using statistical transformations.

Chartists or technicians claim that by taking time to chart past prices (and other related historical financial data) and analyse them carefully, investors will be able to make superior forecasts of prices and hence abnormal profits. This is because, they believe, history repeats itself; that "what goes up must come down"; that "what has hit rock bottom must rise again" [Sivalingam (1990), p. 4].

Chartists maintain that history repeats itself because people tend to 'repeat' themselves. "Human psychology being what it is, investors and traders tend to react the same way to a set of market conditions every time they occur" [NYIF Group (1989), p. 4].

In contrast to the view of fundamental analysts (see Section 4.4), technical analysts do not believe that it is necessary to study economic fundamentals in order to know where the price of a security is going [see Reilly (1985)]. Instead, they

[6]According to Levy (1967), technicians have the view that stock markets are oligopolistic in nature and therefore, they believe that there is an unequal distribution of critical information throughout the market place. "As the awareness of critical information gradually spreads, influencing the actions of market traders, recurring patterns and continuing trends in price movements are produced" (p. 69).

contend that all variables affecting value (e.g., economic, financial, political and even psychological variables) are eventually reflected in price [Levy (1967)]. Studying economic fundamentals is considered futile because price is governed by basic economic and psychological inputs so numerous and complex that no individual can hope to understand and measure them correctly [see Bhalla (1983)].

The basic philosophy and assumptions of technical analysis can be summarised as follows[7]:

- The market value of a security is determined solely by the interaction of supply and demand.
- Supply and demand are governed by numerous factors - some rational and some irrational. Included in these factors are fundamental elements (i.e., those relied upon by the fundamentalists), opinions, moods, guesses (good and bad) and blind necessities. The market weights all these factors continually and automatically.
- Though there are fluctuations in the market, share prices tend to move in trends that persist for an appreciable length of time.
- Reversals or changes in trends are caused by shifts in supply and demand.
- Shifts in supply and demand (and hence price movements) - which are gradual rather than instantaneous - whatever their cause, can be detected sooner or later in charts of market actions.
- As history repeats itself, many chart patterns tend to recur. Consequently, chart monitoring is fundamental in forecasting price movements.

Clearly, technical analysts have sought to rationalise the basis of what they are

[7]See Levy (1967), p. 83; Pinches (1970), p. 105; Francis (1988), p. 581 and Hirt and Block (1990), p. 263].

doing on the widely accepted economic premise that prices are determined by supply and demand. In fact, in one respect, the philosophy that underlies technical analysis appears to concur with the thinking of the EMH supporters: that the market as a whole has a superior knowledge to that of individual investors; whatever causes stock price to go up or down already reflected in the price of current trades [see NYIF Group (1989), p. 3].

The major differences between the philosophy and assumptions of technical analysis and the EMH relate to the information dissemination process and to how quickly investors adjust stock prices to reflect this new information [Reilly (1985)]. When new information comes to the market, technicians believe that it will not be available to everyone [see footnote 11]. Moreover, analysis of the information and subsequent action by the various groups in the market, are believed to take place over a period of time rather than rapidly. Thus, given this gradual dissemination of information and gradual analysis and action, contradictory to the EMH, technicians hypothesize that stock prices move slowly to a new equilibrium, following the release of new information into the market [see Reilly (1985), p. 195].

Because price adjustment is believed to be gradual, technical analysts contend that during the adjustment period, prices tend to move in a trend (i.e., in one direction) that persists (for a significant period) until a new equilibrium is reached. In this connection, the task of a technician is to derive a system that enables him/her to detect the *beginning* of a movement from one equilibrium value to another, so that advantage can be taken from this 'gradual change in equilibrium value' to garner above average returns. So, given this basic premise that *stock prices move in trends that persist* - at least until influencing factors alter the demand-supply relationship [see

Maturi (1994)] - technicians employ a wide variety of tools or 'barometers'[8] to assess the strength of supply and demand factors [see e.g., Pinches (1970), p. 105; Fischer and Jordan (1987), p. 88].

Quite a large number of tests have been conducted attempting to obtain statistically reliable estimates of the worth of various technical trading strategies. As we have discovered in Chapter Three, these tests have given less than overwhelming support to the various technical theories examined to date, while at the same time not supporting random walk unequivocally. For example, Kemp and Reid (1971) in an early study of the behaviour of equity prices in Britain write,

> "Our conclusion is that share price movements were conspicuously non-random over the period considered. This result, we feel, should be a caution to those who have been startled by the apparent finding of randomness in share price movements in their studies. Their findings are often as much a product of the method of analysis as they are an intrinsic feature of the data" (47).

The widely held view among academicians is that technical analysis is useless because, in their early studies they did not find enough evidence of patterns in past share price changes [see e.g., Lofthouse (1994)]. Since the studies of technical analysis that have demonstrated careful data collection, risk adjustment and testing procedure are rare, some have countered the academicians' view with the following points [see e.g., Fischer and Jordan (1987), p. 535]:

a) The same technical theories are often applied differently by different technical analysts. The success of the strategy is often dependent on the man rather

[8]Teweles *et.al* (1992) classify technical devices into four broad categories: (i) pattern on price charts; (ii) trend-following methods; (iii) character-of-market analysis; (iv) structural theories.

than the method alone. Whether the tests that have been performed on technical theories or technical tools as they are used in practice, could be questioned. For example, the joint evaluation of price and volume is central to some kinds of technical analysis, whereas in the academic literature, tests that have jointly analysed volume and price are rare.

b) Many technical analysis schemes have not been tested. Only selected phases of technical analysis have been rigorously tested, and at a time, only one. It is possible that technical methods that have yet been untested will prove to have greater usefulness that those already examined. Moreover, technicians frequently use a combination of numerous technical indicators or methods.

Joy and Jones (1986) point out that weak-form market efficiency is not synonymous with market efficiency with respect to technical analysis because the latter is broader than the use of past price changes alone. The analysis of past price history is only one form of technical analysis. Believing that technical analysis has *not* been tested thoroughly, and in the spirit rigorous academic research, Joy and Jones (1986) criticise the claim that technical analysis has been shown to be useless, on the following grounds:

a) There is not a one-to-one mapping between weak-form analysis of market efficiency and technical analysis.

b) Many weak-form tests of market efficiency are not direct tests of specific forms of technical analysis. These tests do not actually attempt to measure the returns from trading.

The profit validity of technical analysis which has been the subject of a rather heated debate over the last 30 or 40 years, is still an open controversy [see Mandell

and O'brien (1992)]. While in the random walk literature, many researchers have seriously questioned the overall value of technical analysis - that the market is efficient enough to enable abnormal profit from trading based on past security prices - adherents of technical analysis have done very little to defend their theories against such critiques.

All that chartists appear to have done is to claim that their various trading systems and tools work [see e.g., Damant (1971)], without proving or demonstrating that their methods can consistently outperform a simple buy and hold strategy [see Fischer and Jordan (1987)]. Treynor and Ferguson (1985), "In Defence of Technical Analysis" - in an attempt to demonstrate the usefulness of knowing past price information in making investment decisions, using a "Bayesian probability estimate" - have shown that past prices, when combined with other valuable information can indeed be helpful in achieving "unusual profit". They however conclude that, "it is the nonprice information that creates the opportunity. The past prices serve only to permit its efficient exploitation" [p. 773; see also Sorensen (1985)].

A number of recent studies using more sophisticated procedures have demonstrated that technical analysis is a worthwhile activity[9]. Golberg and Schulmeister (1988) for example, have conducted an interesting study of the efficacy four major types of "objective" technical trading rules using the S&P 500 Index. Different from the previous studies (which concentrate on testing filter rules using daily and lower frequency data), they test the profitability of a number of widely used technical trading rules (i.e., moving average models, momentum models, the point and

[9]For a brief survey of literature that appears to suggest the profitability of technical trading strategies, see e.g., Pruitt and White (1988).

figure technique, and filter rules) in both the cash and futures markets, using hourly data. The study arrived at the following conclusions (p. 2):

(i) "stock price movements do possess systematic price runs and that past prices do contain information relevant for predicting future price movements";

(ii) "although this price information may be unexploitable in the cash market for stock, it is exploitable in the futures market for stock, i.e., there are exploitable profit opportunities available in stock index futures";

(iii) "one of the major results of this study is that all of the technical rules examined are considerably more profitable with hourly data than they are with daily data";

(iv) ... the stock market, in the broader sense, is therefore inefficient".

Pruitt and White (1988) use what they termed as "the CRISMA (Cumulative volume, Relative Strength, Moving Average) trading system" to determine the profitability performance of a multi-component technical trading system incorporating price, volume, and relative strength indicators on individual security issues. Their conclusions are as follows (p. 58):

> "The results of the study, which are consistent across several different return-generating models, provide impressive support for the success claims of technical analysts. They suggest that the CRISMA trading system is capable of outperforming a simple buy-and-hold strategy over a significant period of time, even after adjusting for timing, risk, and transaction costs".

Based on their results, Pruitt and White (1988, p. 58) confidently write:

"Who says technical analysis can't beat the market? Not us. Not any more". 10

examination of technical analysis from a number of aspects leads us to some puzzles:

If the technical trading rules really are profitable, why does not everyone use them? Why does not the use of these rules lead to disappearance of the initial profit opportunities? If technical analysis is useless and has no value to investors, how can it survive over long periods of time? What is the significance, if any, of trading based on technical strategies (i.e., noise trading) for stock price movements? Seemingly, the answers to these questions are deceivingly complex. Given the imperfections, inefficiencies and irrationalities that appear to characterise (to some extent) some stock markets [see e.g., Ariff and Johnson (1990)]; given the increasing evidence documented in the literature that stock returns (to some extent) are predictable (see Section 4.6), technical analysis might be helpful to investors[10]. According to such arguments, technical analysis might be of some, albeit limited, value in conjunction with fundamental analysis[11] in guiding investment decisions in such 'inefficient' stock markets [see e.g., Fischer and Jordan (1987); Teweles (1992)].

4.4-Fundamental Analysis

Fundamental analysis - an investment approach which is perhaps most commonly employed by investment professionals - as defined by Mandell and O'brien

[10]Technical analysis is claimed to have a number of advantages [see e.g., Reilly (1985), pp. 475 - 476; Francis (1988), pp. 603 - 604]. Although there is little theoretical basis for the technical approach, there are enough investors (charting practitioners) who do believe in its predicting power [see e.g., Teweles *et.al* (1992), p. 438; Maturi (1994), p. 32; Bhalla (1983), p. 308] that it could perhaps become self-fulfilling. With this in mind (and although there is very limited empirical evidence that would support such a belief), the impact of technical analysis on stock market behaviour should not be simply ignored.

[11]In the investment community, investors are often recommended to put their money in quality stocks, but buy and sell them on the basis of technical analysis. As described by Bhalla (1983, p. 310), "The orthodox synthesis between the two basic approaches is that once fundamental analysis has found the stocks, their purchases or sale can best be timed through technical analysis".

(1992, p. 339), refers to the examination of economic factors of supply and demand that are expected to influence the future income and value of an investment. In Spooner's (1984, p. 79) words, "Fundamental analysis is a method of systematically modelling facts - economic and industry statistics, financial ratios, et.al - in order to derive in a logically coherent manner an explanation, hence an understanding, of observed phenomena".

The fundamental approach to security analysis which is based on what Malkiel (1973, p. 19) describes as the **firm-foundation theory**, involves a detailed, objective, scientific examination or analysis of all components of the value of a security [see Mandell and O'brien (1992)]. Spooner (1984, p. 79) accents that fundamental approach to security analysis is procedurally congruent to the method articulated by Darwin with respect to the natural sciences. As "applied business scientists", fundamental analysts or fundamentalists observe, model and draw conclusions with the object of making progress: They buy shares issued by a company only after determining that it is structurally fit to survive in a growth industry and suited to the dynamics of the economy[12] [see Spooner (1984, p. 80].

The basic tenets of fundamental analysis can be summarised as follows[13]:

- At any point in time, every stock has an intrinsic value. This intrinsic value depends on the earnings potential of the stock which, in turn, depends upon underlying

[12]This implies that fundamentalists buy shares based on the principle of *survival of the fittest* (which was introduced by Charles Darwin in his book, *Origin of Species*) and by doing so, according to Spooner (1984, p. 80), they contribute in a self-fulfilling way to a company's fitness. Further, it is believed that, with their 'coexistence in competition with one another' (under the principle of survival of the fittest), they instigate "behaviour that results in the most efficient allocation of financial resources" [Spooner (1984, p. 80].

[13]See Chandra (1993), p. 18; Fischer and Jordan (1987), p. 87; Reilly (1985), p. 196 and Bhalla (1983), p. 283.

economic (fundamental) factors. Thus, the intrinsic value of a stock - in principle, should be equal to the present value of the future stream of income from that particular stock, discounted at an appropriate risk adjusted rate of interest - can be established by a penetrating analysis of the fundamental factors relating to the company, industry and economy.

- At any point in time, there are some securities, the prevailing market prices of which, would differ from their intrinsic values. Sooner or later however, the market prices of those securities would approach their intrinsic values.

- Above-average returns can be earned by buying *undervalued* securities and selling the *overvalued* ones.

Accordingly, the focus of fundamental analysis is on intrinsic value (sometimes known as the present value or the economic value) or what fundamental analysts consider as the real worth of a stock [see Teweles *et.al* (1992), p. 437]. Believing that actual prices tend to move towards their intrinsic values or equilibrium prices, then endeavouring to estimate the intrinsic value of a security is considered equivalent to making a prediction of its future price; and this, according to Fischer and Jordan (1987), is the essence of the predictive procedure implicit in fundamental analysis.

Fundamental analysts argue that the price of a stock is equal to the discounted value of the stream of future income from the stock, and hence, at any time, it is a function of a set of anticipated payoffs and anticipated capitalisation rates corresponding to future time periods [Pinches (1970), p. 104]. The price of a stock changes as anticipations change and a major source of altered anticipation is of new information [Fischer and Jordan (1987), p. 98].

In case there is something less than complete dissemination of information, it

is argued that, the actual price of a stock will generally be away from its intrinsic value or theoretical value[14]. Fundamentalists believe that, more often than not, the market can be wrong in appraising the value of a stock. Hence, the job of a fundamental analysts is to detect the *mispriced* (i.e., overvalued or undervalued) stocks based on their 'unbiased' estimate of intrinsic values.

Fundamentalists assert that, at any given point of time, some stocks may be selling at levels significantly above or below their fair levels (i.e., intrinsic values) because some information concerning those stocks has not yet been correctly evaluated by the market. Given such a phenomenon, it is possible to isolate and quantify information about the market (or the economy), industries, or individual companies' operations that has not yet been discovered and used by others to create profitable opportunities.

Using the dividend valuation model, the intrinsic value or present price (P_0) of a share is determined by the present value of an expected stream of future dividends (the first of which is D_1) discounted at an appropriate risk-adjusted discount rate (r). The formula - the Gordon-Shapiro (and Williams) model - that is normally used by financial analysts is

$$P_0 = \frac{D_1}{(r - g)} \tag{4.1}$$

or, in terms of the rate of return

[14]See Pinches (1970, p. 104; Bhalla (1983), p. 283 and Fisher and Jordan (1987), p. 87.

$$r = \frac{D_1}{P_0} + g$$

where g is an assumed constant compound rate of annual growth in the firm's cash dividends.

Another popular fundamental approach to estimating intrinsic value is using earnings valuation models. A variation on the dividend model, this approach substitutes earnings as the main income stream for valuation[15].

Even though professional fundamental analysts and technical analysts appear to have enjoyed a peaceful coexistence - and in the investment community, both fundamental and technical approaches are commonly viewed and employed as complementary rather than alternatives to one another - for decades they have been quarrelling intellectually [see Francis (1988)]. The fundamental approach to security analysis is in sharp contrast to technical analysis. Indeed, technical analysis is sometimes considered to be the antithesis of fundamental analysis because it involves relatively very few of the scientific tools of economics [see Mandell and O'brien (1992)].

The basic difference between the philosophy of fundamental analysis and technical analysis is in terms of factors supposed to determine movements in share prices. According to fundamental analysts, *forces outside the market* - fundamental economic and political conditions - are the major determinants share price behaviour [see e.g., Teweles (1992)]. Technical analysts, on the other hand, posit that *forces*

[15]For a discussion on this approach, see e.g., Hirt and Block (1990), pp. 196 - 208 and Francis (1988), pp. 515 - 518.

inside the market - human psychology: people's opinion, belief, attitude and sentiment (towards the market) - are the major elements worth considering in 'stock pricing' or in making investment decisions. So, if fundamental analysts believe that the stock market is rooted 90% in *economics* and 10% in *psychology*, technical analysts hypothesise that it is 90% *psychological* and only 10% *logical* [see Chandra (1993); Bhalla (1983)]. Correspondingly, if technical analysis is in accord with the castle-in-the-air theory[16], fundamental analysts disagree with this theory [see e.g,, Sivalingam (1990)].

If the focus of fundamental analysts is on *intrinsic value*, technical analysts concentrate on *trends* of historical price movements. This implies that fundamental analysts seek to forecast *security values*, whereas technical analysts are trying to forecast *security prices* [see Francis (1988), p. 581]. Put another way, fundamental analysts are interested in the total return[17] in stocks over relatively long periods, whereas technicians are interested in the interpretation of stock price movements over short periods[18] [see Teweles *et.al* (1992); Francis (1988),]. Therefore, the fundamental approach to security analysis is more likely to be favoured by long term investors, whereas technical approaches are more commonly employed by speculators or traders interested in short term capital gains.

The neo-classical economists and financial theorists who in general, conjecture that stock markets are efficient, disagree not only with the chartists and the believers

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[16]According to Chandra (1993, p. 19), those who subscribe to the castle-in-the-air theory generally use some form of technical analysis. Odd-lot theory, contrarian investing and consensus indicators are among the major investment approaches that are based on investor psychology [see Maturi (1994), p. 95].

[17]And hence, they carefully consider dividend return as well as expected price appreciation.

[18]And hence, they try to forecast short-run shifts in supply and demand that will affect the market price of one or more securities.

in the 'castle-in-the-air' school of thought, but also with fundamental analysis. As we have examined in the previous chapter, advocates of the efficient market theory maintain that the market adjusts very rapidly to new information, and because of this, shares tend to be correctly priced at any given time. As prices randomly readjust their equilibrium values, there will be no such thing as undervalued or overpriced securities; and price movements are unpredictable.

When a market is perfectly efficient, it is said to be in **continuous equilibrium**[19]. If any disequilibrium exists in the market, even temporary in nature, then the market is said to be less than perfectly efficient.

In Chapter Three, the empirical evidence that we have gathered, suggests that stock markets are not perfectly or strictly efficient. Regarding this issue, Francis (1988) has the view that stock markets might behave somewhat similar to the one suggested by Cootner's (1962) 'price-value interaction model'[20] that prices tend to fluctuate randomly in pursuit of constantly changing intrinsic values; that prices will fluctuate freely within the *reflecting barriers* [see Francis (1988), p. 435]. A market of this nature is termed an **intrinsic value random-walk market**[21].

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[19]The concept of *continuous equilibrium* was developed by Paul Samuelson (1973). The concept refers to the perfectly efficient market where the market prices of securities equal the randomly fluctuating intrinsic values at every instant in time. When a new piece of information is released, the intrinsic value of a security changes and consequently, its market price adjusts towards the new value.

[20]In Paul Cootner's model, security prices are viewed as a series of constrained random fluctuations around their intrinsic values or true values. He hypothesizes that there are two groups of investors in the market. The first group, which Francis (1988, p. 433) refers to as the "unsophisticated investors" are those who just have access to public news media for their information but may not know how to interpret that news. These investors are largely responsible for share prices diverging from intrinsic values.

The second group - the "professional investors" [Francis (1988), p. 433] - are those who have the resources to discover news as well as the ability to estimate intrinsic values before the "nonsophisticated investors" can even get the news. So, when a security's price appears to differ significantly from its true value, the "professional investors" find it profitable to correct the disequilibrium.

[21]The phrase was coined by Fama (1965a).

In an intrinsic value random-walk market, fundamental analysis could play an important role in evaluating security prices. Fundamental analysis could be very useful in detecting the occasionally mispriced shares [see Aczel (1988)]. Fundamental analysts who discover valuable information that the market has not yet digested and reflected in its security prices, may be able, as suggested by Francis (1988), to select shares that earn higher-than-average returns[22]. Whether a stock market is 'an intrinsic value random-walk market' or not, however, is an empirical issue.

4.5-Models of Market Equilibrium

Although there have been traditional arguments about whether technical analysis or fundamental analysis is more important and effective in understanding share price behaviour and hence, in making investment decisions, a great deal of attention has been directed towards the efficient market hypothesis (EMH) and its implications for all types of investment analysis. Hypothesizing that stock markets are well-ordered and efficient, the neo-classical financial economists proposed that shares should be picked based on their risk and return characteristics: that the return to a share is dependent on its risk class. Based on this belief and assertion, they then developed what some authors call the 'modern investment technology' comprising Modern Portfolio Theory, Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT).

The aforementioned theories are parts and variants of a collection of theories,

[22]That is, after considering various types of costs such as transaction costs, the cost of getting access to information and the cost of interpreting the information.

generally known as the capital market theory, which attempts to explain the behaviour of securities markets. While portfolio theory which deals with what investors should do - describing how rational investors should build efficient portfolios - is an aspect of *normative economics*, models of asset pricing which describe how assets might be priced, are in the realm of *positive economics*.

The story of modern portfolio theory began in the 1950s, with the classic contributions of Harry Markowitz (1952, 1959) who developed a theory of portfolio selection. His work has resulted in a revolution in the theory of finance leading to the development of modern capital market theory. Doubtlessly, these frameworks and rules for selecting efficient securities and portfolios not only revolutionized capital market theory but also laid the foundations for subsequent development of general equilibrium models of asset prices known as the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Model (APT). Both of these models are based on the concept of linear relationships between risk and return, a concept which was first systematically analyzed by Markowitz and then extended by William Sharpe (1963).

4.5.1-The Market Model

Notwithstanding that portfolio theory provides a basis for determining efficient frontiers or efficient portfolios, the determination of such portfolios requires a substantial amount of data and calculations. With this in mind, Sharpe (1963) formulated a model which was considered a major breakthrough in the practical utilization of portfolio theory developed by Markowitz (1952, 1959).

In his article, Sharpe (1963) introduced the idea that the return of any security

could be related to the return of the market as a whole[23]: that the computation of the covariance between individual pairs of stocks could be considerably simplified if their relationship could be linked through the market as a whole. This relationship, known as the market (single-index or diagonal) model (MM), is specified as a simple least squares regression as follows

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{4.2}$$

where

R_{it} = the return on security i in time period t;

R_{mt} = the market return for the same period;

β_i = beta, representing the slope of the line[24];

α_i = alpha, the intercept term for security i;

ε_{it} = the unexplained residual return (which is the difference between the actual and the expected return) observed in period t. In other words, ε_{it} is the classical mean-zero normally distributed error term.

The MM (equation 4.2), is the simplest of the three basic types of models of asset pricing that have most frequently been employed by capital market researchers[25]. The model is based on the fact that returns on security i can be linearly

[23]The return of the market could be approximated by using the return on a suitable stock market index. For a mathematical discussion of the market model, see e.g., Fama (1973).

[24]The line showing the average tendency of a stock's returns to vary with the market's, that can be drawn from equation (4.2), is known as the *characteristic line* [see e.g., Lofthouse (1994, p. 17; Francis (1988), p. 760].

[25]The other two models are the CAPM and the counterpart to the CAPM which has come to be known as the *empirical market line* [see Copeland and Weston (1988), pp. 361 - 362].

related to returns on a 'market' portfolio.

From the model, β_i indicates the expected responsiveness of the return of security i to changes in the level of the market index. The intercept term, α_i, represents the expected return on security i when the market return is zero. The market itself has a beta of 1 and thus, if a security has a beta equal to 1, the security's returns is expected to go up and down with the return for the market. If beta is greater than 1, assuming α is zero, returns on the security are expected to be higher than the market when market returns are positive and lower than market returns when market returns are negative. A negative beta would imply that the returns on the security and the market tend to move in opposite directions.

The MM is very similar to the CAPM (see Section 3.5.2); it can be regarded as the *ex post* version of the CAPM[26] [Griffiths (1990), p. 88]. Both models express the mean return on a risky asset as a linear function of a 'market' factor [Peasnell (1986), p. 34]. The MM which provided the conceptual foundation for the CAPM [Dobbins *et.al* (1994), p. 48], permits a practical implementation of the CAPM: it provides an empirical link that allows us to test the theoretical relationships that are contained in the CAPM [Jacob and Pettit (1984), p. 381].

Perhaps, because of the similarity of mathematical construct between the two models, the CAPM is sometimes confused with the MM. These two models are essentially different however, in a number of respects[27] [see Peasnell (1986), p. 34;

[26]According to Jacob and Pettit (1984, p. 400), in equilibrium, α_i will equal $(1 - B_i)R_f$ if the security is priced according to the CAPM. Also, *ex post*, α_i reflects the past performance of the security if the market index used in the relationship is the market portfolio of the CAPM.

[27]These fundamental differences explain why researchers have encountered considerable difficulties in designing appropriate tests of the CAPM: the MM is testable, while the CAPM is not.

Hawawini (1984), p. 13]:

(i) The MM which is simply a statistical model[28] developed in order to reduce the data used in the construction of efficient portfolios, unlike the economic CAPM, is not supported by economic theory [see Copeland and Weston (1988), p. 362].

(ii) The MM applies to both future and historical prices, whereas the CAPM is simply a statement about expectations.

(iii) The 'market factor' in the MM can be any convenient stock market index, whereas the market portfolio in the CAPM must be the value-weighted aggregate of all risky assets.

(iv) The intercept term in the MM can take any value, whereas in the CAPM it is precisely specified.

The validity of the MM has been well established by a large number of studies using the data from the New York Stock Exchange [see King (1966); Fama *et.al* (1969)][29]. Studies that have been performed on European data have produced similar results [see e.g., Hawawini (1984)].

4.5.2-The Capital Asset Pricing Model

The MM, albeit a very useful model from the practical research point of view, has some weaknesses. For example, as mentioned earlier, the model is developed without any theoretical foundation. To overcome such shortcomings, Sharpe (1964) proposed another model known as the Capital Asset Pricing Model (CAPM).

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[28]Being just a *statistical* description of the association between the returns of individual securities and those of a market index, unlike the CAPM, the MM is actually not an equilibrium asset pricing model [see Hawawini (1984), p. 11].

[29]For a survey of early literature on the market model, see e.g., Jensen (1979).

The CAPM de facto, was independently and more or less simultaneously, developed by Sharpe(1964), Lintner (1965) and Mossin (1966) - about twelve years after Harry Markowitz laid down the foundation for modern portfolio management in 1952. The theory is therefore, often referred to as the Sharpe-Lintner-Mossin CAPM.

The birth of the CAPM is of great historical significance because it was the first equilibrium model of asset pricing under the assumption of uncertainty[30]. Today, this mean-variance Capital Asset Pricing Model has emerged as a very important concept in modern investment theory and practice. The CAPM has been the basis of a very large number of empirical studies which, as claimed by Hakansson (1989), show that the CAPM provides a rather good first approximation of observed return structures in the financial markets of various countries. The importance of the CAPM in the literature of investment, has been aptly described by Lofthouse (1994, p. 33) in the following words:

> "The capital asset pricing model is part of the vocabulary of investment, and anybody who reads the academic and professional literature has to know the gist of the theory".

The CAPM or the security market line (SML) as it is also called, is a relationship explaining how assets should be priced in the capital markets [Fischer and Jordan (1987)]. It seeks to specify the relationship between risk and return.

For a well diversified portfolio, the only relevant risk is systematic risk because the unsystematic risk tends to approach zero as the number of randomly selected securities in the portlio is increased. Since unsystematic risk can be diversified away

[30]For a historical perspective (in some detail) of the development of the theory of asset pricing under the assumption of uncertainty about future asset returns, which started at least with the work of Irving Fisher in 1906, see Brennan (1989).

easily, the main factor that risk-averse investors should consider in deciding whether a security yields enough rate of return for them to invest, is *systematic risk*[31]. In equilibrium, the market should only reward investors for bearing the undiversifiable risk[32] - the systematic risk.

The CAPM - "a centerpiece of modern financial economics" [Bodie *et.al* (1989, p. 228] - which provides a methodology to determine asset prices under the conditions of equilibrium, relates the expected return to each level of systematic risk. These expected returns can be interpreted as the appropriate rate of return the investors should expect for each level of undiversifiable risk assumed. The model assumes that extra risk will only be borne for extra return, and assets with the same level of risk will yield the same return [Lofthouse (1994)].

The CAPM not only prescribes optimal portfolios for investors but also derives an equation relating the expected return and risk of any security [Rutterford (1993]. The CAPM, as defined by Francis (1988), is a linear relationship in which the expected rate of return from an asset is determined by that asset's systematic risk. This relationship is summarised in what has been called the Security Market Line of the CAPM [Copeland and Weston (1989); see also Allen (1985)]:

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[31]The sources of systematic risk are those factors that occur systematically such as changes in the purchasing power of money (i.e., inflation), interest rate fluctuations, 'bull and bear' of the market and political factors. These factors - encompassing changes in economic, political and sociological environment - are so general in influencing the riskiness of a security that it is impossible to avoid them via portfolio diversification.

[32]An investor will not be rewarded for any risk arising as a result of holding the share on its own, and not as part of a diversified portfolio. In other words, in equilibrium, *systematic risk* is the only risk that should be priced because *unsystematic risk* is assumed to approach zero in a large portfolio.

$$E(R_i) = R_f + \frac{[E(R_m) - R_f]Cov(R_i, R_m)}{\sigma^2_m} \tag{4.3}$$

where $E(R_i)$ and $E(R_m)$ are the expected return on security i and on the market portfolio, respectively. The SML intersects the vertical axis at the riskless rate, R_f, and this riskless rate of interest is the appropriate rate of return for an asset with zero risk. $Cov(R_i, R_m)$ is the covariability of returns on security i with returns of the market portfolio; σ^2_m is the variance of returns on the market portfolio.

Equation 4.3 simply states that the return required (*ex ante*) by investors on any asset or security is equal to the return, R_f, on a risk-free asset plus an adjustment for risk. The relevant risk here - the systematic risk or undiversifiable risk - is determined by the covariability of returns on an individual security with those of the market portfolio. This measure, $cov(R_i, R_m)/\sigma^2_m$, is usually referred to as the 'beta' (β) coefficient. Thus, the CAPM is frequently written as follows:

$$E(R_i) = R_f + [E(R_m) - R_f]\beta_i \tag{4.4}$$

or [see Rutterford (1993), p. 266]

$$E(R_i) = a_i + b_iE(R_m) \tag{4.5}$$

where a_i is equal to $R_f - \beta_iR_f$ and b_i is equal to β_i.

In equation (4.4), $[E(R_m) - R_f]$ is the quantity that represents the slope of the SML. β_i, the independent variable representing the systematic risk of security i,

determines the dependent variable, $E(R_i)$. In this linear relationship, the higher the beta (β_i) for an asset, the higher the systematic risk and therefore, the higher must be the expected return. Further, the difference in beta between any two assets will determine the difference in their expected returns.

In sum, the CAPM suggests that the systematic risk is the only ingredient in determining expected returns on an asset [Fischer and Jordan (1987), p. 628]. Further, the model suggests that, an expected rate of return is made up of two components [see Francis (1988), p. 768]:

(i) The *price of time* which is represented by the CAPM's intercept, R_f. This component of the expected rate of return on an asset, compensates the investor for delaying consumption in order to invest.

(ii) The *price of risk* which is measured by the slope of the CAPM, $[E(R_m - R_f]$. This component which is equal to the expected return on the market portfolio in excess of the risk-free rate, indicates how much extra risk has to be borne in order to obtain an extra unit of expected return.

When the market *price of risk* is multiplied by the beta coefficient of an asset, we get what is known as the *risk premium*[33]. This is actually the 'appropriate extra amount' that should be added to the riskless rate in order to find the expected rate of return for an investment in a risky asset.

The expected rate of return from any asset or portfolio, as suggested by the CAPM [i.e., equation (4.4)] can then be summarised in words as follows:

[33]It is this risk premium that induces investors to invest in risky instead of riskless assets.

(Equilibrium expected return)	= (Price of time or reward per unit time)	+	(Price of risk or reward per unit risk)	×	(Beta coefficient)

Investors are rewarded for their patience. They are also rewarded for bearing risk. The relevant measure of risk is the contribution of each individual security to the risk of market portfolio: the systematic risk. Thus, the beta coefficient plays an important role in determining an asset's rate of return. For investors who hold a security or portfolio which has a beta of equal to 1 (i.e., it has the same risk as the market portfolio), they will expect to get the market return. Investors who hold a riskless security or portfolio (i.e., the one with a beta of 0), will expect to earn a riskless rate of return (i.e., the price of time).

Markedly, the CAPM - "an *accepted* model in the securities industry" [Haugen (1990), p. 252] - has implications for asset pricing and investment decisions[34] [see e.g., Francis (1988), pp. 769 - 770 and Rutterford (1993), p. 258]. A key implication of the CAPM is that a security's beta determines its equilibrium price: *ceteris paribus*, the higher the beta the higher the security's expected return and the lower its price [Jacob and Pettit (1984), p. 363]. In equilibrium, every asset must be priced so that its risk-adjusted required rate of return falls on the SML [Copeland and Weston (1988), p. 198]. Thus, the SML can be used as a benchmark for security performance[35].

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[34]The CAPM actually lends itself to many applications - for valuing risky securities and portfolios, for valuing a firm's cost of capital and for combining securities into portfolios - just to mention a few. For discussions on the practical applications of the CAPM, see e.g., Sivalingam (1990), pp. 168 - 172; Lofthouse (1994), pp. 25 - 26 and Haugen (1990), p. 252.

[35]Haugen (1990, p. 252) posits that the CAPM will not be so widely used if it were not regarded as extremely useful benchmark [cf. Copeland and Weston (1988), pp. 202 - 205].

The CAPM is an extremely useful tool for financial decision making because it quantifies and prices risk [Copeland and Weston (1988)]. The true or the required rate of return for a security or portfolio, under the conditions of capital market equilibrium, can be estimated from the SML [see Sivalingam (1990)]. Since the model allows the expected return and risk of a security or portfolio to be estimated, alternative investments can be easily compared.

If the observed or expected rate of return for a security is lower than the rate of return determined by using the SML, the security is said to be *overpriced* because its expected rate of return is too low to induce investors to accept its systematic risk. The return for such a security is not commensurate with its systematic risk, and this therefore, is the signal for investors to sell the security. The resultant selling pressure would push the price down and then, the expected rate of return on the security will rise. Selling pressure and price adjustments will continue until the security is priced on the SML.

Similarly, if the observed or expected rate of return of a security is higher than the rate of return calculated from the SML, the security should be bought because it is *underpriced.* The security offers an exceptional return for the amount of risk an investor has to bear. Thus, intense buying activity and price adjustments that follow, will bring the security back to its equilibrium position.

Investors who believe that the method suggested by the CAPM is the right approach in valuing securities, will not attempt to select investments by using other techniques such a technical analysis and fundamental analysis; they will simply select securities on the basis of risk and expected return predicted by the CAPM. In contradiction to the technicians or fundamentalists who expect to earn better than

average return from their share selection and timing skills, those adherents of the CAPM will only expect a 'fair' return for the risk that they have borne.

Sharpe (1964) and Litner (1965) and others who developed the CAPM have shown that a security's expected return in excess of the risk-free rate (R_f) is proportional to that security's systematic risk. Nonetheless, this linear model of market equilibrium rests on a set of restrictive assumptions concerning the structure and organisation of financial markets, the behaviour of investors and the returns of securities. These assumptions are summarised below[36]:

(i) Financial markets are perfect: no transaction or information costs, no taxes and no restrictions on short selling.

(ii) The quantities of assets available are fixed; all assets are marketable and perfectly divisible.

(iii) Investors are risk-averse individuals whose objective is to maximise the utility of their wealth one period hence; each of them always prefers more wealth to less.

(iv) Investors are price takers and have homogeneous expectations regarding asset returns.

(v) There exists a risk-free asset, and investors may issue (borrow) or purchase (lend) unlimited amounts at the risk-free rate.

(vi) Securities' returns are normally distributed.

These assumptions under which the CAPM is derived are, of course, violated in the real world, but the model is fairly resilient to their relaxation [see Copeland and

[36]These assumptions (and their implications) are discussed, inter alia, in Copeland and Weston (1988), p. 194; Peasnell (1986), p. 29; Hawawini (1984), p. 12; Fama (1973), p. 328; Griffiths (1990), p. 82 and Brennan (1989), p. 95.

Weston (1988), p. 205; see also Elton and Gruber (1991), p. 325]. Since the earlier work of Sharpe (1964) and Lintner (1965), there have been many works [including those by Black (1972) and Merton (1973)] - both theoretical and empirical - on this so-called two-parameter model [see e.g., Jensen (1972)]. Some of the assumptions as outlined above, have been relaxed, and more general versions of the CAPM have been developed[37].

For several years, the CAPM received the blessing of the vast majority of professional investors and financial academics; it was touted as the "new investment technology". The major attractiveness of the CAPM is its ability to present important theoretical insights in simple and practical terms that could be applied in practice.

The CAPM has not only been modified (and used in a great variety of ways) but also has been subjected to extensive empirical testing [see e.g., Ross (1978); Hawawini (1988)]. The literature and research on the CAPM also involves discussions on serious and complex econometric issues [see e.g., Peasnell (1986), p. 34; Huang and Litzenberger (1988, Chapter. 10].

Some of the problems associated with the CAPM has been highlighted by Richard Roll in his article in 1977. Among other things, he points out that the only testable hypothesis associated with the theory is whether or not the market portfolio is mean-variance efficient. In empirical testing, according to Roll, a proxy measure must be used for the market portfolio, but unless the market portfolio can be identified exactly - or a portfolio where the returns are perfectly correlated with those of the

[37]For summaries and discussions on the various modifications and extensions that have been made to the Sharpe-Lintner-Mossin CAPM - the nonstandard forms of the CAPM - see inter alia, Hawawini (1984), pp. 12 & 13; Copeland and Weston (1988), pp. 205 - 212; Brennan (1989), pp. 97 - 100 and Elton and Gruber (1991), Chapter Twelve.

market portfolio - it is impossible to accept or reject the CAPM.

Tests of the CAPM using United States data have generally concluded that the evidence supporting the model is weak [see e.g., Lofthouse (1994); Hawawini (1984)]. The same conclusion, as Hawawini (1984, p. 13) points out, holds true for European equity markets; "international evidence is not very supportive either" [Lofthouse (1994), p. 12].

To conclude, even though the CAPM is not perfectly validated by empirical tests[38], one cannot generally reject the hypothesis that the behaviour of security prices is consistent with some versions of the CAPM[39]. The CAPM appears to be a reasonable approximation to the manner in which securities are priced in the actual capital markets.

Even though returns are likely to be determined by some factors (such as market capitalisation and earnings) in addition to beta, beta is probably relevant to security pricing. Even though risk is a more complex concept than is assumed in the CAPM, the simplicity of the model does help and guide us towards thinking about some difficult issues. Accordingly, and given the fact that there are few simple alternatives to the CAPM which investors can use to provide estimates of future expected returns on a share, it is believed that the model will still continue playing its pivotal role as 'basic' to much investment thought. While the debate on the CAPM's empirical validity and attempts to determine if alternative models fit the data better, the model's current usefulness and applicability for understanding security markets and

[38]For summaries and discussions on empirical tests of the CAPM, see inter alia, Haugen (1990), Chapter 8; Copeland and Weston (1988), pp. 212 - 219; Bodie *et.al* (1989), Chapter Twelve and Elton and Gruber (1990), Chapter Thirteen.

[39]See Peasnell (1986); Hawawini (1988) and Copeland Weston (1988)

investment decisions is a positive force behind its continued use [Jacob and Pettit (1984)].

4.5.3-The Arbitrage Pricing Theory

Formulated by Ross (1976), the APT is a linear return generating model that assumes that the return on an investment is a function of more than one factor [see also Ross (1994)]. While it is possible for investors to eliminate unsystematic risk through diversification, it is not possible to diversify away a share's exposure to a variety of macroeconomic factors. Ross (1976) argued that the average long-term return of an asset is dependent on its sensitivity to *unanticipated* changes in a few economic variables.

Like most economic theories, the APT, which is a model of risk-return relationship offering explanations about what determines the prices of market assets, is developed under a number of assumptions [see Francis (1988), p. 407; cf. Griffiths (1990), p. 119]:

(i) it assumes that most people prefer more wealth to less wealth;

(ii) it assumes that most people are risk-averse - that they will not buy risky investments unless they expect to earn higher rates of return than they could earn from investing in risk-free assets;

(iii) it assumes that investors can assess any asset's risk factor (or factors) and assign numerical values to it.

The underlying assumptions outlined above appear to be plausible and not too restrictive.

Consider a set of N securities with returns $R_1, \ldots, R_i, \ldots, R_N$. The APT

assumes that the rate of return on each of the N securities is linearly related to a number (k) of systematic factors ($F_1, \ldots, F_j, \ldots, F_k$) common to the N securities[40]. The statistical relationship between an individual security's (i) return and the factors is expressed as

$$R_i = E(R_i) + \beta_{i1}F_1 + \ldots + \beta_{ik}F_k + e_i \tag{4.5}$$

where R_i is the random return on asset i, and $E(R_i)$ is its expected return. β_{ik} is the sensitivity of *i*'s returns to the kth factor. F_k is the kth factor where $E(F_k) = 0$[41], and e_i is a random noise term which has the expected value of zero [i.e., $E(e_i) = 0$][42].

Equation (4.5) simply says that the actual return on security *i* is the sum of its expected return, $E(R_i)$; the positive or negative influences[43] associated with the factors, F_k, which are common to all securities; and e_i which represents the unexpected portion of the return on security i which is not explained by the factors. This residual or unsystematic risk component, e_i, which captures unexpected events unique to firm i, is not impounded into the asset's expected return, $E(R_i)$.

The APT is developed based on an economic principle - the *law of one price* - which states that the same good cannot sell for two different prices [Francis (1991),

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[40]The number (k) of systematic factors is assumed to be smaller than the number (N) of securities. Only systematic risk factors are considered in the APT because they are the sources of risk that cannot be eliminated through diversification.

[41]If $E(R_i)$ is the expected return on the asset, the effect of the factors is expected to be zero (0) because the market has already incorporated expectations about these factors in the asset's price. The actual return on asset i will only be affected by any surprises in these factors that were not anticipated.

[42]Assuming a diversified portfolio, e_i approaches zero [see Ross (1978), p. 893].

[43]The sensitivity coefficient, β_i, can be positive or negative from factor to factor and from stock to stock [see Haugen (1990), p. 257].

p. 295; see also Jacob and Pettit (1984), p. 409]. In equilibrium[44], any asset should plot on what mathematicians call the *k-dimensional hyperplane*. This implies that any asset that has an expected rate of return that lies above (below) this k-dimensional hyperplane is *underpriced* (*overpriced*), and therefore, its price should seek an economic equilibrium at a higher (lower) level [see Francis (1988), p. 418].

The derivation of the APT also requires the following additional assumptions that are shared by the CAPM [see Francis (1991), p. 315; Hawawini (1984), p. 14]:

(i) capital markets are perfect[45];

(ii) investors have homogeneous expectations.

"The arbitrage theory of asset pricing (APT), while conceptually different" (from the CAPM), "retains the desirable simple features of the original theory" [Ross (1978), p. 893].

Apart from the similarities mentioned above, the APT is different from the CAPM in a number of facets. The APT, unlike the CAPM, can be derived without requiring the existence of the market portfolio. Compared with the CAPM, the APT is less restrictive in its assumptions [see e.g., Hirt and Block (1989), p. 647; Mandell and O'brien (1992), p. 453], and it admits into the analysis several fundamental economic factors that can cause uncertainty in the market. It is this ability of the APT to accommodate several sources of systematic risk that has been considered by many as an advantage of the APT in comparison with the CAPM [Shanken (1982)].

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[44]According to Hirt and Block (1989, p. 647), the APT does not assume equilibrium markets, but the concept of arbitrage behaviour will drive markets to equilibrium as investors try to make risk-free profits.

[45]Perfect markets is an assumption widely used by economists because, by assuming capital markets are perfect, economists can exclude the possibility that prices are manipulated or distorted away from their equilibrium values.

Nevertheless, to some extent, the generality of the APT is a weakness: The model gives financial researchers no clues about which risk factors may affect the pricing of any asset. We do not know the number and nature of the systematic factors affecting the return to a given security. These factors have to be determined empirically [Hawawini (1984)]: "Investment analysts must act like detectives who use economic theory to discover the relevant sensitivity coefficient", (β_i), "and then estimate the actual values of these coefficients" [Francis (1988), p. 417].

Even though there is no universal agreement on what factors have the greatest impact on stock returns [Hirt and Block (1990)], Chen, Roll and Ross (1986) isolated four major macroeconomic factors as follows:

(i) unanticipated changes in the rate of inflation;

(ii) unanticipated changes in the index of industrial production;

(iii) unanticipated changes in the yield spread between high-grade and low-grade corporate bonds;

(iv) unanticipated changes in the slope of the term structure of interest rates, as measured by the difference between the yields on long-term government bonds and T-bills.

Previously, Roll and Ross (1984) in their empirical research, have identified almost the same factors that significantly influenced security returns. They are, unanticipated changes in inflation, unanticipated changes in risk premium and unanticipated changes in the slope of the yield curve.

According to Haugen (1990), the APT is inherently, more testable than the CAPM because it does not rely on the observation of a particular portfolio (the market

portfolio) which is inherently unobservable[46]. As suggested by Jacob and Pettit (1984), it is useful to think of the CAPM and the APT as different variants of the true, but perhaps unknown, equilibrium pricing model. Both of these elegant theories are useful in suggesting ways security prices and equilibrium returns might be established.

4.6-Some Recent Results and developments

Modern investment theory rests on two basic assumptions [see e.g. Mullins (1994); Hawawini (1988)]:

(i) Securities markets are very competitive and efficient;

(ii) securities markets are dominated by rational, risk-averse investors, who seek to maximise satisfaction from returns on their investments.

Thus, if, in reality, the markets are inefficient and investors in general are found not behaving rationally, then the validity of the theory as descriptor and predictor of equity returns and behaviour, could be questioned. Recent theoretical and empirical developments in financial economics suggest that stock markets may not really be efficient and the markets are not dominated by rational investors. These more recent results and findings are treated in the following sub-sections.

4.6.1-Excess Volatility and Social Dynamics

Fluctuations or volatility in financial asset prices have long been the concern of both financial theorists and practitioners. For practitioners, volatility is important

[46]Meanwhile, the view that the APT is inherently more susceptible to empirical verification than the CAPM has been challenged by Shanken (1982).

for the valuation of options, for the assessment and management of portfolio risk and for judging the efficacy of market institutional arrangements [see Copeland and Stapleton (1988), p. 1][47]. For researchers in financial economics, the issue is important in drawing conclusions about the efficiency of capital markets.

One strand of the efficient markets literature is that asset prices should reflect fundamental value alone [see e.g., Pratten (1993)]. An investor who buys and holds shares, and pays less than *ex post* fundamental value receives an abnormal profit. Then, in an efficient market, arbitrage activities will push prices to be efficient forecasts of "perfect-foresight"[48] fundamentals [see De Long and Becht (1992), p. 8]. Since ownership of shares gives the owner rights to a flow of dividends, fluctuations in stock prices are commonly argued to result solely from changes in the present value of the expected future dividend [see e.g., West (1988a)].

While it has long been recognised that the volatility of equity returns has changed over time[49], recent findings (essentially in the U.S.) indicate that fluctuations in stock prices are too large to be justified solely by changes in the present value of the expected future dividends (discounted at a constant discount rate).

The model commonly used in the *excess volatility* (or *variance bound*) literature is the dividend valuation model[50],

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[47]Cf. Schwert (1989), p. 1115; Scott (1991), p. 582.

[48]That is, the present discounted value of dividends plus the discounted terminal price [see e.g., Mankiw *et.al* (1991)].

[49]See e.g., Officer (1973), Merton (1980) and Kearns and Pagan (1990).

[50]See e.g., Shiller (1981a, b, 1984); Kleidon (1986).

$$p_t = \sum_{\tau=1}^{\infty} \frac{E(d_{t+\tau} \mid \Phi_t)}{(1+r)^{\tau}} \tag{4.6}$$

where p_t and $d_{t+\tau}$ are price and dividend, respectively; r is an assumed constant discount rate and $(X \mid \Phi)$ denotes the conditional distribution of the random variable X given the information Φ. A new variable p^*_t (which is called "perfect foresight" price in much of the variance bound literature), is defined as

$$p^*_t \equiv \sum_{\tau=1}^{\infty} \frac{d_{t+\tau}}{(1+r)^{\tau}} \tag{4.7}$$

Comparing (4.6) and (4.7), it shows

$$p_t = E(p^*_t \mid \Phi_t) \tag{4.8}$$

which according to Shiller (1981a, b) implies the variance bound,

$$var(p_t) \leq var(p^*_t) \tag{4.9}$$

Since the price rationality forecasts p^*_t by (4.8), the variance of the forecast (i.e., the price) should be less than or equal to that of the variable being forecast (i.e., p^*_t). This is the basis for the inequality which has received increased attention in the finance literature in recent years.

The increasing interest and controversy on this notion of *excess volatility*[51] in financial asset prices - that security prices are too volatile to accord with efficient markets - has been stimulated by the original work of LeRoy and Porter (1981) and, especially, Shiller (1981a, b). In his seminal work to examine the view that changes in the level of stock market reflects news about future dividends, Shiller (1981a) found that the standard deviation of stock prices was about five times greater than would be expected from the volatility of dividends. However, those early results have not gone unchallenged in the literature.

A number of works, including those by Flevin (1983), Scott (1985), Kleidon (1986), Marsh and Merton (1986) and Mankiw, Romer and Shapiro (1985, 1991) have called into question the validity of Shiller's results, for a variety of (technical) reasons. Marsh and Merton (1986) for example, criticised the tests' assumption that dividends are stationery around a time trend. Flevin (1983) and Kleidon examined the small sample properties of the tests and argued that they are extremely biased towards finding excess volatility.

The criticism of the early volatility tests of LeRoy and Porter (1981) and Shiller (1981a, b) motivated the emergence of "the second generation of tests" [Scott (1991)], contained in papers, inter alios, by Mankiw *et.al* (1985), Scott (1985), Campbell and Shiller (1987) and West (1988a).

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[51]Shiller (1989, p. 2) defines *excess volatility* as the variability of price movements which is too large to be justified in terms of efficient markets models, given the relatively low variability of fundamentals and given the correlation of price with fundamentals. There is an excess volatility in a stock price, as defined by West (1988b, p. 640) when

$$V/V^* \rangle 1$$

where V = the volatility of the market's forecast of fundamentals (i.e., the variance of a stock price); and V^* = the volatility of the econometrician's measure of fundamentals (i.e., a certain function of dividends).

Mankiew *et.al* (1985) in their "unbiased reexamination of stock market volatility" using new tests which they claim "do not suffer from the problem Flevin and Marsh and Merton discuss" (and using the same data as Shiller uses) report that "while our unbiased volatility tests do not find evidence as striking as that Shiller reports, we do find evidence contradicting the model" (p. 696).

Similarly, West (1988a) examines the presence of excess volatility in stock prices by employing an approach which is free from the assumptions required by the Shiller (1981) volatility test. His results indicate that stock prices are too volatile to be the expected discounted value of dividends, with a constant discount rate. "Among the explanations for the test results are that discount rates vary and that there are rational or nearly rational bubbles or fads".

In a more recent study, MacDonald (1994), following the lead of Campbell and Shiller (1987), uses cointegration methodology to test the excess volatility in the U.K. stock market. He concludes, "Our findings were somewhat mixed . . . One rationalisation would simply be to accept the view that stock market prices are driven by fads and the market is therefore irrational" (p. 74).

Summarising, even though early examinations of excess volatility in the stock markets undertaken by LeRoy and Porter (1981) and Shiller (1981a, b) were criticised and challenged, more recent studies which relax some of the restrictive assumptions and employ new methodologies, continue to produce evidence against the EMH and the notion that stock prices reflect fundamental value. Camerer (1989, p. 22) in his survey paper on excess volatility (and other related issues) - theory and evidence - highlights two conclusions that emerge from "the combative debate about variance inequalities" (excess volatility):

(i) "Stock prices do fluctuate more than perfect foresight prices (calculated with constant discount rates), as if prices consist of rational expectations of perfect foresight prices *and* mean-reverting fads"; and

(ii) "prices might appear to fluctuate excessively even if they were rational, because of small-sample bias, non-stationarity of dividends, or variation in discount rates".

There are several researchers who have the view that socio-psychological factors do play an important role in affecting the deviation of stock prices from their fundamental values. They include West (1988b), Schwert (1989) and Pratten (1993).

Robert Shiller, a Yale economist[52] who repeatedly asserts that stock prices vary too much - and this is the evidence of market inefficiency - was the pioneer in recent attempts to 'revive' the behaviourial approach to studying stock markets and share price behaviour. In a 1984 Brooking Institute paper, Shiller (1984) posits that investing in speculative assets is a social activity, and it is therefore, plausible that investors' behaviour (and hence prices of speculative assets) would be influenced by social movements: social dynamics. Since fluctuations in attitudes or fashions often occur widely in the society and often appear without any apparent logical reason, his argument goes, it is plausible that attitudes or fashions regarding investments would also change spontaneously or in arbitrary social reaction to some widely noted events. Thus, Shiller (1984) hypothesises that *social psychology* or *mass*[53] *psychology* may

[52]For a good review Robert Shiller's work and contribution (as a financial economist and a guru to some segments of the financial community) to the theory and practice of capital market investment, see Schwert (1991).

[53]From the sociological point of view, a *mass* refers to a plurality of individuals who are usually physically dispersed, unknown to one another and who focus their thoughts and actions to the same subject [Klausner (1984), p. 58].

well be the dominant cause of movements in the price of the aggregate stock market.

According to Shiller (1989), for hundreds of years, it has been commonly accepted that prices in speculative markets are influenced by capricious changes in investor sentiments, changing fashions, fads or bubbles[54]. In the past few decades, this commonly accepted view has been dominated and replaced by the EMH. Shiller (1989) claims that the developments in the efficient markets literature have been the galvanizing force behind his suggestion for the revival of the old idea[55] of investor psychology in the stock market analysis:

(i) The concept of market efficiency is defined and interpreted in various ways[56]. However, the practice in empirical finance literature is to speak of tests of market efficiency as if this concept had unambiguous meaning [Leroy (1989), p. 1595].

(ii) Not only the null hypothesis of market efficiency is ill defined[57], but the alternative hypothesis also remains ill defined. As a result, no amount of statistical evidence can resolve such ill-defined hypotheses [Shiller (1989), p. 52].

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[54]*Fads* and *fashions* are sociological terms. A fad which may arise within a diverse range of arenas, is defined by Klausner (1984, p. 67) as an ardent but relatively short-lived interest in some idea, object or behaviour.

According to Klausner (1984, p. 68), fashion, as in the case of fad denotes collective change in choice regarding some idea, thing or behaviour. The difference between fad and fashion is that, the notion of fad refers to a rapid, abrupt and relatively brief change in preference; fashion denotes a slower, continuing pattern of change. Further, changes in fashion are more likely to be of a cyclical nature.

For economic treatment (in some detail) and modelling of the theory of fads and bubbles, see e.g., Blanchard and Watson (1982), Camerer (1989), Cochrane (1991) and West (1988b).

[55]Shiller argues that the efficient market theory itself is actually a very old theory. To justify his assertion, he quotes what George Gibbon wrote in his book *The Stock Exchange of London, Paris and New York* published in 1889, that when "shares become publicly known in an open market, the value which they acquire there may be regarded as the judgement of the best intelligence concerning them [see Shiller (1989, endnote 3, p. 438].

[56]See Shiller (1989, p. 77; LeRoy (1989); see also Chapter Three.

[57]See e.g., Rubinstein (1975); LeRoy (1976); Jensen (1978) and Beaver (1981)

(iii) In the literature, the various pieces of "anomalous evidence" regarding market efficiency has generally never been connected with psychological alternatives; and instead, those anomalies are described as "small" even though they may be the consequence of sizable valuation error [Shiller (1989), p. 63][58].

(iv) Price movements in the stock market appear to show excess volatility. If stock prices were set in accordance with efficient markets models, they would be fairly volatile, but not as volatile as we actually observed [Shiller (1989), p. 431].

(v) There is evidence that fashions, fads or bubbles *do* importantly influence prices of speculative assets [Shiller (1989), p. 49][59]. The results of Roll (1984) and French and Roll (1986) are among the evidence that suggests that share price movements might be influenced by factors other than economic fundamentals.

(vi) Many economists have the view that the sudden worldwide collapse of stock prices on October 19, 1987, was irrational [Hardouvelis (1989), p. 1]. The survey evidence by Shiller (1987) for the U.S. market, and by Shiller, Konya and Tsutsui (1988) for the Japanese market, supports this view [see also Shiller (1990b).

With "complete absence of news that can possibly be related to market fundamentals" [LeRoy (1989), p. 1613] and no other recognizable event outside the market appears to be immediately responsible for the October 19, 1987 stock market selloff, we should turn to consideration of a theory of the crash as being determined endogenously by investors: that the timing of the crash was related to some internal dynamics of investor thinking, investor reactions to price and to each other (Shiller

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[58]See also LeRoy (1989), pp. 1609 and 1613; Summers (1986).

[59]In the stock market literature, it has been increasingly suggested that the literature on cognitive psychology which documented the way people use information and make decisions might be helpful in further understanding the behaviour of stock markets. See e.g., Arrow (1982) and LeRoy (1989).

(1989), p. 398].

Despite the increasing evidence that share prices exhibit excess volatility, it would be misleading to claim that the debate on the issue of excess volatility and the role of socio-psychological factors in explaining this stock market phenomenon, is over. In fact, the subject has seemingly become "increasingly sophisticated, voluminous and controversial" [Camerer (1989), p. 3].

There are already several good surveys of this growing literature on excess volatility and social dynamics in financial markets. They include, by West (1988b), Shiller (1989, Chapter 4), LeRoy (1989), Scott (1991) and Pratten (1993, Chapters 4 and 16).

4.6.2-The Overreaction Hypothesis

While the rationality of financial markets has been a widely debated subject for quite a long time[60], the so called **overreaction hypothesis** represents another attempt to represent human elements or irrationality in explaining the behaviour of share prices. De facto, interest in market overreactions is not new: it dates back, as claimed by Howe (1986), at least as far as the tulip bulb craze in the 1630s. John Maynard Keynes is believed to be one of the earliest economists to report observations about overreaction in markets.

Research in cognitive psychology [see e.g., Kahneman and Tversky (1973); Grether (1980)] suggests that in making forecasts or decisions, individuals tend to deviate from the norm of rationality: they tend to give excessive weight to recent

[60]See Russell and Thaler (1985), De Long *et.al* (1990) and De Bondt and Thaler (1990). Cf. Friedman (1953) and Fama (1965b).

information and underweight prior information (or data). In stock markets, the tendency for people to "overreact" to unexpected and dramatic news events might be a common phenomenon that moves stock prices. If this is the case, prices would be biased by either too much optimism or pessimism, relative to long run fundamental values. Then, prices would be consistently pushed to either high or low unstable levels.

One of the most influential and controversial papers in this line of research is the work of De Bondt and Thaler (1985) which presents evidence of return reversals over long intervals. De Bondt and Thaler interpret their results as a manifestation of irrational behaviour of investors which they refer to, as "overreaction"[61].

Being concerned with the developments in "anomalous" literature of stock markets, and motivated by work in cognitive psychology on intuitive prediction, De Bondt and Thaler (1985) propose what is today known as the *overreaction hypothesis*. They hypothesise that if stock prices systematically overshoot, their reversal should be predictive from past data alone (without having to use accounting data). This *overreaction hypothesis* which implies a violation of the weak-form of market efficiency, consists of two parts:

(i) Extreme movements in stock prices will be followed by subsequent price movements in the opposite direction (i.e., the direction effect); and

(ii) the more extreme the initial price change, the greater will be subsequent adjustment (i.e., the magnitude effect).

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[61]The tendency of the prior period's worst stock return performers (losers) to outperform the prior period's best return performers (winners) in the subsequent period, is labelled as "overreaction" because this phenomenon suggests that the market has overreacted in the initial period, and that it subsequently corrects itself [see Zarowin (1990), p. 113].

In this preeminent study of stock market overreaction, De Bondt and Thaler (1985) found that the results are consistent with the predictions of the hypothesis. Stocks that experience poor performance (losers) as well as those with the largest price increase (winners) over the past three to five years, reverse their behaviour in subsequent year. The "overreaction" effect is found to be asymmetric: portfolios of prior losers substantially outperform prior winners. More surprisingly the large positive returns were earned by the loser portfolio in January. In their follow-up paper, De Bondt and Thaler (1987) report additional evidence that support the behaviourial hypothesis of investor overreaction.

According to Howe (1986), any event in which there is a price reaction followed by a correction (reversal) can be taken as evidence of overreaction. Replicating the previous work of De Bondt and Thaler (1985), Howe (1986) found that the evidence is strongly consistent with the overreaction hypothesis. The author then conclude that "The magnitudes of the 'overreaction' returns suggest that there are economically significant - that is, exploitable" (p. 76).

Market participants can be said to overreact, as defined by Brown and Harlow (1988), when unexpected favourable (unfavourable) announcements induce trading behaviour that results in price appreciation (depreciation) that is excessive relative to the actual value implied by the nature of the event.

In their research, Chopra *et.al* (1992) introduce some improvements to the methodology used in the previous studies of market overreaction. They note that they have found an economically-important overreaction effect even after adjusting for size and "beta effect". According to the authors, in portfolios formed on the basis of prior five-year returns, extreme prior losers outperform extreme prior winners by 5-10% per

year during the subsequent five years. They claim that it is unlikely that this effect can be attributed to risk measurement problems, since returns consistent with the overreaction hypothesis are also observed for "the short windows surrounding quarterly earnings announcement days".

Interestingly, Chopra *et.al* (1992) also report that the overreaction effect that they have found is not homogeneous across size group; but instead, it is much stronger for smaller companies than for the larger ones. While smaller firms are held predominantly by individuals, and institutional investors are the dominant holders of large firms (where there is no evidence of overreaction found), these authors posit that their finding suggests that overreaction by individuals is more prevalent than overreaction by institutions.

Other empirical examinations of stock market overreaction were accomplished among others, by Lehman (1990), Alonso and Rubio (1990) for Spanish equity market, Kryzanowski and Zhang (1992) for the Toronto Stock Exchange and Stock (1990) for the German stock market. Except for the one by Kryzanowski and Zhang (1992), all these studies appear to supply evidence of investor overreaction. Kryzanowski Zhang (1992) noted however, that empirical evidence on the reversal behaviour of American stock prices appears to depend on the test methodology used.

There are two interesting implications that could be conceived of, associated with the empirical evidence of stock market overreaction:

(i) The possibility that the markets are dominated by irrational investors; and

(ii) the possibility for investors to earn abnormal profits by purchasing or selling securities in advance of any subsequent correction.

Nonetheless, rather than providing us insights into definitive conclusions about

the irrationality of stock markets and the economic exploitability of the phenomenon, these empirical findings have considerably provoked another controversy in the profession. De Bondt and Thaler's (1985) work has received considerable attention in the literature not only because the authors find a very large difference in returns (i.e., about 8% per year) between winners and losers during the five-year post-ranking period, but also because they interpret findings as evidence of systematic valuation errors in the stock market caused by irrationality (investor overreaction). A number of subsequent papers contend that De Bondt and Thaler's results are subject to various methodological problems [see e.g., Brown *et.al* (1988)].

Vermaelen and Verstringe (1986) argue that the overreaction effect is a rational market response to risk changes [see also De Bondt and Thaler (1987)]. Further, Chan (1988) and Ball and Kothari (1989) argue that the winner-loser effect is explained almost entirely by intertemporal changes in risks and expected returns.

Zarowin (1990) presents evidence that he claims shows that the market is not characterised by the overreaction phenomenon hypothesised by Be Bondt and Thaler. The tendency for losers to outperform winners, according to the author, is not due to investor overreaction, but to the tendency for losers to be smaller-size firms than winners. Thus, "the winner vs. loser phenomenon found by DeBondt and Thaler appears to be another manifestation of the size phenomenon in finance" (p. 124).

Chopra *et.al* (1992) generalised that the quantitative magnitude of the overreaction effect is highly sensitive to the procedures used in computing abnormal returns, particularly in any study which abnormal returns are being computed over multiple-year periods. Further, Dissanaike (1994) argued that in many of the overreaction studies, the method used to compute cumulative returns - the arithmetic

method - is flawed, and therefore, estimates of portfolio performance can be affected.

4.6.3-Mean Reversion, Mean Aversion and Returns Predictability

In recent years, the early findings that stock returns are unpredictable, have been reexamined and challenged. Recent research into the behaviour of share prices employing newly developed methods reports evidence that returns are negatively serially correlated over the long periods and also positively autocorrelated (particularly over the short horizons). These new findings could be interpreted as a challenge to the long-held view that share prices follow a random walk: that the estimated correlations are close to 0.0 and therefore the predictability of returns is not economically significant.

Whereas early tests of market efficiency concentrated primarily on examining autocorrelations of daily and weekly returns, the more recent research has focused on the behaviour of returns calculated over long horizons. Perhaps empirical evidence documented in the literature of excess volatility and overreaction hypothesis, has provided insights and motivation for a group researchers into further examining the possibility of stock returns to exhibit "reversal behaviour"[62] over long horizons. Perhaps Summers's (1986) critique that early tests of share price behaviour - that the conventional interpretation of the autocorrelation for short-horizon returns - have low power, has provided stimulus for researchers to initiate new tests using more sophisticated procedures.

Consequently, a series of papers - most of them based on variance-ratio

[62]As we have already discussed, the literature on excess volatility suggests that equity prices tend to fluctuate "excessively", and the literature on overreaction hypothesis implies that extreme movements in equity prices are followed by extreme movements in the opposite direction.

methodology[63] of Cochrane (1988) and multiperiod-return autocorrelation (or long-horizon regression coefficients) tests - of note, by Fama and French (1988a), Poterba and Summers (1988), Lo and MacKinlay (1989) and Jegadeesh (1990, 1991) conclude that there is a significant negative autocorrelation in long horizon stock returns. Such a negative serial correlation to stock returns, a tendency to revert to some average values over long periods, is interpreted as an eventual reversion of stock prices in their fundamental values [see e.g., Basu and Vinod (1994), p. 51]. Such a reverting tendency of stock returns is known as **mean reversion** in stock prices.

Engel and Morris (1991, p. 21) define mean reversion as the tendency for prices to overshoot but eventually revert to true values. In Poterba and Summers's (1988, p. 27) words, "If market and fundamental values diverge, but beyond some range the differences are eliminated by speculative forces, then stock prices will revert to their mean. Returns must be negatively serially correlated at some frequency if 'erroneous' market moves are eventually corrected".

Black (1989, p. 1) points out that mean reversion can occur in two ways:

(i) the expected return on the market can go in a direction opposite to that of the market; and

(ii) the expected return can revert towards a mean level.

While strictly speaking, there would be zero serial correlation in share price changes and hence no tendency for stock returns to revert to some statistical mean if

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[63]If stock price follows a random walk, the variance of k-year returns (r_k) should equal k times the variance of one-year returns (r_1) [see Engel and Morris (1991, p.27]:

Variance (r_k) = k × Variance (r_1)

or,

Variance (r_k)/[k × Variance (r_1)] = 1.

A variance ratio of less than unity implies negative serial correlation, and a ratio of greater than unity implies positive serial correlation. See Chapter Five.

prices follow a random walk, the presence of mean reversion over long horizons implies that a given change in stock price tends to be reversed over subsequent years by a predictable change in the opposite direction. So, if such a finding is really true, then long term stock returns are far more predictable than originally thought. Explanations of mean reversion commonly offered in the literature primarily centre on fads, noise traders, rational speculative bubbles and time-varying expected returns [see McQueen (1992), p. 1; Poterba and Summers (1988), pp. 46 & 54]. Claiming that the amount of mean reversion may change over time, Black (1988) suggests further that changing mean reversion may help us to understand the stock market crash of 1987.

Summers (1986), in challenging that most tests of market efficiency have virtually no power against what he calls the fad alternative [also see Camerer (1989)] shows that most common models of an inefficient market can be characterised as ones in which prices take long temporary swings away from fundamental values. He translates (models) this into a statistical hypothesis that prices have slowly decaying stationary components.

Subsequently, Fama and French (1988a) used the mean reversion hypothesis as proposed by Summers (1986) to examine autocorrelations of stock returns for increasing periods and found the pattern which is consistent with the hypothesis that stock prices have a slowly decaying stationary component. In these tests of mean reversion by regressing multiyear returns on past multiyear returns for investment horizons of one to ten years, some of the conclusions that they have made are as follows [cf. Schwert (1989), p. 1146]:

(i) "We conclude that the tests for 1926 - 85 are consistent with the hypothesis

that stock prices have both random-walk and stationary components" (p. 256).

(ii) "Our results add to mounting evidence that stock returns are predictable . . . that 25 - 45 percent of the variation of 3 - 5 year stock returns is predictable from past returns" (p. 247).

In another paper, Poterba and Summers (1988) use variance ratio tests to investigate the presence of mean reversion in stock prices. They hypothesise that a stock price is the sum of a permanent component (which evolves as a random walk) and a temporary component (which follows a transitory process)[64] . Testing the stock price data from the U.S. and 17 other countries, they conclude, among other things, that:

(i) "The results consistently suggest the presence of transitory components in stock prices, with returns showing positive autocorrelation over short periods but negative autocorrelation over longer periods" (p. 28). They further stress that noise trading - trading by investors whose demand for shares is determined by factors other than their expected return - provides a plausible explanation for the transitory components in stock prices.

(ii) "In recent years, mean reversion is more pronounced in smaller foreign equity markets than in the U.S (p. 45).

The hypothesis that the stock prices contain slowly decaying components[65]

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[64]Two possible interpretations are suggested for the presence of the transitory component:
(i) the transitory component may reflect fads; that is, speculative-induced deviations of prices from fundamental values; or
(ii) it may be a consequence of changes in required returns.

[65]If stock prices or the index levels contain a temporary component, then in the long run they tend to revert to their trends. In his paper, Jagadeesh (1991) refer to such a nature and behaviour of stock prices as *mean reversion.*

has also been tested by Jagadeesh (1991) using the U.S. and the U.K. data. His conclusions are as follows (p. 1427):

(i) "Although the evidence that the equally weighted index of stocks exhibits mean reversion is significant in the period 1926 - 1988, this phenomenon is entirely concentrated in January".

(ii) "In the post-war period both the equally weighted and the value-weighted indices exhibit seasonal mean-reversion in January".

(iii) While the above-mentioned results are for the U.S., "A similar phenomenon is also observed for the equally weighted index of stock traded on the London Stock Exchange".

Jog and Schaller (1991) are among those who contend that traditional tests of market efficiency which focus on daily or weekly returns have low power against market inefficiencies which take the form of long swings of actual prices away from their fundamental values. Then, alternatively using panel data approach "in a new way" in their tests, Jog and Schaller (1991) claim to have provide strong (i.e., not only statistically but also economically significant) evidence for the existence of mean reversion. Therefore, the null hypothesis of serial independence of stock returns is rejected "by the variance ratio tests at the .001 level for most horizons". The transitory component in stock prices is reported to account for between 16% and 40% of the variance of returns.

While most previous research on mean reversion has focus on the U.S. stock markets, Frennberg and Hansson (1993) conduct some tests of the random walk hypothesis for the Swedish stock market, covering the period from 1919 to 1990. Using both the variance ratio test and the test of autocorrelations of multiperiod

returns, they found that the Swedish stock prices "have not followed a random walk in the past 72 years" (p. 175). The results of the study suggest that the Swedish stock returns are positively autocorrelated for short investment horizons (i.e., one to twelve months) and negatively autocorrelated over longer returns horizons (i.e., five years or more). Thus, they reject the random walk hypothesis.

Among the most recent studies of mean reversion in stock returns is the one that has been accomplished by Basu and Vinond (1994). They arrive at the following conclusions (p. 51):

(i) stock returns are mean reverting if there are "strict diminishing returns in the underlying production technology"

(ii) stock prices do not tend to revert to the mean in "economies where the technology displays increasing or constant returns".

While several recent studies found negative serial correlation for stock returns over long horizons using monthly and annual data, a study by Lo and MacKinlay (1988) interestingly demonstrates that stock returns are positively correlated over short horizons (i.e., using weekly observations).

De Bondt and Theler (1989) highlight the fact that one type of mean reversion - "mean reversion in cross-sectional stock prices" (p. 193) - has been discussed in the literature at least since the time of Benjamin Graham (1949), one of the pioneers of security analysis. The "contrarian" advice (or view) of Benjamin Graham who advocated the purchase of shares that seemed to have low prices relative to their intrinsic (fundamental) values is based on the premise that such low prices are temporary in nature and can be expected to bounce back after one or two years[66].

[66]Also see Blume and Siegel (1992), p. 23 and Lehmann (1990).

Recent research has not only documented evidence indicating that future returns might be predicted on the basis of past returns, but there is also evidence that dividend yield [Keim (1985); Rosenberg, Reid and Lanstein (1985)] and price-earnings ratio [Basu (1977, 1978, 1983) and Campbell and Shiller (1988)] appear to be useful in explaining future returns[67]. Whereas the hypothesis that dividend yields forecast returns has a long tradition among practitioners and academics, Fama and French (1988b) offer new evidence that the forecasting of power dividend yields increases with return horizon. Similarly, using dividends and earnings to measure fundamental values, Campbell and Shiller (1988a, b) detected that prices are mean reverting over-year, three-year and ten-year horizons.

Despite the increasing evidence documented in the literature that share price changes are serially correlated, the issues of mean reversion as well as the predictability of stock returns are still controversial. On the one hand, such evidence could be interpreted as a violation of the EMH[68]. The focus of the debate is primarily on whether these findings indicate movements of the market away from fundamental values as suggested by Shiller (1984) Summers (1986) Black (1986), de Bondt and Thaler (1985, 1987) and Shefrin and Statman (1985) or, whether they are related to long-term changes in expected returns[69].

On the other hand, the statistical significance of these findings has been

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[67]Also see Shiller (1984, 1990).

[68]Note however that, it is well known [see e.g., Leroy (1973), Lucas (1978) and Michener (1982)] that serial correlation of returnd does not necessarily imply a violation of market efficiency. Cochrane (1991, p. 471) points out that most of the finance literature interprets return forecastability (although not unanimous) as evidence for slowly changing investment opportunities in the real economy, efficiently reflected in asset markets.

[69]See Lehmann (1990), p. 2; Blume and Siegel (1992), p. 23.

questioned. Shortly after the publication of Fama and French's (1988a) paper, Richardson and Stock (1989) rigorously show that for a long return horizons, 720 observations as used by Fama and French (1988a) is a small sample. With such a small effective sample size, the test statistics for mean reversion are said to have low power and therefore, the results are less significant than reported. Similarly, Cecchetti *et.al* (1990) challenge the previous findings of mean reversion with the argument that much of the serial correlation in historical stock returns could be attributed to small sample bias. Further, they conclude that "the evidence drawn from variance ratios and return regression coefficients are not sufficient to rule out equilibrium models" (p. 417).

Kim *et.al* (1991) also criticize the earlier papers on mean reversion on statistical grounds. They show that the evidence of mean reversion in stock prices provided by the variance ratio and multiperiod-return autoregression tests is overstated due to the assumption of normally distributed returns. Additionally, they argue that mean reversion is entirely a pre-war phenomenon (i.e., the 1926 - 1946 period which includes the Great Depression and the World War II).

Another critique of mean reversion tests comes from McQueen (1992). Reexamining long-horizon stock returns, he found that previous work overstates the evidence of mean reversion: "The overstatement is largely due to the implicit weighting of ordinary least-squares tests, which place more weight on the Depression and World War II observations, which have both large error variances and stronger mean-reverting tendencies. Additionally, the reliance on asymptotic statistics and the improper focus on only the most negative estimates of mean reversion contribute to the overstatement . . . the random walk cannot be rejected . . . " (p. 1).

Markedly, the conflicting opinion expressed in the aforementioned papers highlights the fact that the issue of mean reversion and the predictability of stock returns is far from being settled. Mean reversion in share price changes has perhaps, turned into an more interesting and complicated issue when a group of researchers also produce a fair amount of evidence rejecting the hypothesis that stock returns are unpredictable but, such rejection is in favour of the alternative of positive autocorrelation. In other words, a number of recent studies produce evidence that stock returns (instead of mean reverting) display a tendency towards persistence - a characteristic that has been termed "**mean aversion**" by Kim *et. al* (1991).

For the U.S. data, while several recent studies found evidence of negative serial correlation for stock returns over long horizons using monthly and annual data, a study by Lo and MacKinlay (1988) demonstrates that stock returns are positively correlated over short horizons (i.e., using weekly observations). Additionally, in appraising the evidence of mean reversion in stock returns provided by the variance-ratio and multiperiod-return autocorrelation tests presented in a number of previous papers, Kim *et.al* (1991) find evidence of **mean aversion**: post war data displays a tendency towards persistence in returns. They note that, "The evidence of mean aversion after World War II is shown to be as strong as that for mean reversion over the whole period" (p. 527).

For the U.K. data, evidence of mean aversion has been documented by Mills (1991, 1993a). Using monthly data, Mills (1991) reports that the results from the variance ratio and other tests point clearly to a rejection of the null hypothesis of the unpredictability of U.K. stock returns at horizons ranging from three months up to eight years. This rejection is in favour of positive autocorrelation, and hence, **mean**

aversion. The author suggests that the evidence of mean aversion seems to rule out the popular mean-reverting models of stock prices that comprise the sum of a random walk and a stationary component. He further underlines that these results of positive autocorrelation in returns do not necessarily imply that the U.K. stock market is inefficient or that prices are not rational assessments of fundamental values, because, as Lo and MacKinlay (1988) point out, rational expectations equilibrium prices do not need to form a martingale sequence (of which the random walk is a special case).

Using a modified version of the methodology proposed by Lo (1991), Mills (1993a) finds evidence of long-term memory in monthly U.K. stock returns over the period 1965 - 1990. The author claims that this finding of a tendency of stock returns to be positively correlated at long lags is consistent with findings of mean aversion reported for the same data set in Mills (1991). Moreover, according to the author, these results which are similar to those of Lo (1991) for the U.S., imply excess volatility in the sense of Shiller (1981a).

4.6.4-Noise Trading and Alternative Models

Actually, much of the debate on stock market theory and evidence up until 1986 has been generalised by Fisher Black [Black (1986)] in his presidential address to the American Finance Association, entitled "Noise". Additionally, LeRoy (1989) provides a survey of literature on capital markets until 1989. Literature surveys on market efficiency and equity pricing can also be found in Hawawini (1988), Fama (1991) and Blume and Siegel (1992).

Black (1986) used the term "noise" in a wide context of economics and finance. In his "basic model of financial markets" (p. 529), noise is contrasted with

information[70]. According to Black, noise is what makes our observations imperfect, and because of noise, we are forced to act largely in the dark. It is noise that makes it very difficult to test either practical or economic theories about the way that financial or economic markets work.

Black (1986) also discussed the usefulness of *noise trading* - the trading activity of those without sound fundamental information - for society. In addition, Black went on to suggest a 'modern definition' of an efficient market.

As far as stock markets or financial markets are concerned, among the salient points raised by Black can be summarised as follows:

▸ There are two types of traders at work in financial markets: information traders who trade on information, and noise traders[71] who trade on noise.

▸ Because the whole structure of financial markets depends on relatively liquid markets in the shares of individual firms, noise makes financial markets possible. Noise trading - trading on noise as if it were information - provides liquidity to the markets, although it makes the markets imperfect.

▸ Noise trading puts noise into market prices, causing them to deviate from fundamental or intrinsic values. So, the price of a stock reflects both the information and noise.

▸ Like a drunk who tends to wander further and further from his starting point, the noise that noise traders put into stock prices will be cumulative. The research and actions taken by the information traders will cause prices to revert to their

[70]*Noise*, as Rao (1992, p. 100) points out, is a nebulous concept based on sentiment and beliefs that do not necessarily reflect cash flows.

[71]Noise traders or uninformed traders, according to Rao (1992, p. 100), include those who trade on the advice of financial gurus, for sentimental reasons, for liquidity, or whatever.

fundamental values over time. Information trading will force prices back to intrinsic values, but gradually.

▸ Both price and fundamental value will look roughly like geometric random walk processes with non-zero means.

▸ Because price tends to return to its fundamental value, the variance of price two years from now will be much less than twice the variance of value two years from now.

▸ While volatilities do change over time, short term volatility of price will be greater than the short term volatility of fundamental value.

▸ Because the price of a stock is a noisy estimate of value, we can never be sure how far any stock's price is from its fundamental value.

▸ Even though noise causes markets to be somewhat "inefficient", at the same time noise makes it difficult to trade profitably. Even sophisticated traders will have difficulty in recognising and exploiting the substantial differences that exist between price and intrinsic value.

▸ The market may be "efficient" even though share prices differ from their fundamental values: *An efficient market is one in which price is within a factor of two of value; that is, price is more than half but less than twice, of its fundamental value.* Under this definition, Black (1986) expressed his belief that almost all markets (i.e., at least 90%) are efficient almost all of the time.

The role of noise trading, bubbles[72] or fads in affecting share price behaviour

[72]While there are several formal definitions of what a *bubble* is, the basic intuition behind the term, according to Stiglitz (1990, p. 13), is straightforward: "If the reason that the price is high today is *only* because investors believe that the selling price will be high tomorrow - when 'fundamental' factors do not seem to justify such a price - then a bubble exists".

has been recognised increasingly in the literature. Apart from the work of Robert Shiller discussed in Sub-section 4.6.1, several other attempts to stress the importance of noise trading or bubbles in modelling a stock market can be found in the literature[73]. Among the interesting ones are the models developed by De Long, Shleifer, Summers and Waldmann (1989, 1990, 1991), Cutler, Poterba and Summers (1988, 1990, 1991) and Campbell and Kyle (1988)[74].

4.6.5-Some Shortcomings of the Efficient Markets Paradigm

Apparently, the theory of stock markets has gone through three stages. From the belief that the markets are inefficient, it swung to a decade in which the academics believed they are efficient. As we have discussed in Chapter Three, the general academic view appeared to be that the EMH was true; that the weak-form of the hypothesis was true, that the semi-strong form of the hypothesis was mainly true and that the strong-form was, probably, not. Empirical research since about the last fifteen years however, has produced evidence to suggest that stock markets are much less efficient than academics previously thought. Perhaps, the empirical evidence discussed in the present chapter warrants the view that it is possible to beat the stock markets: "possible but hard" [Lofthouse (1994, p. 39)].

An interesting development in the literature of stock markets in more recent years has been the reexamination of the basic theoretical model of the EMH. The accumulation of asset pricing anomalies, the debate over the excess volatility, market

[73]See e.g., Flood and Garber (1980), Blanchard and Watson (1982), Tirole (1985), Diba and Grossman (1986), Diba (1989), Trueman (1988), Day and Huang (1990) and Kirman (1991).

[74]Due to limited space, these models are not discussed here.

overreaction and mean-reverting in stock returns, and the stock market crash of October 1987, have all contributed towards an intellectual environment which encouraged the questioning and reexamining of the basic theoretical framework of the hypothesis. This reexamination has revealed a logical inconsistency in the EMH itself.

There is a paradox in the theory of strict informational efficiency of capital markets. If markets are fully efficient, prices will adjust instantaneously to new information. If the price of a security adjust instantaneously to new information about the security, there would never be any trading among individuals as a result of new information. If there is no trading, there would be no incentive to collect information on any security. Since no information is produced, prices cannot reflect all information, and therefore, the hypothesis of efficient markets collapses.

Grossman and Stiglitz (1980) have shown that when the hypothesis of market efficiency is true and information is costly, competitive markets break down. So, in the real world, a market must be sufficiently inefficient to allow informationed traders to recover their costs of information [cf. Verrecchia (1979)].

Laffont and Maskin (1990) have shown that when traders have rational expectations, the efficient markets hypothesis breaks down with imperfect competition. The authors argue that imperfect competition adds a new complication to the efficient market question because, when some traders are large, the amount of information conveyed by prices is, to some degree, a matter of their strategic choice.

LeRoy (1989) highlights the fact that a very striking piece of evidence (which is seldom listed in the finance literature as one of the major anomalies conflicting with market efficiency) is the high volume of trade on organised securities exchanges. Being a zero-sum or negative-sum (if brokerages charges and costs of information are

included) game, such transactions in an efficient market can be considered as pure risk uncompensated by positive expected gain. Thus, rational agents would not exchange securities as much as the real-world market participants do. The willingness of market participants to pay for information is another issue. If this purchased information makes profitable trades possible, the securities markets cannot be informationally efficient. If markets are efficient, market participants are irrationally wasting their money in acquiring such information.

Empirically, the subject of market efficiency will become more complex if we take transactions costs into consideration. Joy and Jones (1986) argue that:

(i) Although the bid-ask spread is an important component of transactions costs, typically, EMH studies have associated transactions costs primarily with brokerage costs.

(ii) Since returns are a function of transactions costs, which are in turn, a function of security characteristics, returns should be adjusted for incremental transactions costs attributable to security characteristics. According to the authors, few EMH tests have actually made this adjustment.

LeRoy and LaCivita (1981) point out that most empirical tests of market efficiency are joint tests of three assumptions: (i) stationarity, (ii) rational expectations, and (iii) an "expected-value" model. "Each element of the joint hypothesis may be challenged" (p. 536).

Even though the EMH has several weaknesses, as noted in Chapter Three, the hypothesis should not simply be abandoned. The efficient markets paradigm which has proven to be a powerful engine for intellectual growth in financial economics, is still a useful guide for investors as well as for researchers. Even though in reality stock

markets may not be efficient, they appear to be highly competitive or nearly efficient.

If the EMH is discarded, we have to look for an alternative to explain share price behaviour. Even though there are several alternative models or hypotheses that have been introduced in the literature, the empirical implications of these models are still not clear. As Brown *et.al* (1988, p. 384) put it:

> "... until we accumulate compelling evidence that stock prices consistently under- or overestimate their underlying fundamentals in the long run, discarding models based on rational investor behaviour would seem to be unwarranted".

4.7-Summary and Conclusion

This chapter examines the various hypotheses and explanations of share price behaviour and formation offered under different schools of investment thought. Empirical evidence supporting or refuting those 'theories' and models are also surveyed.

The castle-in-the-air theory asserts that the behaviour of share prices is influenced by mass psychology. Thus, the theory suggests that share prices can be predicted by predicting the behaviour of the crowd in the market.

The philosophy of technical analysis appears related to that of the castle-in-the-air theory: that 'the final results of the market' - the prices - are totally determined by the people or the 'factors' inside the market. So, in order to predict the behaviour of future prices, one has to study the behaviour of the market or past prices.

Fundamental analysis, on the one hand is similar to the castle-in-the-air theory

and technical analysis because it is based on the premise that stock markets are not efficient; that at any point in time there are some shares in the markets which are underpriced and/or overpriced. So, the task of a fundamental analyst is to identify such shares.

Advocates of the castle-in-the-air theory and technical analysts appear to believe that investment is primarily an art[75]. Fundamental analysts, on the other hand, seem to view investment as a science rather than an art. As such, their investment decisions are based on a number of 'scientific techniques'.

Adherents of the EMH also employ a 'scientific approach' to investment decisions. Because they believe that the market discounts everything, there is no way to garner abnormal profit by making investment decisions based on available information. An investor can only earn higher profit if he/she is willing to assume higher risk. Thus, to guide their investment decisions, they formulated some models of equilibrium asset pricing - the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) - based on a trade-off between risk and returns: The higher the riskiness of an asset, the higher its expected return.

Recent research nonetheless, has produced a growing body of evidence suggesting that stock markets are not wholey efficient; that share prices are not solely determined by economic fundamentals but also by other factors. Recent results indicate that, to a very limited extent, share prices are predictable.

What then determines the price of an equity security? In the standard

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[75]Allen and Taylor (1989) note:

"Clearly, chart analysis has a large subjective element, and there are probably as many methods of combining and interpreting the various techniques as there chartists themselves" (p. 3).

See also Taylor (1969).

economics paradigm, it is the intersection of supply and demand curves for a particular asset that determines its price.

From the literature that we have surveyed, the forces of demand for and supply for, a security, are governed by both economic fundamentals (rational factors) and socio-psychological factors (irrational factors or noise). Accordingly, the price of a share can be decomposed into two components [see Poterba and Summers (1988); Fama and French (1988a):

(i) A permanent component (the fundamental value or intrinsic value). Poterba and Summers (1988) propose that this component evolves as a random walk.

(ii) A transitory component (the sentimental value or irrational value). This component which, according to Poterba and Summers (1988) reflects speculation-induced deviations of prices from fundamental values[76] (or may be a consequence of changes in required returns), follows a stationary process.

When a stock market is efficient, its prices reflect only fundamental values. When a market is inefficient, share prices deviate, to some extent, from their fundamental values. When stock markets are 'inefficient', equity prices may be statistically as well as economically predictable.

[76]Because of noise trading, prices deviate from their fundamental values, and asset prices reflect more than just information about expected cash flows [Rao (1992, p. 101].

CHAPTER FIVE

ISSUES TO BE INVESTIGATED

AND

THE RELATED LITERATURE

5.1-Introduction

Our survey of literature on stock market theory, evidence and practice in the preceding chapters, reveals a number of interesting issues and developments. The most salient ones, can be summarised chronologically in the following points:

a) During about the first half of the twentieth century, there was little evidence of any awareness that share price behaviour approximates a random walk, albeit the foundation for the theory that speculative prices follow a random walk had been laid down by the pioneer work of Louis Bachelier since the 1900.

b) In the 1970s and during about the first half of the 1980s, there was almost a consensus in the academic literature that stock markets *in general* were efficient.

c) Perhaps, the year of 1987 can be considered as the turning point in the history of efficient market hypothesis (EMH). In their quest for the explanations to the momentous occasion of worldwide stock market crash of October 1987,many researchers have started to question the validity of the EMH.

d) Recent findings suggest that stock markets are not really efficient; or, they are only *nearly* efficient. Essentially, by the end of last decade, a body of literature suggesting that stock returns are predictable, has emerged.

e) Along with several worldwide political and economic reforms that took place during the decade of 1980s, the concept of global investing has become more prominent in the practitioner literature. In this connection, emerging equity markets have received increased attention.

The present empirical research was planned with such developments in mind. As the title of the thesis implies, the stock market of interest is the Kuala Lumpur Stock Exchange (KLSE).

The question of the behaviour of stock prices/returns has often been related to the issue of stock market efficiency because the two concepts, as we can find in the literature, are almost inseparable. Regarding the "current crisis in efficient market theory", Keane (1991) has made two interesting statements:

(i) "The practical issue at stake for investors, however, is not whether the market is efficient or inefficient, but *how* efficient" (p. 31).

(ii) "The most significant lesson of recent market history, however, is that unexplained price behaviour is not necessarily irrational, and that irrational behaviour is not necessarily exploitable, and finally that exploitable behaviour is not necessarily worth exploiting" (p. 34).

In the spirit of these Keane's (1991) statements, in this study we are not going to get directly involved in the complex issue of *whether* a market is efficient or not. Rather the theme of our research concerns the issue of *how* efficient a market is: *the predictability of stock returns in an emerging stock market.* In order to put our

findings into context, comparisons between the behaviour of stock returns on the KLSE and a number of selected exchanges will be made.

This chapter is developed in three sections. The major issues that will become the focus of our empirical research, are discussed in Section 5.2. Literature related to these issues - methods employed in the previous studies as well as their findings - are also featured in this section.

Stock market "forecastability" is one of the major aspects of stock market behaviour investigated in the present thesis. To accomplished this, some *Bayesian methods* of forecasting will be employed. Since these methods/models employing *out-of-sample* forecasting are relatively new in the stock market literature, we devote one section - Section 5.3 - to discuss these procedures in some detail.

Concluding remarks for the chapter is in section 5.4.

5.2-Statements of the Problems

The subjects of interest for our empirical research have been outlined in Chapter One. They are highlighted and discussed in further detail in the following subsections:

5.2.1-The Behaviour of Stock Returns in an Emerging Market vis-a-vis Developed Exchanges:

Do stock returns on the KLSE behave significantly differently from the behaviour of stock returns on the developed exchanges?

In many respects, stock markets in developing countries are different from their

counterparts in the developed world. For example, these emerging markets are relatively young, small and thinly traded.

Given their idiosyncrasies as discussed in Chapter Two, we expect the behaviour of stocks traded on emerging stock exchanges to be somewhat different from the behaviour of those stocks traded on the well-established exchanges. We examine this issue by comparing some statistical properties of daily, weekly and monthly share price indices from the KLSE with the same indices from some selected well-established stock markets. These examinations and comparisons are considered useful and helpful to some extent, in trying to verify the common belief that equity investments in emerging stock markets are relatively risky[1]. Moreover, this aspect of our empirical investigations which is preliminary in nature, could provide use with some basic/general information about the behaviour of shares traded on the KLSE.

5.2.2-The KLSE and International Stock Market Linkages:

As markets become more integrated[2], is there still ample room to diversify internationally and/or, can we predict future returns in a domestic market based on innovations in major exchanges[3]?

Recent history is witness to a remarkable growth in inter-regional flows of capital and equity investments. Economic and political reforms that had taken place

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[1]See e.g., *IMF Survey*, April 16, 1990, p. 121; Errunza (1994), p. 83.

[2]See e.g., *World Economic and Financial Surveys: Private Market Financing for Developing Countries*, International Monetary Fund, Washington, DC, November 1995.

[3]In their study, Longin and Solnik (1995) assert that they have found evidence of predictable components in the time-variation of international correlation: "Indeed, we have extensive international evidence of predictable time-variations in the equity return distribution. Expected returns seem to depend worldwide on a set of information variables such as the dividend yield and various interest-rate-related variables" (p. 6).

in many parts of the world have made those regions more open to foreign influence and foreign investments. *Investors Chronicle* (February 4, 1994, p. 37) describes these recent global "cataclysmic changes", in a sentence:

> "The seismic events in recent years - the demise of Soviet power and of the dictatorial clones who suffocated freedoms throughout Eastern Europe, the democratisation of Latin America, the economic surge of China and the rapid rise of the Pacific Rim countries - have all conspired to foreshadow major shifts in the old economic order".

As a result of these reforms and developments, in recent years, cross-border investments or global asset allocation strategies have become a new phenomenon in the investment community[4]. Specifically, this globalisation of financial transactions and activities, as Arshanapalli and Doukas (1993) point out, is frequently attributed to a number of different factors such as the relaxation of controls on capital movements and foreign exchange control[5], improvements in computer and communication technology that have lowered the cost of cross-border information flows and financial transactions [cf. Dwyer and Hafer (1988), p. 3], and the expansion in the multinational operations of major corporations.

Halpern (1993) suggests a number of additional factors that have encouraged

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[4]See e.g., *The Economist*, January 9, 1993, p. 47; *BusinessWeek*, September 4, 1995, pp. 40 - 41.

[5]As noted in the *Economist* (February the 17th, 1996), while foreign investment has been hampered, at least until recently, by many factors such as capital controls, opaque markets and the high cost for fund managers of setting up overseas, "In the past few years, these barriers have been falling - especially in emerging markets, where the gains from diversifying are biggest" (p. 91).

During 1994 and 1995, developing countries took various further steps to liberalize foreign investors' and foreign brokers' access to domestic markets and to remove or reduce obstacles to domestic companies' ability to raise capital in international markets. For a detailed survey on these new developments, see the *World Economic and Financial Surveys: Private Market Financing for Developing Countries*, International Monetary Fund, Washington DC, November, 1995.

the integration of worldwide capital markets: the improved disclosure regulations, the capital constraint and settlement problems and capital issuer recognition of the benefits from diversification of capital sources.

Actually, the issue of links between national stock markets has long been attracting researchers' attention. Since the publication of Grubel's (1968) study in 1968, a considerable amount of work has been done on the relationships among national stock markets - to investigate the extent to which international markets are integrated or segmented. The common theme of these studies concerns the merit of international portfolio diversification.

The benefits that may be derived from portfolio diversification have been demonstrated in the pioneer work by Markowitz (1952) and Tobin (1958). Markowitz (1952) developed a rigorous mathematical model of individual behaviour where investment portfolios were evaluated in terms of their mean returns and the total variance of their returns. The return on a portfolio which is simply the weighted average return of its constituents, is given by

$$E(\tilde{R}_p) = \sum_{i=1}^{n} w_i E(\tilde{R}_i) \tag{5.1}$$

where $E(\tilde{R}_p)$ is the expected return on the portfolio, w_i is the proportion of the value of the portfolio invested in the security *i*. $E(\tilde{R}_i)$ is the expected return on the security *i*. According to Markowitz (1952), the risk of a portfolio is a function of the weightings of each of its constituents and of the covariance of each of its constituents with each other. This relationship is given as

$$\text{Var}(\tilde{R}_p) = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j COV_{ij} \tag{5.2}$$

where Var (R_p) is the variance of the portfolio; w_i is the proportion of funds invested in security *i* and w_j is the proportion invested in security j. COV_{ij} is the covariance between returns for securities i and j.

Markowitz's seminal work has provided an impetus for international diversification in general and for diversifying across emerging markets in particular. Markowitz's emphasis on the covariation between asset returns and, by implication, correlation, underlines the importance of measuring the degree of correlation between returns on investment in emerging markets amongst one another and with the more developed markets.

Further devlopment in this field was the work of Tobin (1958). The author demonstrated that given the possibility of an investment in a risk-free asset and also in a risky asset or portfolio, an investor can construct a portfolio of two assets and achieve any desired balance of risk and returns by shifting the proportion held in each asset.

The work of Markowitz (1950) and Tobin (1958) laid the foundations for the development of the Capital Asset Pricing Model (CAPM) in the 1960s. The Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM) discussed in Chapter Four - expressing the equilibrium implication of portfolio theory (with restrictive assumptions) brought out that the correlations between assets could be explainable by a common factor (returns on the market portfolio). In partially segmented international financial markets however, it seems less plausible that correlations of returns between assets traded in the different markets could be explained by a single factor.

Subsequent development of the Arbitrage Pricing Theory (APT) - also discussed in Chapter Four - emphasised that the correlations of returns between assets are likely to be explained by more than just one factor. That this may also apply to correlation of returns between assets traded in different national markets is an empirical question that has received little attention. If we find non-zero correlations between returns on assets traded in different markets, then the CAPM and the APT, if they apply in international partly segmented markets, would imply that at least one or more common factors may be explaining returns in these markets.

The potential gains from international portfolio diversification depend upon the degree to which national markets are dependent upon each other. Theoretically, risk in a portfolio can completely be eliminated when the returns from assets are perfectly negatively correlated. Part of the risk in a portfolio can still be reduced as long as the correlations between stock returns are less than unity[6].

According to Levy and Sarnat (1970), the existence of a relatively high degree of positive correlation within an economy suggests the possibility that risk reduction might be facilitated by diversifying securities portfolios internationally. Through international diversification, it would appear possible for an investor largely to eliminate that part of his (her) portfolio risk associated with the economics of a particular country; and consequently, the investor would be left, theoretically, with only the risk associated with worldwide economic conditions [Watson (1978). p. 196].

The benefits of international portfolio diversification have been well documented in several early studies, including those by Grubel (1968), Levy and

[6]For an exposition of how international diversification reduces the total risk of a portfolio, see Solnik (1996), Chapter Four.

Sarnat (1970), Lessard (1974, 1976), Solnik (1974a, b), Agmon (1972, 1973), Watson (1978) and Hanna (1980). Meric and Meric (1989) have provided empirical evidence that "there is more to be gained from diversification across countries than across industries. Diversification across countries, even if within a single industry, results in a greater risk reduction than diversification across industries within countries" (p. 639). In this study, principal components analysis - a special form of factor analysis -was used to analyse patterns of covariance among 17 national stock market indices (from developed countries) covering a period of 1973 to 1987. The Box's M statistical tests were used to study the inter-temporal stability of the matrix of correlation coefficients among these 17 national stock market indices.

A more recent study by Heston and Rouwenhorst (1994) which examined monthly index returns (from 1978 to 1992) for 12 European countries, has also documented similar evidence [as the one provided by Meric and Meric (1989)]. In another recent study, Hunter and Coggin (1990) concludes that, while there is a limit on the benefits from international diversification, the potential gain is seizable indeed.

There are also several studies which concentrated on the possibility of diversification into emerging markets. For example, Lessard (1973) Errunza (1977, 1983), Agtmael and Errunza (1982), Errunza and Padmanabhan (1988) and Bailey and Stulz (1990) demonstrate that emerging stock markets should be included in global portfolios: that diversification into emerging markets would have been beneficial in terms of both increased returns and reduced risk.

In their study, Bailey and Stulz (1990) used daily, weekly and monthly dollar returns on Pacific Basin market (including the Malaysian stock market) indices (from January 1977 to the end of 1985) to investigate (using correlation analysis) the benefit

to U.S. investors of diversifying into these markets. They found that, while these markets were not equally open to foreign investors, risk reduction provided by diversifying into these Pacific Basin stocks was substantial.

Solnik's (1990) study - using monthly price indices which cover the period of December 1977 to December 1988 - appears to provide another strong case for diversifying into the emerging stock markets of the Pacific Basin. Korea, Taiwan and Thailand are among stock markets which are found to have demonstrated a very low correlation (sometimes negative) among themselves and with stock markets in Australia, Japan, Germany, France, United Kingdom and the United States. However, since over the period of his study (i.e., December 1977 to December 1988), these markets were closed to foreign investors, the author concludes that, "... it is unclear whether the very large diversification benefits that have been measured in this study subsist once investment restrictions are dropped" (p. 13).

In his survey paper, Errunza (1994) has underlined the following points regarding the issue of diversification into emerging stock markets (EMs) for global investors:

(i) The long run path of return correlations is, not surprisingly, unpredictable. "In the short term, there is little reason to expect meaningful increases in EM return correlations that would threaten their diversification potential " (p. 84).

(ii) "With respect to currency risk, the evidence suggests that the currency factor does not contribute toward increased risk of EM portfolios" (p. 85)[7].

(iii) "One of the most important findings that has investment management

[7]Halpern (1993, p. 51) posits that institutional investors, particularly in the United States, historically have accepted the wisdom that currency movements cancel one another out over time and do not affect long-run returns [cf. Hauser *et.al* (1994)].

implications is that the country factor dominates world, currency and industry influences in the case of the EMs and most of DMs" (p. 85). The author refers to the work of Errunza and Padmanabhan (1988), Divecha *et. al* (1992), Lessard (1976) and Drummen and Zimmermann (1992) to support his claim.

A number of papers have attempted to explain the low comovement between markets and the cross-sectional differences in volatility. Lessard (1976), Grinold *et.al* (1989) and Drummen and Zimmermann (1992) among others, regress individual stock returns on global, industry, and national factors and conclude that national factors dominate the explained part of stock price variances. These studies have also detected significant role for industry factors. In his paper, Roll (1992) argues that industrial composition is important for explaining cross-sectional differences in volatility as well as correlation structure of country index returns. Heston and Rouwenhorst (1994), besides suggesting that differences in industrial structure can be used to explain why some markets are more volatile than others, also provides additional explanation for the low international return correlations: differences in local monetary and fiscal policies, and differences in institutional and legal regimes.

While the existence of low correlations (i.e., $r < 1$) between a domestic market and foreign markets is the "necessary" condition for investors to enjoy possible gains from diversification outside their domestic capital market, the presence of inter-temporal stability of the correlations matrix among national stock exchanges is considered as the "sufficient" condition for meaningful *ex ante* international portfolio diversification [see Philippatos *et.al* (1983)]. Should there be a considerable instability in international correlations over time, the benefits of international diversification might be less obvious. Specifically, inter-temporal instability of the correlation

structure will result in a continuously changing efficient frontier and hence, the selection of an *optimal ex ante* investment strategy would be very difficult for investor to identify [Maldonado and Saunders (1981), p. 55].

Empirical research examining the presence of the "necessary" and the "sufficient" conditions for profitable international portfolio diversification has indeed, produced conflicting evidence. These conflicting results perhaps, might be explained by the divergence of empirical methods used[8], separate sample countries, dissimilar sample periods[9] and variable differing intervals.

While several early studies - among others, by Levy and Sarnat (1970), Granger and Morgenstern (1970), Ripley (1973), Agmon (1974) and Panton *et.al* (1976) - have provided evidence that correlations among national equity markets is statistically insignificant or very low, a number of studies, including those by Hilliard (1979), Schöllhammer and Sand (1985), Jaffe and Westerfield (1985), Wheatley (1988) and Eun and Shim (1989) report a substantial amount of interdependence among national stock markets. A study by Hilliard (1979) using spectral techniques for example, found some very close relationships among world's major stock markets (located in New York, London, Paris, Frankfurt, Amsterdam, Zurich, Milan, Toronto, Sydney and Tokyo). Hilliard's results are contrary to the findings of Granger and Morgenstern (1970) who also used spectral analysis (on weekly data for stock indices in eight countries) but found little or no relationship between major stock exchanges.

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[8]Solnik (1977) among others, has pointed out some of the methodological problems associated with previous empirical studies that might explain the differences in results.

[9]Errunza (1977) argues that both Grubel's (1968) study (which examines eleven developed countries for the period 1959 to 1966) and Levy and Sarnat's (1970) study (which examines twenty-eight countries for the period 1951 to 1967) suffer from possible bias due to time period selection.

Hilliard's (1979) study however, has a number of limitations: The period of study - from July 1973 to April 1974 - was not only very short but also "includes the OPEC embargo, an event of major world wide significance" (p. 107). The data used were daily data which were converted to the U.S. numeraire.

Schöllhammer and Sand (1985) used Box and Jenkins's (1970) ARIMA (autoregressive integrated moving average) time series analysis to analyse the possible co-movement among national stock price changes on a daily basis from January 1, 1981 through June 30, 1983. Included in their sample are stock markets from United Kingdom, West Germany, France, Italy, Netherlands, Switzerland and the United States. This study "provides evidence of a statistically significant degree of interdependence among the stock price movements of the United States, the United Kingdom, Germany, Switzerland and the Netherlands" (p. 17). Strong economic linkages between the major European countries and the United States is among the explanations that the authors offer for this phenomenon: "Since stock market indices can be viewed as indicators of the expected, economically relevant developments in a country, one might hypothesize that the high degree of economic interdependence that exists among the EC countries and the U.S. will manifest itself in the synchronization of stock market developments in these countries." (p. 18).

Wheatley (1988) in testing international equity market integration using "a simple version of the consumption-based asset pricing model", finds little evidence against the joint hypothesis that equity markets are integrated internationally and that the asset pricing model holds[10]. The data for this study are from the U.S and 17 other

[10]Whetaley's (1988) results appear to be in contradictory with the results of a previous study by Cho *et.al* (1986) who investigated the validity of the Arbitrage Pricing Theory (APT) in an international setting. Using data from eleven countries (including the U.S., Japan, Hong Kong and Singapore), their results led

countries (including Japan, Hong Kong and Singapore) for the period 1960 to 1985.

Eun and Shim (1989) who investigated the international transmission mechanism of stock market movements by estimating "a nine-market vector autoregression (VAR) system" (p. 241) found that, being "the most influential in the world" (p. 243), innovations in the U.S. stock markets are rapidly transmitted to other markets "in a clearly recognizable pattern, whereas no single foreign market can significantly explain the U.S. market movements" (p. 241). The data base for the study were daily stock market indices at closing time, in terms of local currency units, of the world's nine major stock markets: Australia, Japan, Hong Kong, United Kingdom, Switzerland, France, Germany, Canada and the United States. The period covered was December 31, 1979 through December 20, 1985.

Arshanapalli and Doukas (1993) exploited the newly developed theory of cointegration "to provide new methods of testing the linkage and dynamic interactions among stock market movements" (p. 193). These authors based their study on daily closing price indices from five major exchanges in New York, London, Frankfurt, Tokyo and Paris. Results of the study indicate that the degree of international co-movements among stock price indices has increased substantially for the post-October 1987 period, with a considerable impact of the U.S. market on the French, German and the U.K markets. Nonetheless, it is worth noting that results of cointegration tests should be interpreted with care. As stressed by Maddala (1992), there are many problems with the use of these tests and their interpretation. Among others, the authors points out that, in a way, in the case of both unit roots and cointegration, there is too

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them to reject the joint hypothesis that the international capital markets are integrated and the APT is valid internationally.

much emphasis on testing and too little on estimation. There is also the problem of the power of these tests, according to Maddala (1992).

More recently, in examining the common stochastic trends among the national stock prices of the U.S. and five East Asian countries (i.e., Japan, Taiwan, Hong Kong, Singapore and South Korea), Chung and Liu (1994) found that stock price series are nonstationary and yet cointegrated. Using "Johansen's maximum likelihood estimation procedure" (p. 241), to analyse weekly data on national stock price indices (based on local currencies) from these six countries, they arrived at a conclusion that the result suggested that "the U.S. and Taiwan markets may not belong to a 'common' stock region containing the remaining four countries" (p. 241). These remaining four countries are Japan, Hong Kong, Singapore and South Korea.

The inter-relationship between the Malaysian stock market and a number of well-established markets, has been studied - in a series of papers - by Othman Young (1987/88, 1989, 1993). In his 1987/88 and 1989 papers, Othman Yong examined the validity of the general belief that the performance of a stock market is highly influenced by major stock markets in the world. The focus of the study was on the performance of the KLSE in relation to the performances of stock markets in Hong Kong, Tokyo, New York and Singapore. Using weekly closing indices (for a period between January 1983 to December 1987) of the Hang Seng Index, Nikkei Index, Dow Jones Industrial Average, KLSE Industrial Index and SES Industrial Index which were "transformed into percentage changes in indices"(p. 37), the data were examined using correlation analysis. Results of the study indicated that there is some validity in the claim of interdependencies between stock markets. The author attributed this to the globalisation of information flow and trade relations among these economies indices.

However, according to the author, while the correlation coefficients between price movements on the KLSE and those on other exchanges under comparison were found to be statistically significant, they were not high enough to validate the claim that the performance of the Malaysian stock market was highly influenced by the performances of major stock markets in the world.

In his 1993 paper, Othman Yong (1993) used daily and weekly indices of the stock markets of Malaysia (KLSE Industrial), Hong Kong (Hang Seng), Australia (Australian All Ordinaries), Japan (Nikkei Dow Jones) and the United States (Dow Jones Industrial Average) for a period from January 1984 to December 1988. Similar to his previous studies these indices were transformed into percentages in indices. In this paper however, the issue of stock market comovement was examined from both the parametric approach (i.e., correlation analysis) and nonparametric approach (i.e., the Wilcoxon matched-pairs signed-ranks test and Kruskall-Wallis one-way analysis of variance). Two major findings of the study are as follows:

(i) Correlation coefficients between the Malaysian markets and other exchanges mentioned above are statistically significant.

(ii) Both the parametric and nonparametric tests show that the relationship between these markets are not stable over time and therefore "it is difficult to construct an optimal investment strategy based on the comovements" (p. 65).

The works of Othman Yong (1987/88, 1989, 1993) appear to have some limitations. The sample period for the studies are quite short and the number of countries included in the studies are also limited. In all of these studies, the author used only the KLSE sectorial index (i.e., the KLSE Industrial Index) rather than the KLSE Composite Index or the EMAS (All-share) Index. The data were transformed

into percentage price changes rather than logarithm price changes.

Using different indices[11], a different time period (i.e., January 1984 through December 1994) and different approaches, we reexamine the extent of covariations between the KLSE and other exchanges. We also extend the work of Othman Young (1987/88, 1989 and 1993) by including more stock exchanges - most stock exchanges in the world - in our study. In addition, this study involves data for multiple time periods (i.e., including 1987 and not including 1987). Specifically, the present study attempts to address the following issues:

(i) Is there any potential gain for Malaysian investors to diversify internationally? Or, as world economies and stock ownership become more integrated, and correlations across markets may increase, has the apparent benefits of regional diversification become less obvious [see Halpern (1993), p. 48]?

(ii) What is the degree of correlation between the Malaysian stock market and other stock market?

(iii) To what extent could the movements of stock returns on the KLSE be explained by innovations in other exchanges, particularly the major exchanges of the world? How influential are "world factor(s)" in determining these interrelationships?

(iv) Are the correlations of stock returns between the KLSE and other exchanges inter-temporally stable?

(v) How efficient is the KLSE in processing international news/information? Put another way, how rapidly are price movements in one (major) exchange are transmitted to the KLSE?

[11]It appears to be a convention in the literature that stock price indices are used in studying the interrelationship among the national stock exchanges of the world.

If the KLSE were found to be highly correlated with certain other exchanges, could we use events or past movements in these markets to 'predict' future movements in the KLSE?

A number of authors hypothesise that the greater the relative economic dependence on international trade, the higher would be the correlation between the national market and the world market [see e.g., Hunter and Coggin (1990); Eun and Shim (1989); Schöllhammer and Sand (1985)][12]. Ripley (1973, p. 357) writes:

> "Countries whose incomes move in a similar manner may have stock prices that also move in unison.... Countries that trade extensively with one another are likely to have strong income ties".

Malaysia is a relatively open economy [see e.g Fong (1990)][13]. Thus, we hypothesise that the movements of the Malaysian stock market are highly correlated with movements in several foreign exchanges[14]. Nonetheless, there may be some national exchanges sufficiently lowly correlated with the KLSE that they offer

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[12]As interpreted by Dwyer and Hafer (1988, p. 6), "... international trade creates a link between at least some stocks in different markets". In addition to trade, Dwyer and Hafer (1988) also suggest that multinational operations by firms create links (between national stock exchanges) through ownership of real assets that can affect firms headquartered in different countries.

[13]See also the *Far Eastern Economic Review*, April 4. 1996, p. 38.

[14]Solnik (1996) contends that economies that are more open to the world - Malaysia, Mexico, Korea and Portugal - tend to have the highest correlation with developed markets.

Lin *et.al* (1994) suggest three possible reasons for the international correlations of stock market price changes:

(i) International economic linkages: When two economies are related through trade and investment, any news about economic fundamentals in one country most likely has implications for the other country.

(ii) Financial market integration: The growing financial market integration will increase the degree of correlation between the stock returns of different countries by making portfolio managers in the home market more responsive to changes in foreign markets.

(iii) *Market contagion*: Stock price in one country may be affected by the changes in another country beyond what is conceivable by connections through economic fundamentals. Under this market-contagion scenario, speculative trading and noise trading [see Black (1986); De Long *et.al* (1990)] may occur in the international context: Price movements driven by fads and a herd instinct may be transmitted across borders. The October 1987 stock market crash is often cited as evidence for international bear-market contagion.

significant opportunities for international portfolio diversification (involving the Malaysian shares).

To summarise, given the recent trend of international investing, it has been widely claimed that international stock markets have become more integrated or highly correlated. If this is the case, has the apparent benefits of international diversification become less obvious? If this is the case, on the other hand, can we predict movements on the Malaysian stock exchange based on innovations in major foreign exchanges?

5.2.3-The "Predictability" of Stock Returns:

If stock returns were predictable, to what extent could they be predicted? If stock returns were forecastable, could we improve their "forecastability" by employing some newly developed forecasting procedures?

It might be interesting and beneficial to begin by quoting what has been written by Makridakis (1986) in introducing his paper on "The Art and Science of Forecasting":

> "Can the future be predicted? The answer is 'it depends'. Certainly some aspects of the future can be predicted with a high degree of accuracy, whereas others are less predictable, or completely uncertain. The exact timing of sunrise tomorrow or a year from now can be predicted with a precision measured to hundredths of a second. However, it is much more difficult to accurately forecast changes in stock prices, exchange rates, or when the next recession will hit the economy" (p. 15).

As the topic for their paper, Fuller and Kling (1990) ask, "Is the stock market predictable?". "Predicting the Unpredictable?" is the title of a small book by Mills

(1992). In his conclusion for the book, Mills (1992) notes, "Financial markets are often predictable to some extent, but the crucial question is whether this predictability can be exploited to make excess profits from trading in the markets" (p. 36).

Whether stock returns (or price changes) are predictable, is an old question - a question of long-standing interest to both academics and practitioners. Eugene Fama (1965a, p. 34) writes:

> "For many years the following question has been a source of continuing controversy in both academic and business circles: To what extent can the past history of a common stock's price be used to make meaningful predictions concerning the future price of the stock?"

Further, in his book entitled *The Art of Forecasting*, Bean (1969) begins his chapter on "Predicting the Stock Market" with the following words:

> "It was said some years ago that in no other area of human endeavor has so much brainpower been applied as in that of forecasting the stock market. Perhaps this still holds true today. Where else do we have so many people involved daily in trying to anticipate domestic and world-wide developments in politics, in economic activity, in weather - and trying to predict the effects of these interrelated changes and expectations on the price of securities. If expectation is a 'product', then all those engaged in speculation and investment constitute the largest 'industry' in the world, with its millions of investors, hundreds of thousands in banks, brokerage houses, investment institutions and clubs, and practically all corporations - all examining and analyzing facts and trends and creating expectations, determining market values. . . . Predicting the stock market is therefore an exercise in predicting the predictor" (p. 57).

In his paper entitled "Forecasting Stock Market Prices: Lessons for Forecasters" which was selected "the best paper published in the *International Journal of Forecasting in 1991 - 1993*"[15], Granger (1992) wrote:

> "Despite stock returns once having been thought to be unpredictable, there is now plenty of optimism that this is not so,...If this optimism justified, and if yes, what are the lessons for forecasters working with other data sets? As there is an obvious possible profit motive driving research into the forecastability of stock prices, or at least returns, one can expect more intensive analysis here than elsewhere" (p. 11).

Granger (1992, pp. 11 and 12) further argues:

> "It is surprising that more of the studies surveyed do not provide results of forecasting exercises....If a method exists that consistently produces positive profits after allowing for risk correction and transaction costs and if this method has been publicly announced for some time, then this would possibly be the evidence against the EMH....Only if a profitable rule is found to be widely known and remains profitable for an extended period can the efficient market hypothesis be rejected.... This research program agrees with the modern taste in the philosophy of science to try to falsify theories rather than to try to verify them. Clearly, verification of EMH is impossible".

Recent findings do suggest that stock returns are somewhat predictable[16]. This phenomenon has been reported in several studies; the prominent contributions being

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[15]The *International Journal of Forecasting*, Vol. 11, No. 4, 1995, p. 585.

[16]As discussed in Chapter Four, there are two major reasons for the predictability of stock returns, offered in the literature: the market is inefficient or the required rate of return is changing over time.

Keim and Stambaugh (1986), Poterba and Summers (1988), Fama and French (1988a, 1988b), Lo and MacKinlay (1990), Jegadesh (1990, 1991), Mills (1993a, 1993b) and Harvey (1995).

As we have reviewed in Chapters Three and Four, much of the recent research suggests that past prices and returns contain information useful for forecasting purposes. Studies that provide evidence of stock market predictability - that expected returns, variances and covariances exhibit temporal variation and are predictable - might be grouped into the following categories based on the approaches/testing procedures employed[17]:

(a) Regression-based tests. Regression tests over medium and long horizons have been implemented, inter alios, by Scott (1985), Flood *et.al* (1986), Fama and French (1988a, b) and Campbell and Shiller (1988a, b).

(b) Variance ratio methodology. Studies using this approach which provide evidence of mean reversion/mean aversion in stock returns are implemented by Poterba and Summers (1988), Lo and MacKinlay (1988, 1989) and Mills (1991, 1993a, b), to name a few.

(c) Excess volatility tests begun by Shiller (1981) and LeRoy and Porter (1981). Many empirical tests of asset price behaviour/market efficiency call for the comparison of an asset's market price to its fundamental value. This fundamental value or intrinsic value is defined as the market's expected discounted present value of future cash flows. However, since investors' true expectations cannot be observed, in practice an asset's market price is compared with the econometrician's estimate of

[17]For detailed discussions on the related literature - theories, methodologies and evidence - see Chapters Three and Four.

fundamental value. While in the traditional approach, this estimation procedure involves assuming that market participants expected future cash flows to grow at some constant rate as in the popular Gordon model [see Chapter Four], in Shiller's (1981) seminal work expected cash flows are replaced with actual dividends. Shiller (1981) argued that stock prices are too volatile to be accounted for by changes in fundamentals. He assumed that discount rates are constant - a fallacy.

(d) Tests based on a particular models such as the CAPM [see e.g., Ferson and Harvey (1991); Malkamäki (1992)] and the APT [see e.g., Ferson and Korajczyk (1995)]. Umstead (1977) utilized "the transfer function model building methodology" introduced by Box and Jenkins (1970) to arrive at a conclusion that "aggregate quarterly stock prices are inefficient enough so that the application of transfer function model building techniques to publicly available information could have permitted an investor to earn a portfolio return in excess of the return which was commensurate with the portfolio risk" (p. 427). Pesaran and Timmermann (1985) whose study was based on "a recursive modelling approach" to examine monthly data from the U.S. over the period of 1954 to 1992, also report that the degree to which stock returns were predictable "increased to a level where, net of transaction costs, it could have been exploited by investors in the volatile markets of the 1970s" (p. 1201).

(e) Tests/trading strategies which utilize some techniques advocated/practised by technical analysts as well as those recommended by fundamental analysts.

Technical analysis has a long tradition in forecasting movements in financial markets [see e.g., Plummer (1993)]. Even though this approach has been criticised and even scorned by academics, in recent years with growing evidence against the efficient markets hypothesis, technical analysis has been gaining credibility among both market

participants and financial economists. As we have reviewed in Chapter Four, a number of recent studies have shown that technical trading rules, to some extent, appear to be capable of predicting future prices/returns[18]. Neftci (1991) has tried to place technical analysis on a more firm theoretical foundation and demonstrated that the trading rules devised by technical analysts could be formalised as non-linear predictors.

Similar to technical analysis, some approaches devised by fundamental analysts appear to be useful for forecasting financial markets. These have been discussed in Chapter Three (Section 3.8 - anomalous literature) and Chapter Four (Section 4.4 - fundamental analysis).

Beside its strength, each of the methodologies mentioned above of course, is not free from being controversial - has its weakness and suffers from certain statistical difficulties[19]. For example, Kim, Nelson and Startz (1991) show convincingly that the outcome of tests conducted by Poterba and Summers (1988) and Fama and French (1988) is strongly conditional by the choice of sample interval. Likewise, volatility tests (as featured in Chapter Four) have been criticised, among others, by Kleidon (1986), Marsh and Merton (1986) and Merton (1987). The crux of this volatility tests criticism is that out-of-sample events might be the dominate determinant of fluctuations in stock prices. If this is so, according to Mankiw *et.al* (1991), in-sample dividends will not provide an adequate lever for tests of market rationality.

Notwithstanding that the aforementioned tests/methodologies are not free from being controversial, the relevant issue (particularly for investors) is that stock markets

[18]Other studies involving technical analysis: Brock *et.al* (1992) and Silber (1994) for stock markets; Allen and Taylor (1989) and Taylor and Allen (1992) for foreign exchange markets

[19]Some of these issues are discussed in Chapter Four. See also Mankiw *et.al* (1991).

seem to be "predictable". Accordingly, the relevant question is: if stock returns or changes in stock prices were predictable, how well could a forecaster forecast?[20] In response to this issue, Fuller and Kling (1990) conducted some *out-of-sample* forecasting tests. To the claim of previous researchers that stock returns are predictable, Fuller and Kling (1990) have made some comments, including the following (p. 28):

> "Recently, however, there has been some renewed interest in exploring the issue. Fama and French (1988a, 1988b), Campbell and Shiller (1988) and Shiller (1984) now suggest that long-term market returns are, indeed, predictable. These authors, however, generally do not use true, *out-of-sample* forecasting tests.
>
> "Fama and French (FF) claim in both papers that their models have highly significant predictive ability to forecast market return. Predictability in their sense corresponds to finding (ex post) significant in-sample regression coefficients.
>
> "We subjected the FF models to true out-of-sample forecasting tests, with mixed findings. One of the FF models failed to outperform even the simplest of the alternative models, while the other model may have produced superior results. Final conclusions on market efficiency are open to question nevertheless".

Congruent with the recent findings that stock movements are somewhat predictable, and in the spirit of Fuller and Kling's (1990) and Granger's (1992)

[20]Alfred Cowles (1933) was among the earliest researchers to evaluate statistically how well professional forecasters predict stock prices.

comments highlighted above, the present thesis initiates some "true" *out-of-sample forecasting* tests[21] to 'measure' and 'compare' the "forecastability" of stock returns in an emerging market. The procedures of measurement to be employed, are discussed in Section 5.3 and in Chapter 6 (i.e., Sub-section 6.4.4).

Our decision to implement some out-of-sample forecasting tests for stock returns on the KLSE, could be justified by the following:

(a) Testing the "forecastability" of stock returns/prices from an out-of-sample perspective is still very rare in the literature. By accomplishing this approach, we hope that our results could provide some contributions towards settling this controversial issue of stock market "forecastability".

(b) Our major objective here is to 'measure' the extent to which stock returns/prices are "forecastable". While several previous tests employing various methodologies (as highlighted above), in general find a considerable amount of "forecastability" to returns (and excess returns) over several year horizons, we initiate this attempt to 'measure' the magnitude of stock market "forecastability" in light of the claim by Mankiw *et.al* (1991) that their "statistical tests of stock market forecastability and volatility that are immune from the severe statistical problems of earlier tests" (p. 455) albeit provide evidence to reject the null hypothesis of market efficiency, "the rejections are only marginal" (p. 455).

(c) These out-of-sample forecasting tests as given in Section 5.3 (and Chapter

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[21]Renshaw (1993) also appears to believe in the importance of *out-of-sample forecast* when he writes, "...,the only fair test of a forecasting technique based on extreme values is how well it performs in an out-of-sample period" (p. 80).

Similarly, Belsley (1988), in expressing his view on "Modelling and Forecasting Reliability", inter alia, writes:

"The real art of forecasting arises precisely when forecasting into novel situations, i.e., those lying outside the experience of the existing data" (p. 439).

Six) would involve a number of procedures that appear not to have been used with stock market data before. To some extent, perhaps, these time series methods could serve as alternatives to several previous methods which are considered to lack power by Summer (1986) and Shiller and Perron (1986).

Summers (1986) questions the power of common tests of market efficiency. The inability of these tests to reject the hypothesis of market efficiency, according to the author, does not mean that they provide evidence in favour of its acceptance. In fact, the data in conjunction with these tests (such as the serial correlation tests), the author argues, provide no evidence against the view that financial market prices deviate widely and frequently from rational valuation. Shiller and Perron (1986) have shown that it is wrong to presume that power of tests of the random walk hypothesis must be high just because there are very many observations.

5.2.4-The Random Walk vis-a-vis Mean Reversion/Mean Aversion in Stock Returns:

Do stock prices or returns follow a random walk; or, are they mean reverting or mean averting? If they are predictable, they might not follow a random walk.

The random walk is one of the oldest and most well-known models of the behaviour of stock price movements. From our survey of the literature in Chapter Three, we found that it had been almost the consensus among early researchers that the random walk in general, is a good approximation of stock price behaviour. Recent researchers have challenged this view however. As we have discussed in Chapter Four, the literature on mean reversion, excess volatility and the overreaction hypothesis,

appears to reject the belief that stock prices and returns follow a random walk.

While most results that challenge the idea that share prices follow a random walk come from the well-established exchanges, the possibility of mean reversion and/or mean aversion in stock prices/returns on the KLSE does not appear to have been extensively investigated. Our study attempts to examine this issue of randomness in stock returns on the KLSE.

Our survey of literature indicates that heretofore, there has been only one study [by Kok and Goh (1994)] which examined the presence of mean reversion[22] in the KLSE's stock prices/returns. The data that they used in this study, however, are only the weekly closing share price indices over a period of eight years, 1984 to 1991. To cover this gap, the data base for our mean reversion study will be the daily prices/returns of fifty individual company shares, over a period of eleven years, 1984 to 1994 [see Chapter Seven]

5.3-Forecasting Models

5.3.1-Historical Background

Many of the forecasting techniques used today have roots that date to the late eighteenth century [see e.g., Wegman (1983); Sorenson (1970)]. These methods were further developed in the nineteenth century [see Hanke and Reitsch (1992, p. 1]. For example, the method of least-squares was apparently used by Karl Friedrich, the great German mathematician in 1795, though it was first published by Legendre in 1809

[22]Detailed critical review of literature on mean reversion is provided in Chapter Four.

[Kailath (1974, p. 147; see also Sorenson (1970), p. 63][23].

However, the scientific foundations of what was to become the field of forecasting had only been laid down by the late 1930s - for example, with the development of autoregressive and moving average models [Makridakis (1986)]. The Russian mathematician, Kolmogorov in 1941 and Nobert Wiener in 1942, independently developed a linear minimum mean-square estimation technique that provided the basis of modern *smoothing* or *filtering* theory [see Sorenson (1970), p. 63; Makridakis (1976), p. 48)].

By the late 1960s and 1970s, partly due to the work of Kalman (1960) and the influence of the Box and Jenkins (1970) methodology, the field of statistical forecasting started to become more widely applied. Kalman (1960) for example, changed the conventional formulation of the prediction problem into the *state vector model* or the *state space model* [see Otter (1978, p. 41].

By 1970, 'scientific' forecasting had been extensively practised. For example, predictions in the areas of population, transportation, energy, material prices, economy and business, had been made and recorded [Makridakis (1986), p. 17]. The decade of 1970s also witnessed the development of what is known as *Bayesian Forecasting*. Bayesian forecasting (as it is known in the United Kingdom) proposed by Harrison and Stevens (1971, 1976), is primarily a univariate time series forecasting method[24]. The mathematical basis of the Bayesian forecasting models of Harrison

[23]The method of least-squares was then extended to stochastic processes by Kolmogorove, Krien and Weiner [see Otter (1978), p. 41].

[24]According to Fildes (1983), Bayesian methods have also been proposed in the United States, but less general than those of Harrison and Stevens.

and Stevens is the *state-space* representation of the *Kalman filter* [Kalman (1960)][25]. In fact, these models have their roots in the exponential smoothing models of Brown (1959,1963), Holt (1957) and Winters (1960)[26].

During recent years - after several decades of important theoretical developments, empirical findings and practical experience gained through applications - the field of forecasting can be considered to have been entering into a stage of maturity. Today, with the advent and widespread use of electronic computers and with the development of more sophisticated forecasting techniques and computer programs, the field of forecasting has received increased attention.

Actually, the forecast, as stressed by Montgomery and Johnson (1976, p. 3), is not an end in itself; it is merely a means to an end. Since a forecast is rarely accurate, accepting and understanding the size and nature of forecasting errors, as underlined by Makridakis (1986), is crucial: it facilitates learning and reduces the chances of making similar mistakes in the future. This is so because, the alternative of no forecasting is unlikely to improve our ability to cope better with the future. Expressed differently, despite the fact that errors are inherently a part of any forecasting procedure, forecasting is essential in improving our understanding of the future and hence, facilitating the tasks of planning and strategy [see Makridakis (1991), p. 123]. In short, forecasting helps us to reduce risk in making decisions.

The magnitude of the forecasting errors, as suggested by Montgomery and

[25]See Harrison and Stevens (1976), Meinhold and Singpurwalla (1983), Makridakis and Wheelwright (1977, p. 427) and Duncan and Horn (1972).

[26]See Harrison and Stevens (1976), p. 206; Fildes (1983), p. 139.

Johnson (1976), depends upon the forecasting system used[27]. In his survey of literature however, Makridakis (1986) did not find any study that had shown a clear superiority of one method over another: there was not any single method, which over time, consistently outperformed the remaining methods[28] . Thus, Makridakis (1986) suggests that, "The attitude that a single method can forecast well across all situations is not supported by the empirical evidence" (p. 22).

At present, there are many forecasting methods and models available for users[29]. This chapter introduces two of the forecasting techniques employed in the thesis: the exponentially weighted moving average (EWMA) and the exponentially weighted regression (EWR).

5.3.2-The Exponentially Weighted Moving Average (EWMA)

The techniques of averaging or smoothing are well-known in the theory and practice of forecasting[30]. One of such techniques is known as the *moving average.*

In a simple moving average, a constant number of data points (n) is specified

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[27]In Batchelor and Dua's (1990) words,
"The accuracy of any forecast depends on objective features of the environment, such as the nature of the variable being forecast and the length of the forecast horizon, and on attributes of the forecaster, such as his theory (ideology) concerning the process generating the forecast variable, and the technique by which that theory is used to generate a quantitative forecast" (p. 3). According to Makridakis (1986, p. 35), the more the people can influence the future, the more difficult it is for quantitative methods to predict it. This is because, people's actions can change established patterns and relationships and render quantitative forecasting inaccurate.

[28]Batchelor and Dua (1990) also agree with this view when they write:
"No ideology or technique yields consistently more accurate forecasts than others" (p. 3).

[29]Makridakis (1978) distinguishes the time-series methods into six major methodologies: smoothing models, decomposition models, ARMA (autoregressive and moving average) schemes, filters, leading indicators, and various forms of trend extrapolation and naive approaches.

[30]According to Hanke and Reitsch (1992), the assumption underlying these techniques is that he fluctuations in past values represent random departures from some smooth curve. So, once these short-term fluctuations are smoothed, the curve can be used to project into the future in order to produce a forecast.

at the outset and a mean is computed for the more recent observation. Then, as each new observation becomes available, a new mean is computed by dropping the oldest value and including the newest value. The process can be represented as

$$M_t = \hat{Y}_{t+1} = \frac{(Y_t + Y_{t-1} + Y_{t-2} + \ldots + Y_{t-n+1})}{n} \tag{5.3}$$

where

M_t = moving average at time t;

$\hat{Y}_{t+1}$ = forecasted value for the next period;

Y_t = actual value at period t;

n = number of terms in the moving average.

Thus, a simple moving average for period t is simply the arithmetic mean of the n most recent observations. Equal weights are assigned to each observation. However, as pointed out by Davis (1941), if the purpose of estimating the level of a series of observations is to use it for forecasting future observations, it would be more reasonable and appealing to use a moving average which gives more weight to the recent data than past data. For instance, instead of using a simple moving average (n = 5)

$$\frac{(Y_{t-4} + Y_{t-3} + Y_{t-2} + Y_{t-1} + Y_t)}{5} \tag{5.4}$$

we might use

$$\frac{(Y_{t-4} + 2Y_{t-3} + 3Y_{t-2} + 4Y_{t-1} + 5Y_t)}{15} \tag{5.5}$$

In the expression (5.3)[31] we have given 5 times as much weight to Y_t as to Y_{t-4}, instead of equal attention (weight) as given to the ordinary moving average as in the expression (5.2). Meanwhile, the *weighted moving average* in the form of the expression (5.3) suffers two disadvantages [Gilchrist (1976, p. 50)]:

(i) it only uses the five latest observations and ignores the rest;

(ii) it does not possess a very simple recurrence form.

To overcome these disadvantages, a set of weights - the 'exponential' set of weights -is introduced in a model known as the **exponential weighted moving average (EWMA).** As noted earlier, smoothing (averaging) methods in forecasting involve the formation of averages by giving higher weight to the more recent observations than the earlier ones. If the highest weight is given to the current observation and the weight given to the other observations decline geometrically (exponentially) as they become more distant, then the resulting average is known as the exponentially weighted averages or the *exponentially smoothed series* [Holden *et.al* (1991), p. 22]. The operation of the EWMA is known as *exponential smoothing* [Kendall and Ord (1990), p. 129].

Exponential smoothing[32], as defined by Gaynor and Kirpatrick (1994, p. 290), is a method for continually revising an estimate or forecast by accounting for more

[31]The divisor, 15, is the sum of weight: 1 + 2 + 3 + 4 + 5.

[32]For an excellent review of the techniques of exponential smoothing, see Gardner (1985). See also Johnson and Montgomery (1979).

recent changes or for fluctuations in the data[33]. Using this procedure, the forecast for period t+1 (i.e., a new estimate) is the combination of the forecast for the present period (i.e., period t) plus a portion of the random error (Y_t - $\hat{Y}_t$) generated in the present time period:

$$\hat{Y}_{t+1} = \hat{Y}_t + \alpha(e_t) \tag{5.6}$$

Normally, equation (5.4) is written as[34]

$$S_t = S_{t-1} + \alpha(Y_t - S_{t-1}) \tag{5.7}$$

where

S_t = the estimated or forecasted value for the next time period which is made in the present time period, t;

S_{t-1} = the estimated or forecasted value for the present time period which is made in the last time period, t-1;

Y_t = the actual value (or the actual data point) in the present time period;

$Y_t - S_{t-1}$ or e_t = the forecasted error term for the present time period;

α = a weight (or percentage), which, in theory, can range from 0.001 to 1.00. It reflects the speed at which the new forecast adjusts to the error term.

By rearranging equation (5.5), we get equation (5.6):

[33]Fluctuations in the data could be caused by random error, an unexplained component, or an unpredictable outside incident.

[34]Gaynor and Kirkpatrick (1994, p. 290); Montgomery and Johnson (1976, p. 49).

$$\hat{Y}_{t+1} = S_t = \alpha Y_t + (1 - \alpha)S_{t-1} \tag{5.8}$$

which can be expressed in words as follows:

Forecast for the next period = weight × (present period observation) +
(1 - weight) × (present period forecast)

The operation defined by equation (5.6) is known as *simple exponential smoothing* or *first-order exponential smoothing*, and S_t is called the *smoothed value* or the *smoothed statistic.*

To see more clearly how a forecast is constructed in an exponentially smoothed model (i.e., the EWMA) where past values of a series are smoothed in a decreasing (exponential) manner (with more weight given to the more recent observation), consider a set of weights: α, $\alpha(1 - \alpha)$, $\alpha(1 - \alpha)^2$, ... In other words, to represent weight, α is used for the most recent observation, $\alpha(1 - \alpha)$ for the next most recent, $\alpha(1 - \alpha)^2$ for the next, and so forth. Using these weights, each time period, the weighted observation together with the weighted estimate for the present period, are combined to produce a new period forecast. Through the process of continuous substitution, the forecasted level of the series at time t, as shown in Gaynor and Kirkpatrick (1994, p. 291), is as follows:

$$\hat{Y}_{t+1} = S_t = \alpha Y_t + \alpha(1 - \alpha)Y_{t-1} + \alpha(1 - \alpha)^2 Y_{t-2} + \alpha(1 - \alpha)^3 Y_{t-3} + \ldots$$
$$+ \alpha(1 - \alpha)^{t-1} Y_1 + (1 - \alpha)^t S_0 \tag{5.9}$$

To recapitulate, following Muth (1960), the EWMA forecast arises from the following model of expectations adapting to changing conditions:

Let Y_t be the part of a time series which cannot be explained by trend, seasonal or any other systematic factors; let F_t represent the forecast, or expectation of Y_t on the basis of information available through the (t-1)st period. By assuming that the forecast is changed from one period to the next by an amount proportional to the latest observed error,

$$F_t = F_{t-1} + \alpha(Y_{t-1} - F_{t-1}) \qquad 0 \leq \alpha \leq 1 \tag{5.10}$$

By solving the above difference equation, we can obtain a general formula for the EWMA forecast[35]:

$$F_t = \alpha \sum_{i=1}^{n} (1 - \alpha)^{i-1} Y_{t-i} \tag{5.11}$$

Nelson (1973) shows that the EWMA is a true average since the weights sum to unity. That is, $\alpha + \alpha(1 - \alpha) + \alpha(1 - \alpha)^2 + \alpha(1 - \alpha)^3 + \ldots = 1$.

As discussed in Muth (1960), since the weights attached to prior values of Y_t add up to unity, the EWMA forecasting scheme does not, in this respect, introduce any systematic bias[36]. What makes the EWMA procedure particularly attractive,

[35]cf. Nelson (1973, p. 7), Gilchrist (1976, p. 51) West and Harrison (1986, p. 55), Holden *et.al* (1991, p. 22), Harvey (1993, p. 110; 1990, p. 25)

[36]In Jones's (1966) words, "Since the weights sum to unity, the smoothed time series has a tendency to follow changing mean value" (p. 241).

according to Kendall and Ord (1990), is that the model satisfies a *recursive* relation[37] and thus, to update the forecast, we need only the latest observation and the previous forecast.

While the weighting pattern in the EWMA algorithms may be adjusted by selecting different values of alpha (α), the appropriate weighting factor is obtained by simulating the smoothing process several times until an α value that yields the smallest sum of square errors or mean square error, is found[38]. In doing so, we can be guided by the fact that the actual value of α determines the weight given to the current observation - and hence, the extent to which this current value influences the forecast. Expressed differently, the speed at which fast values of the data lose their importance, depends on the value of α [Gaynor and Kirkpatrick (1994, p. 295][39].

A large alpha value will result in a forecast that responds quickly to changes in the data, since, in this case, large weights are given to the most recent observations included in the forecast or estimate. So, if we require a rapid respond to change in the data, a large weighting factor would be necessary. According to Harvey (1993, p. 111), a value of unity for α means that all the information needed for forecasting is contained in the current observation.

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[37]This recurrence relation is clearly shown in Harvey (1993, p. 110). For an excellent review of recursive approaches to time series analysis, see Young (1974).

[38]A number of authors, including Kendall and Ord (1990, p. 130) and Harvey (1993, p. 111) recommended that the values for α are typically in the range of 0.05 and 0.30, depending on the volatility of the series. Brown (1959, 1963) originally argued that the smoothing coefficient should, in general, be between 0.001 and 0.3. Gardner (1985) however, notes that there is a considerable amount of empirical support for the practical use of larger alpha values (or smoothing constants). Newbold (1989) postulates that it is not surprising that the use of larger smoothing constants in many empirical studies has led to smaller mean squared errors: "Many business and economic time series follow models that are close to a random walk" (p. 525). Accordingly, based on the assumption that share prices follow a random walk, in this study we are using a large alpha value as the discount factor.

[39]Cf. Nelson (1973), p. 7.

Conversely, when the value of alpha is very small, the new forecast will be very similar to the old forecast - the new forecast will not reflect with much speed, any changes in the parameters. As such, if predictions are required to be stable and random errors to be smoothed out, a small weighting factor is needed [Gaynor and Kirkpatrick (1994, p. 295]. Harvey (1993, p. 111) points out that, if a value of α equal to zero were admissible, it would mean that no updating would take place.

To begin our forecast using equation (5.4) or equation (5.6) [or, equivalently, equation (5.9)], we need a value of alpha (which can be obtained by trial and error), and an initial forecast value. As suggested in Holden *et.al* (1991, p. 23), a suitable initial forecast might be the average of the first few values of the series or the most recent actual value. These authors also have the view that, in general, the smoothing methods are particularly applicable when the patterns in the data are changing, so that the last few observations include important information.

To generalise, the ideas behind this forecasting approach, as described by McKenzie (1985) are simple and attractive:

> "The forecast of future values are weighted averages of observations with more recent having greater weight than those of more distant past. The motivation for such weighting is that, in this unstable situation, more recent data are inherently more relevant to the future than earlier values" (p. 33).

5.3.3-The Exponentially Weighted Regression (EWR)

The method of EWR is virtually an extended version of the EWMA. If the EWMA provides a method to predict a constant level, the EWR can be used to predict a trend term. To quote McKenzie (1978) in describing the relationship between the

EWMA and the EWR (or the general exponential smoothing),

> "It is used to predict a constant level, and a second difference-equation can be added to allow prediction of a trend term in two distinct ways. A generalization which can deal with polynomial trend is known as Multiple Smoothing. . . . An extension enabling the procedure to cope with seasonals and growth terms is called General Exponential Smoothing" (p. 450).

In generalising the EWMA, Brown (1963) introduced a new approach by setting up forecasting procedures in a regression framework and adopting the method of discounted least squares. This technique which is known in the literature as *discounted least squares* or *general exponential smoothing*[40] or EWR, is basically designed for the estimation and extrapolation of straight lines [West and Harrison (1989, p. 218].

In the ordinary least squares procedure, the parameters are assumed constant. This implies that, in estimating the coefficients by ordinary least squares, each observation (recent and past), has the same importance in determining the estimates. The Brown's EWR method on the other hand, was developed to give more weight to recent observations by considering a discount factor in the least squares criterion[41].

To illustrate the general exponential smoothing or the EWR procedure, consider a linear growth predictor, so that standing at time t, the forecast of Y_{t+k} will be of the form[42]

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[40]See e.g., Abraham and Ledolter (1983), Newbold and Boss (1990).

[41]Abraham and Ledolter (1983, p. 101); Montgomery and Johnson (1976, p. 75).

[42]See Newbold and Boss (1990, p. 189); Harrison (1967, p. 836).

$$F_t(k) = a_t + kb_t \qquad k = 1, 2, \ldots \tag{5.12}$$

where the quantities a_t and b_t are the intercept and the slope of the linear forecast function. In order to implement a forecasting procedure of this sort, we need to determine the appropriate values for a_t and b_t. The method least squares suggests selecting those values for which the sum of squares

$$S = \sum_{j=0}^{t-1} [Y_{t-j} - (a_t - jb_t)]^2 \tag{5.13}$$

is minimum. Equation (5.11), according to Newbold and Bos (1990, p. 189), would be appropriate if our time series were generated by the *global* linear trend model

$$Y_{t-j} = a_t - jb_t + e_{t-j} \qquad j = 0, 1, 2, \ldots, (t-1) \tag{5.14}$$

where Y_{t-j} are the observed values, e_{t-j} are error terms with zero means, fixed variances, and no autocorrelation. Nonetheless, as stressed by Newbold and Bos (1990), such global trend models rarely provide a good description of the behaviour of real business and economic time series. Accordingly, by thinking in terms of a locally evolving linear trend pattern, with the most recent estimate of trend to be projected forward for forecasting, equation (5.11) needs to be modified[43].

Now, under a local linear trend model, information from the past would be discounted. If, for example, we attach weight one to the squared discrepancy between

[43]This is because, the expression implies that in forming the sum of squares, the same weight is given to the current time period, t, as to less relevant distant time periods.

the observation and the forecast function in the current time period, the appropriate weight for the previous period would be δ, for the period before that would be δ_2, and so on. In this case, δ which discounts past observations exponentially and having the value between zero and one, is known as a *discount factor*. Then, using the discount factor δ, a_t and b_t are chosen so that the quantity minimised is[44]:

$$S^*_t = \sum_{j=0}^{t-1} \delta^j [Y_{t-j} - a_t + jb_t]^2 \qquad 0 < \delta < 1 \tag{5.15}$$

so that a_t and b_t satisfy the recurrence relationships[45]:

$$a_t = a_{t-1} + b_{t-1} + (1 - \delta^2)e_t \tag{5.16}$$

$$b_t = b_{t-1} + (1 - \delta)^2 e_t \tag{5.17}$$

where $e_t = Y_t - a_{t-1} - b_{t-1}$. This approach is known as the method of discounted least squares or the EWR[46].

According to Montgomery and Johnson (1976, p. 75), a major advantage of this method is that it is very efficient computationally: Compared to regression analysis as a forecasting technique, in this method the estimated parameters are updated in a simpler way to account for the most recent observation. That is, a_t and b_t are updated each period without reference to information before t-1. Newbold and

[44]See Newbold and Bos (1990), p. 190. Cf. West and Harrison (1989), p. 218; Granger and Newbold (1986), p. 169; Abraham and Ledolter (1983), p. 101 and Harvey (1990), p. 28.

[45]Harrison (1967), p. 836; West and Harrison (1989), p. 219.

[46]For a systematic derivation of this technique, see Brown (1963); Montgomery and Johnson (1976).

Bos (1990, p. 191) posit that an apparent advantage of the general exponential smoothing algorithm is that forecasts depend on the specification of just a single parameter - the discount factor, δ. In their expository paper on "Discount Weighted Regression", Harrison and Johnston (1984) argue that this recursive procedure[47] is simple to program and involves no matrix inversion.

Makridakis *et.al* (1983) posit that this Brown's one-parameter linear exponential smoothing is the method preferred for nonstationary, nonseasonal data, largely because the method has only one parameter (versus Holt's two). In practice, this parameter takes only a restricted range of values, although theoretically δ can assume any value between 0 and 1. According to the authors, experience suggests that the optimal value for δ lies in the range of 0.1 to 0.2; and with this narrowed set of choices for δ, this method is usually viewed as being easier to apply.

Another advantage of this procedure as shown in Kendall and Ord (1990, p. 131) is that it may be extended to consider polynomial models.

5.3.4-Comment

This study employs the techniques of exponential smoothing in order to examine the issue of stock market forecastability. Exponential smoothing, an approach which was first introduced by Holt (1957), was elaborated and widely applied by Brown (1959, 1963) and Holt *et.al* (1960). Other important contributors in this area would include Winters (1960), Brown and Mayer (1961), Theil and Wage (1964), Trigg (1964) and Harrison (1965).

[47]As pointed out by Zehnwrith (1983, p. 119), a recursive approach allows one to forgo many of the computations and storage requirements that would be required if one were to process all the data at the end of each time period.

The methods of exponential smoothing[48] which, in the literature of control engineering are known as *filtering* [Mehra (1974)], are widely used for forecasting and modelling time series[49]. According to Makridakis (1976), while the methods of exponential smoothing were introduced around 1960 by operations researchers, within a few years they were utilized on a grand scale by business enterprises and the military. These methods are popular in many industrial applications such as production planning, production scheduling and inventory control[50]. Nonetheless, our survey of literature does not indicate that exponential smoothing methods have been employed in any previous studies of stock market behaviour.

Several authors attributed the popularity of exponential smoothing procedures in practical applications to a number of advantages[51]. Montgomery and Johnson (1976) who consider exponential smoothing as one of the most widely used classes of procedures for smoothing discrete time series in order to forecast the immediate future, attribute the popularity of this approach to its simplicity, its computational efficiency, the ease of adjusting its responsiveness to changes in the process being forecast, and its reasonable accuracy[52]. Pecar (1994) perceives exponential smoothing as an ideal method due to its simplicity, acceptable accuracy, efficiency and adaptability.

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[48]Sometimes these methods are referred to as "adaptive" methods, implying their ability to adjust their smoothed value depending upon the magnitude and nature of the error [Makridakis (1976)].

[49]For an excellent review of the techniques of exponential smoothing, see Gardner (1985). Makridakis and Wheelwright (1977, p. 425) posit that exponential smoothing resembles filters in terms of computational simplicity, recursive updating and infinite memory.

[50]See e.g., Brown (1959, 1963), Gardner (1985), Makridakis and Wheelwright (1989), and Winters (1960).

[51]Their disadvantage, as suggested by Makridakis (1976) is that there are several models available: users have to select the one best suited to their data and personal preferences.

[52]See also Johnson and Montgomery (1979).

The procedure of "adaptive" or "exponential" forecasting as argued by Theil and Wage (1964) is based on a weighted average of only two sources of evidence: the latest evidence (i.e., the most recent observation) and the value computed one period before. "As such, it is an easy, quick and cheap method; very little information is needed for a forecast; also, the most recent information is used" (p. 198).

Gaynor and Kirkpatrick (1994, p. 312) underline the fact that the ease in updating a forecast by exponential smoothing often outweighs any gain made in using a more complicated technique. For this reason, according to the authors, exponential smoothing is frequently used in generating short-term forecasts.

Gardner (1985, p. 1) describes the popularity and advantages of exponential smoothing in the following words:

> "Exponential smoothing methods are widely used in industry. Their popularity is due to several practical considerations in short-range forecasting. Model formulations are relatively simple. . . . Only limited data storage and computational effort are required. Tracking signal tests for forecast control are easy to apply.
>
> "Perhaps the most important reason for the popularity of exponential smoothing is the surprising accuracy that can be obtained with minimal effort in model identification".

Makridakis and Hibon (1991), suggest two advantages of using the exponential smoothing approaches in forecasting[53]:

(i) although extremely simple and easy to model, these methods have been found by many studies to be as accurate as more complex and statistically

[53]See also Johnson and Montgomery (1979, p. 39), Makridakis (1986).

sophisticated alternatives;

(ii) these methods are robust, easy to program, require a minimum of historical data and the cost of running them on the computer is the smallest of all available alternatives.

In summary, the major advantages of exponential smoothing procedures are: their simplicity and their short-term accuracy.

5.4-Concluding Remarks

In this chapter, we emphasise the literature that relates most closely to the objectives of this dissertation. Because most of the methodologies we employ are relatively unique to stock market research, we are unable to devote much space to directly related empirical studies. Instead, we survey material from the forecasting literature providing background to methodology adopted in the next chapter.

CHAPTER SIX

EMPIRICAL METHODOLOGY

6.1-Introduction

This chapter is developed in four sections and features the statistical methods to be employed in investigating the issues highlighted and discussed in Chapter Five. These statistical methods given in Section 6.3, are design to test the null hypothesis listed in Section 6.2. Section 6.4 concludes the chapter.

6.2-Hypotheses

Our empirical investigations of the behaviour of stock prices/returns on the KLSE will revolve around the following major null hypotheses:

Ho_1: In general, stock returns on the KLSE do not behave significantly differently from those on developed equity markets.

Ho_2: The correlations of returns between the KLSE and foreign Exchanges are not significantly different from zero.

Ho_3: In terms of "forecastability", the KLSE is efficient. The "forecastability"

of stock returns on the KLSE could not be improved even if some newly developed forecasting procedures are employed.

Ho_4: Stock returns on the KLSE follow a random walk: they are not mean reversive and/or mean aversive.

6.3-Test Design

The methods of measurement and the techniques to be used in testing our hypotheses, are developed and explained in the following sub-sections.

6.3.1-The Statistical Properties of Stock Returns: A Preliminary Comparative Analysis

To understand the general behaviour of prices/returns of stocks traded on the KLSE, we begin our empirical study by examining some statistical properties of stock returns, using the two widely referred indices: the *KLSE Composite Index* and the *EMAS (all share) Index*. The daily, weekly and monthly performances of these indices are to be compared with the performances of two indices from the New York Stock Exchanges (i.e., the *New York Composite Index* and the *Dow Jones Composite 65 Index*), the London Stock Exchange (i.e., the *Financial Times All-share Index* and the *Financial Times 100-share Index*) and the Hong stock Exchange (i.e., the *Hang Seng Bank Index* and the *Datastream Total Market Index*)[1]. The Daily, weekly and monthly

[1]The New York Stock Exchange (NYSE) and the London Stock Exchange (LSE) are chosen for this comparison because they are among the most mature and sophisticated exchanges in the world. The Hong Kong Stock Exchange (HKSE) is included in this comparison because of its idiosyncrasies: The HKSE is one of the largest stock exchanges in the Asia-Pacific region; it is an exchange which has just, within the past few years, "graduated" from its "emerging" status [see Wilcox (1992); it is often considered as one

indices from Australia [i.e., the *'Australian Joint Stock Exchange' (AJSE) All Ordinary*) are also included in this comparison because, like Hong Kong, Australia is located in the Pacific Region and geographically quite close to Malaysia[2].

Here, stock returns are defined as

$$R_{it} = \ln(I_t) - \ln(I_{t-1}) \tag{6.1}$$

where

R_{it} = Return on market (index) i at time t;

I_t = Stock price index at time t;

I_{t-1} = Stock price index at time t-1; and

ln = Natural or Napierian logarithm.

The statistical properties to be examined are the mean, standard deviation, kurtosis and skewness[3]. Particularly, our interest here is, to compare the mean and standard deviation/variance of stock returns[4] on the KLSE with those means and standard deviations of stock returns from the selected exchanges mentioned above.

The mean of stock returns on the KLSE ($\bar{x}_1$) will be compared with the mean

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of the most speculative markets in the world [see e.g., Dawson (1982)]. Allan (1982) concluded that Hong Kong was the most volatile of 18 world equity markets which he studied over the period of 1972 to 1981 [See also Solnik (1996)].

[2]Historically, as mentioned in Chapter Two, the KLSE was modelled after the Sydney Stock Exchange when it was established in the early 1960s.

[3]The formulae for calculating these statistical properties, can be found in most elementary statistical textbooks. See also Kritzman (1994).

[4]In financial analysis, it is common that a return distribution is described by its expected return (which is also referred to as the *first moment* of the distribution and is measured by the arithmetic mean of the returns) and standard deviation. The variance (i.e., the standard deviation squared) which measures the dispersion of the observations around the mean, is commonly known as the *second central moment* or the *second moment* about the mean.

of stock returns on another market ($\bar{x}_2$), based on the following null hypothesis (H_0) and alternative hypothesis (H_1):

$$H_0: \bar{x}_1 = \bar{x}_2;$$

$$H_1: \bar{x}_1 \neq \bar{x}_2.$$

The Z-test for two population means defined below[5] , will be used:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sigma_{\bar{x}_1 - \bar{x}_2}} \tag{6.2}$$

where σ_{x-x} is the standard error of the difference.

The standard error of the difference between sample means is given by

$$\sigma_{x-x} = [s_1^2/(n_1 - 1) + s_2^2/(n_2 - 1]^{1/2} \tag{6.3}$$

where s_1^2 and s_2^2 are the sample variances. [Here, X_1 and X_2 are assumed to be uncorrelated].

In comparing the variances/standard deviations of stock returns (i.e., s_1 and s_2)

[5]See e.g., Walsh (1990), pp. 108 & 109; Kanji (1993), p. 23; Clark (1991), p. 110.

between two exchanges, our hypotheses are as follows:

H_0: $s_1 = s_2$;

H_1: $s_1 \neq s_2$

Under the null hypothesis that the variances/standard deviations of the two populations are equal, we will be using the F-test statistic. In this case, the test statistic $F = s_1^2/s_2^2$ follows the F-distribution with $(n_1 - 1, n_2 - 1)$ degrees of freedom [Kanji (1993), p. 37].

6.3.2-Examining the Interrelatedness of the KLSE and Foreign Exchanges

Following the precedent in the literature, the linkages between the KLSE and overseas exchanges are to be examined by using stock price indices[6]. This examination involves a number of steps and procedures as follows:

[6]As noted by Ripley (1973, p. 357), a stock price index, while not accurately reflecting the variation of any one stock price, does represent a good description of general market movements. Even though the results obtained from any study using stock market indices pertain only to the general market movements, they have a direct bearing on the trading strategies of investors - essentially institutional investors - whose diversified portfolios may move in tandem with the market average. Meanwhile, one weakness of price index, as El-Erian and Kumar (1995, p. 332) point out is that, it may behave more systematically than its components because of the effect of averaging.

a) Cluster Analysis

Techniques for **cluster analysis**[7], according to Everitt (1974), seek to separate a set of data into groups or clusters. Cluster analysis as defined by Lorr (1983, p. 1), refers to a wide variety of techniques used to group entities into homogeneous subgroups on the basis of their similarities. It is a generic name for a variety of mathematical methods - numbering in hundreds - that can be used to find out which objects in a set are similar [Romesburg (1984), p. 2]. The end products of these techniques are known as classes, types, groups, categories or *cluster*.

Since much research depends on the estimation of similarities between pairs of things, applications of cluster analysis are found in virtually all disciplines and professions[8]: they are also not new to the social scientists. Indeed, systematic grouping of objects on the basis of common properties dates back to Aristotle and Greeks [Lorr (1983), p. 7]. However, as our survey of literature seems to indicate that the method of cluster analysis which we will be using in this study has not been widely employed in the previous studies of stock market linkages[9], it needs some explanation[10].

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[7]Besides *cluster analysis*, these techniques have been variously referred to as *techniques of Q-analysis, topology, grouping, clumping, classification, numerical taxonomy* and *unsupervised pattern recognition*. However, as underlined by Johnson and Wichern (1992, p. 573), clustering or grouping is distinct from the classification methods. While classification pertains to a *known* number of groups and its operational objective is to assign new observations to one of these groups, clustering analysis is a more primitive technique in that no assumptions are made concerning the number of groups or the group structure. In clustering, grouping is done on the basis of **similarities** or **distances (dissimilarities)**.

[8]See e.g., Romesburg (1984), Everitt (1974)

[9]Drummen and Zimmermann (1992) have used cluster analysis as one of their approaches in examining the linkages among European stock markets.

[10]For comprehensive expositions of the techniques of clustering, see e.g., Chatfield and Collins (1980), Romesburg (1884), Kaufman and Rousseeuw (1990) and Johnson and Wichern (1992).

The techniques of cluster analysis are useful tools for data analysis in several different situations: Among others, they could be used to search for natural groupings in the data, to simplify the description of a large set of multivariate data and to generate hypotheses to be tested on future sample [see Everitt (1974), p. 5]. For the purpose of this study, cluster analysis is considered essential because of its ability, as claimed by Lorr (1983, p. 3):

(i) to generate hypotheses within a body of data by discovering unsuspected clusters;

(ii) to test hypothesised classes believed present within a certain group of cases; and

(iii) to identify homogeneous subgroups characterised by attribute patterns useful for prediction.

The input of a cluster analysis consists of a *raw* data matrix, where the set of objects (i.e., the things whose similarities to each other we want to estimate) is represented in the m rows, and the set of variables (i.e., the *attributes*[11] - the properties of the objects) is represented in the n columns. In other words, the initial step in a cluster analysis, involves the collection of raw data presented in an $m \times n$ matrix of measurements say X, where

[11]The term *attribute* here refers to a property capable of further division; it is a quantitative variable. Contrarily, the property of an object not capable of further division is known as *quality*.

In this case, *clustering* involves the process of grouping *entities* (i.e., things possessing certain properties) into subsets on the basis of their similarity across a set of *attributes*.

$$X = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & \\ \vdots & & & \\ X_{m1} & & \cdots & X_{mn} \end{bmatrix} \tag{6.4}$$

In most cluster analysis, the next step involves the transforming of the data matrix into a square $m \times n$ matrix of interobject similarity or dissimilarity measures. Given the fact that the number of groups is not known, the problems of a cluster analysis as Lorr (1983, p. 3) points out, are threefold: (i) to choose a measure of interobject similarity, (ii) to select a method for forming subgroups once the indices of similarity (or dissimilarity) have been obtained, and (iii) to decide on the number of subgroups present in the data or to construct a hierarchical arrangement. In many respects, cluster analysis has been given its major impetus by the development of the high-speed computer and the rapid appearance of cluster algorithms, since about the middle of the 1950s[12].

While there are several types of clustering techniques, they can be broadly classified into *hierarchical methods* and *nonhierarchical methods*. For our purpose, we will be using the hierarchical methods.

The hierarchical or *multilevel* methods can be subdivided as *agglomerative* or *divisive*. The agglomerative technique begins with all m individual cases or units. At each stage, it combines together the two entities or clusters that are closest. Finally, all cases are combined into one *family*[13] or cluster.

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[12]See Lorr (1983), Everitt (1974)

[13]A hierarchy in the context of cluster analysis may be viewed as a family of nested multilevel classes.

The divisive procedure on the other hand, operates in the opposite direction. It begins with the entire set or collection and subdivides or partitions it into finer and finer subsets at each level.

The results of both agglomerative and divisive techniques may be presented in the form of *tree* or *dendrogram* [see Figures 6.1 and 6.2] - a two-dimensional diagram illustrating the fusions or partitions which have been made at each successive level. In this case, if the agglomerative methods build a tree from branches to the root, the divisive techniques begin at the root and form a branching sequence. If an agglomerative method starts at the base of the dendrogram and works upwards, a divisive procedure starts at the top of the dendrogram and works downwards.

One of the methods for finding a hierarchical tree is known as the *single linkage* or *nearest neighbour method.* Under this procedure, groups are formed from the individual entities by merging nearest neighbours, where the term *nearest neighbour* connotes smallest distance or largest similarity. To illustrate the complete linkage algorithm, consider the matrix of distances between pairs of five objects, namely $\mathbf{D}_1$, as follows:

$$D_1 = \{d_{ik}\} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & & & & \\ 9 & 0 & & & \\ 3 & 7 & 0 & & \\ 6 & 5 & 9 & 0 & \\ 11 & 10 & 2^{*} & 8 & 0 \end{bmatrix} \end{array} \tag{6.5}$$

[In this matrix, the element in the *i*th row and the *k*th column gives the distance, d_{ik}, between *i* and *k*].

Treating each object as a cluster, the clustering starts by merging the two closest items. Since

$$\min (d_{ik}) = d_{53} = 2 \tag{6.6}$$

is the smallest entry in the matrix $\mathbf{D}_1$, objects 5 and 3 are merged to form the cluster (53). The distance between this group and the three remaining objects, 1, 2, and 4, are obtained from $\mathbf{D}_1$ as follows:

$$d_{(53)1} = \min \{d_{51}, d_{31}\} = \min \{11, 3\} = 3 \tag{6.7}$$

$$d_{(53)2} = \min \{d_{52}, d_{32}\} = \min \{10, 7\} = 7 \tag{6.8}$$

$$d_{(53)4} = \min \{d_{54}, d_{34}\} = \min \{8, 9\} = 8 \tag{6.9}$$

Deleting the rows and column of $\mathbf{D}_1$ corresponding to objects 5 and 3 and adding a row and column for the cluster (53), we may obtain a new distance matrix $\mathbf{D}_2$, giving inter-individual distances, and group-individual distances, as follows:

$$\mathbf{D}_2 = \begin{array}{c} \\ (53) \\ 1 \\ 2 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} (53) & 1 & 2 & 4 \end{array} \\ \begin{bmatrix} 0 & & & \\ 3^* & 0 & & \\ 7 & 9 & 0 & \\ 8 & 6 & 5 & 0 \end{bmatrix} \end{array} \tag{6.10}$$

The smallest entry or distance between pairs in $\mathbf{D}_3$ is $d_{(53)1} = 3$. So, we merge merge cluster (1) with cluster (53) to get the next cluster, (153). Now, the nearest-neighbour distance are

$$d_{(153)2} = \min\{d_{12}, d_{(53)2}\} = \min\{9, 7\} = 7 \tag{6.11}$$

$$d_{(153)4} = \min\{d_{14}, d_{(53)4}\} = \min\{6, 8\} = 6 \tag{6.12}$$

These may be rearranged in a distance matrix $\mathbf{D}_3$:

$$\mathbf{D}_3 = \begin{array}{c} \\ (531) \\ 2 \\ 4 \end{array} \begin{array}{c} \begin{array}{ccc} (531) & 2 & 4 \end{array} \\ \begin{bmatrix} 0 & & \\ 7 & 0 & \\ 6 & \mathbf{5^*} & 0 \end{bmatrix} \end{array} \tag{6.13}$$

The minimum nearest neighbour distance between pairs of clusters now is $d_{(42)}$ = 5. Then, objects 4 and 2 are merged to get the cluster (42).

At this stage, we have two distinct clusters, (153) and (42). Their nearest neighbour distance is given by

$$d_{(153)(42)} = \min\{d_{(153)4}, d_{(153)2}\} = \min\{6, 7\} = 6 \tag{6.14}$$

and the final distance matrix, $\mathbf{D}_4$, becomes

$$\mathbf{D}_4 = \begin{array}{c} \\ (531) \\ (42) \end{array} \begin{array}{c} \begin{array}{cc} (531) & (42) \end{array} \\ \begin{bmatrix} 0 & \\ \mathbf{6^*} & 0 \end{bmatrix} \end{array} \tag{6.15}$$

Therefore, clusters (153) and (42) are merged to form a single cluster of all five objects (12345). The groupings, and the distance/similarity levels at which they

occur, are illustrated in the following dendrogram

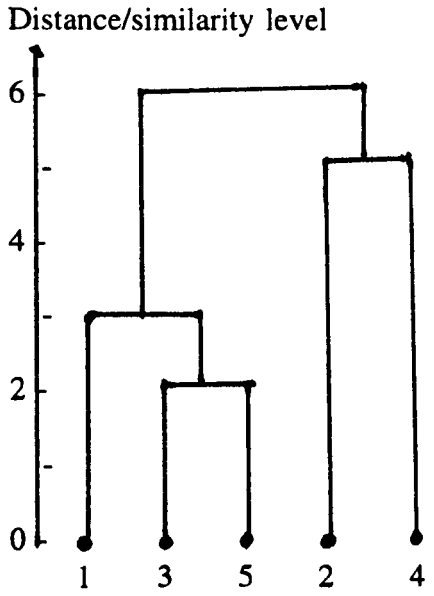

Figure 6.1 - *Single Linkage Dendrogram*

Another method of hierarchical cluster analysis is known as the *complete linkage* or *furthest neighbour method.* This approach proceeds in much the same manner as single linkage. However, under this method, at each stage, the distance (similarity) between clusters is determined by the distance (similarity) between the two elements, one from each cluster, that are most distant. In other words, the distance between groups is now defined as the distance between their most remote pair of individuals.

The complete-linkage clustering ensures that all items in a cluster are within some maximum distance (or minimum similarity) of each other. Since, in examining stock market linkages we are looking for stock markets which are 'nearest' in terms of similarity in their price movements, the complete-linkage clustering approach is considered not appropriate for our purpose. As such, the single-linkage or nearest

neighbour clustering method will be used. Further, since we are using *Minitab* to implement clustering process, we use correlation (as given in *Minitab*) to measure distance.

The unique feature of a cluster (hierarchical) analysis is that, whichever method is chosen, the whole clustering scheme can be summarised in a dendrogram. While, at the bottom of a dendrogram all units form separate groups, at its top all units fall into a single group.

In essence, cluster analysis is chosen as an approach in our analysis of stock market linkages because of its uniqueness: A dendrogram which is the end product of this procedure, as suggested by Krzanowski (1988), provides a good overall impression of the information contained in a matrix of dissimilarities. The *clustering coefficient scale* (which can be presented either in terms of similarity or in terms of dissimilarity) that can be placed at the side of the dendrogram, provides a graduation. Thus, by looking at a dendrogram one can see immediately which groups of individual cases or units are similar to each other. By just referring to the scale of the clustering coefficient, one can easily judge which groups are most, and which ones are least, homogeneous. Moreover, as Krzanowski (1988) advocates, the dendrogram can be 'cut' at any chosen position to see which members fall into which groups, either at a chosen level of clustering coefficient or at a chosen number of groups.

The techniques of cluster (hierarchical) analysis, albeit they are not new in the literature and practice, they are not widely used in stock market analysis. From our survey of literature, we have found that heretofore, there are only three studies which employed this approach in examining stock market behaviour. Panton *et.al* (1976) employed hierarchical clustering to examine comovement characteristics of twelve

major stock markets from developed countries using weekly price indices for a period of 1963 to 1972.

Cheung and Ho (1991) also used cluster analysis as one of their procedures in examining the intertemporal stability of the relationships between the Asian emerging markets (including Malaysia and Singapore) and developed markets. However, as far as the Malaysian stock market is concerned, the problem with this study is that the sample period chosen is between January 1977 and June 1988. During this period, the Malaysian stock market and the Singapore stock markets were twin stock markets. As such, the two markets were found to be moving very closely together.

In another study, Drummen and Zimmermann (1992), employed the *average linkage clustering* method to examine "similarity" among twelve European stock markets based on daily index returns from January 1986 to November 1989. They found that the German stock market was very "similar" to the Swiss stock market and the U.K. stock market was very "similar" to the Netherlands stock market.

As discussed above, hierarchical clustering analysis offers a number of advantages, and this method appears to be capable of producing useful results when it is employed to study stock market linkages. For these reasons, we chose this approach as one of our procedures in examining stock market linkages.

b) Correlation (Pearson) Analysis

Correlation analysis is the study of the relationship between two variables, and the *correlation coefficient (r)* is calculated to measure the strength as well as the direction of this linear relationship [Clark (1991), p. 65]. One statistic that can compute the correlation coefficient between two variables, X and Y, is known as the

Pearson product-moment or simply Pearson coefficient, defined as[14]

$$r_{xy} = \frac{\sigma_{xy}}{\sigma_x \sigma_y} = \frac{Cov(X, Y)}{[Var(X)Var(Y)]^{1/2}} \tag{6.16}$$

where σ_x and σ_y are the standard deviations for variable X and variable Y, respectively.

The correlation coefficient can range from +1 to -1. While a correlation coefficient of -1.0 indicates a perfect negative or inverse relationship, a correlation coefficient of +1.0 indicates a perfect positive or direct relationship. When r_{xy} equals 0, there is no relationship between the two variables (i.e., X and Y).

When the correlation coefficient is squared, it is known as the *coefficient of determination*. The coefficient of determination which is denoted as r^2 and may range from 0.0% to 100.0%, tells us the percentage of variation in the dependent variable (Y) which is explained by the variable (X).

To test the null hypothesis that the value of r is zero, the test statistic given by

$$t = [r/(1 - r^2)^{1/2}][n - 2]^{1/2} \tag{6.17}$$

is calculated and this follows Student's t-distribution with (n - 2) degrees of freedom [Kanji (1993, p. 33].

Correlation analysis is a method which has been widely used by previous

[14]See Gaynor and Kirkpatrick (1994), p. 44; Ramanathan (1992), p. 30; Walsh (1990), p. 246.

researchers in examining international stock market linkages[15]. So, using this method in our study would enable us to compare our results with the results of previous studies.

c) Partial Correlation Analysis

Partial correlation analysis can be considered as a 'more detailed analysis of correlation'. It is a special case of correlation analysis: conditional correlation analysis.

The *partial correlation coefficient* is a particularly useful tool in searching for causal relationships [Stoodley *et.al* (1980), p. 228]. So, for stock markets which appear to be highly correlated with the KLSE, we proceed with our study by examining their partial correlation coefficients.

A partial correlation coefficient as defined by Daniel and Terrell (1992, p. 559), is a measure of the contribution of an individual variable when the other variables are held constant. So, the purpose of computing the partial correlation coefficient is to measure the *net* correlation between the dependent variable and one independent variable after eliminating the influence of one or more variables in the model.

Suppose that we have three variables, Y, X_1 and X_2. In order to exclude the influence of X_2 on Y, we regress Y on X_2 and find the residual $e_1 = Y^*$. To eliminate the influence of X_2 on X_1, we regress X_1 on X_2 and find the residual $e_2 = X_1^*$. Then, Y^* and X_1^* representing the variations in Y and X_1 respectively, left unexplained after we have removed the influence of X_2 from both Y and X_1. The partial correlation

[15]See e.g., Grubel and Fadner (1971), Watson (1978), Errunza and Padmanabhan (1988), Othman Yong (1987/88, 1989, 1993), Hunter and Coggin (1990), Divecha *et.al* (1992) and Speidell and Sappenfield (1992).

between Y and X_1 holding X_2 constant - denoted by $r_{y1.2}$ - is nothing else than the simple correlation between the residuals, Y^* and X_1^*; that is[16]

$$r_{y1.2} = r_{y^*x1^*} \tag{6.18}$$

The partial correlation between Y and X_1 holding X_2 constant, which ranges in value from -1 to +1 (as does simple correlation), can be expressed in terms of simple correlation as

$$r_{y1.2} = \frac{r_{y1} - r_{y2}r_{12}}{[(1 - r^2_{y2})(1 - r^2_{12})]^{1/2}} \tag{6.19}$$

As far as our empirical work is concerned, we are going to find the partial correlation between Y and X, holding R and S constant. This process involves the following steps:

(i) constructing Y^* by finding residual of Y, after regressing Y on R;

(ii) constructing X^* by finding residual of X, after regressing X on R;

(iii) constructing Y^{**} by finding residual of Y^*, after regressing Y^* on S;

(iv) constructing X^{**} by finding residual of X^*, after regressing X^* on S.

The final stage involves finding the correlation between Y^{**} and X^{**}, which is the *net* correlation of Y and X after excluding the influence of R and S. For example, we can implement the above process to find the partial correlation coefficient (or the

[16]In the subscript, the symbol to the right of the decimal indicates which variable is held constant, while the two symbols to the left of the decimal indicate which variables are being correlated.

net correlation coefficient) between the stock price on the Kuala Lumpur Stock Exchange at time t ($KLSE_t$) and the stock price on the Hong Kong Stock Exchange at time t ($HKSE_t$) by excluding the influence of the $KLSE_{t-1}$ and the stock price on the Stock Exchange of Singapore at time t (SES_t).

It is worth noting here, as Salvatore (1982, p. 156) points out, that partial correlation coefficients give only an ordinal and not a cardinal, measure of *net* correlation. The sum of the partial correlation coefficients between the dependent and all the independent variables in the model need not add up to 1.

The *coefficient of partial determination* which is the square of the partial correlation, provides useful information about the interrelationships among variables. For instance, $r^2_{y1.2}$ tells us what proportion of the remaining variability in Y is explained by X_1 after X_2 has explained as much of the total variability in Y as it can [Daniel and Terrell (1992), p. 560].

To test the null hypothesis that $r_{y1.2}$ is zero, we can use the t-test statistic as given by equation (5.17), but with (n - 4) degrees of freedom.

6.3.3-Examining the "Forecastability" of Stock Returns

While most studies found in the literature claiming that stock markets are predictable are based on 'in-the-sample' forecasts, this study attempts to examine the issue with the 'out-of-sample' approach. In doing so, some techniques from the theory of forecasting are used.

Forecasting means predicting future events. Forecasting as defined by Gaynor and Kirkpatrick (1994, p. 2), refers to an attempt to foresee events by examining the past. In doing so, according to the authors, forecasting techniques may be based on

the experiences, judgements, and opinions of "experts" or on mathematical models that describe the pattern of past data.

Belsley (1988) emphasises that good out-of-sample forecasting requires a "meaningful and proper" model: "In order reliably to forecast beyond the experience of the data (that is, beyond the situations represented in the data upon which estimates are based), it requires a meaningful and proper model, or equivalently for emphasis, without a meaningful and proper model, there can be no reliable forecasting beyond the experience of the data" (p. 439).

In general, models are approximations to reality[17]. They provide some relations between variables to facilitate current decisions or forecasting of the future. Models - econometric models essentially - attempt to explain economic or business phenomena and increase our understanding of relationships between and among variables.

According to Makridakis (1986, p. 28), data series are characterised by random and systematic (or non-random) changes which can, in turn, be of a temporary or permanent nature. We hypothesise that, being an economic *time series*[18], a stock's prices or returns exhibit both types of changes - random and systematic changes[19].

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[17]Belsley (1988, p. 440) defines *modelling* as the act of providing the best possible description of one's understanding of the relevant aspects, both statistical and deterministic, of the process or mechanism (the real-life phenomenon) that generates the data of interest.

[18]Montgomery and Johnson (1976, p. 7) define a *time series* as a time-ordered sequence of observations (realizations) of a variable.

[19]As expressed in Makridakis (1991):
"... we well know that economic and business series fluctuate a great deal. It is also well recognized that some of these fluctuations are random while others are systematic (which are, in turn, temporary or permanent)" (p. 126).

Accordingly, these two types of movements are represented by two types of models[20]: the *Steady Model* (or also known as the *Steady State Linear Dynamic Model*) - to describe the random movements (or the constant process) in the time series; and the *Linear Growth Model* - to describe the systematic changes (or the upward drift and/or downward trends) in the data series.

a) The Steady Model

Under this model, stock prices or returns are assumed to follow a stochastic process represented by the following equations:

$$Y_t = U_t + v_t \qquad v_t \sim [0; V_{(v)}] \tag{6.20}$$

$$U_t = U_{t-1} + w_t \qquad w_t \sim [0; V_{(w)}] \tag{6.21}$$

where Y_t is the observed prices (or returns) for period t; U_t may be thought of as the intrinsic value or the underlying level (of the process) at time t. v_t and w_t are uncorrelated random disturbances or noise, each with zero mean and variances $V_{(v)}$ and $V_{(w)}$.

The first equation, equation (6.20), is known as the *observation equation*. It describes how data is generated from the explained factor plus a random noise (the unexplained factor). The assumption that the random component, v_t, has an expected value of zero and its variance is constant [i.e., $E(v_t) = 0$ and $V_{(v)} = \sigma^2_{(v)}$] is equivalent to saying that Y_t is a random variable with mean U_t and variance $\sigma^2_{(v)}$.

[20]These two types of models are discussed in Harrison (1967), Harrison and Stevens (1971, 1976) and Smith (1979) So, for a detailed explanation and mathematical derivations of these models, see Harrison and Stevens (1976).

The second equation, equation (6.21), is known as the *system equation*. It reflects the underlying level which varies through time in the manner of a random walk.

Time series forecasting, as pointed out by Montgomery and Johnson (1976, p. 13), consists of estimating the unknown parameters in the appropriate model and using these estimates, projecting the model into the future to obtain a forecast. Here, assuming that we start at time t-1, we are interested in two variables: the next observation, Y_t, and the underlying level at that time, U_t. So, as our first step, it is convenient to use the system equation to make a forecast of the value of U_t, given the information available at time t-1. In the second stage, we can employ the observation equation, and this leads to the forecast of the next observation, Y_t.

The optimal predictor for this Steady Model as shown in Harrison (1967) is the simple *exponentially weighted moving average* (EWMA). The formula for the EWMA is given by the following equation [see equation (5.8) - Chapter Five]:

$$\hat{Y}_{t+1} = S_t = \alpha Y_t + (1 - \alpha)S_{t-1} \tag{6.22}$$

where

$\hat{Y}_{t+1}$ (or S_t) = the estimated or forecasted value for the next time period which is made in the present period, t;

S_{t-1} = the estimated or forecasted value for the present time period which is made in the last time period, t-1;

Y_t = the actual value (or the actual data point) in the present time period; and

α = a weight (or percentage).

The uniqueness of EWMA as a forecasting technique is that past values of a series are smoothed in a decreasing (exponential) manner by giving higher weight to the more recent observations than to the earlier ones. The speed at which past values of the data lose their importance can be easily manipulated by controlling the value of weight, α. In this study, we assign a value of unity to α, because the underlying assumption of our Steady Model is that stock prices/returns follow a random walk. A value of unity for α would imply that all information needed for forecasting is contained in the current observation. Based on this predetermined α value, the forecasted values (and errors) at various time periods can be obtained by employing equation (6.22) given above.

b) The Linear Growth Model

As suggested by Montgomery and Johnson (1976), a trend in the level of the process of a time series can be represented by a linear trend model. This can done by a simple extension of the Steady Model to incorporate the slope. This extended model, known as the *Linear Growth Model*[21] states that the price (or return) for a stock at one period of time is equal to its value at the previous time plus the slope plus a random error:

Observation Equation

$$Y_t = U_t + v_t$$

[21]Harrison and Stevens (1976, p. 217) claim that this model is highly relevant to applications.

System Equations

$$U_t = U_{t-1} + b_t + w_t \tag{6.23}$$

$$b_t = b_{t-1} + \varepsilon_t \tag{6.24}$$

where b_t represents the slope or growth rate at period t; ε_t is a random error with zero mean and variance $V_{(\varepsilon)}$.

Forecasting under a system given by the Linear Growth Model, as stressed by Harrison and Stevens (1976, p. 207), involves two separate stages[22]:

(i) to estimate the current parameter values - U_t and b_t - from the available data Y_t, Y_{t-1}, Y_{t-2}, . . . ; and

(ii) to extrapolate this information forward in time to make inferences as to future values of the observation variable Y_{t+k} (k = 1, 2, . . .).

In assessing the predictability of stock returns (or prices) using the Steady Model, the method of measurement that will be used, as mentioned above, is the exponentially weighted moving average (EWMA)[23]. For the Linear Growth Model, the Brown's (1963) method of *exponentially weighted regression* (EWR) will be used as the method of forecasting [see Chapter Five].

The optimal predictor of the Linear Growth Model as shown in Harrison (1967), appears to be the particular form of the Box and Jenkins predictor recommended by Holt (1957). Nonetheless, Harrison (1967) suggests that there is

[22]See also Priestley (1976), p. 229.

[23]Harrison (1967) has shown that for the generating process such as assumed under the Steady Model, the EWMA supplies the optimal linear least squares predictor. See also Muth (1960).

nothing to gain by using Holt's method instead of Brown's[24]; that Brown's method, as many have suggested, is at least as good as Holt's and it should therefore be preferred for non-seasonal forecasting [Makridakis (1976, p. 51].

This Brown's (1963) EWR - an extended version of the EWMA - is a forecasting procedure in a regression framework which is developed by adopting the method of discounted least squares. While in the ordinary least squares procedure the parameters are assumed constant, under the EWR a discount factor is used to give more weight to the recent observations.

As pointed out by West and Harrison (1989) the EWR is a approach which is basically developed for the estimation and extrapolation of straight lines. So, in implementing the EWR forecasting procedure using δ as the discount factor, the values of a_t and b_t which are the intercept and the slope of the linear forecast function, respectively, are chosen so that the quantity (i.e., sum of squares) minimised is [see equation (5.15) - Chapter Five]:

$$S^*_t = \sum_{j=0}^{t-1} \delta_j [Y_{t-j} - a_t + jb_t]^2 \qquad 0 < \delta < 1 \tag{6.25}$$

where Y_{t-j} are the observed values; a_t and b_t satisfy the recurrence relationship[25] [see equations (5.16) and (5.17) - Chapter 5]:

[24]Comparing the Holt's and Brown's methods, Harrison (1967) arrived at the following conclusion: "Sampling errors associated with the estimation of Holt's forecasting parameters outweigh any theoretical advantage which the predictor may be thought to possess, and, therefore, it is more convenient to work with Brown's predictor" (p. 838).

[25]Notice that the weight/discount factor assigned to equation (6.26) is different from the one assigned to equation (6.27). This is because, equation (6.26) represents the level whereas equation (6.27) represents the growth term.

$$a_t = a_{t-1} + b_{t-1} + (1 - \delta^2)e_t \tag{6.26}$$

$$b_t = b_{t-1} + (1 - \delta)^2 e_t \tag{6.27}$$

and the forecasted error term, $e_t = Y_t - a_{t-1} - b_{t-1}$.

In the literature, it is suggested that the optimal value for δ lies in the range of 0.1 and 0.2 [see e.g., Makridakis *et.al* (1983)]. In the present study, in searching for the minimum forecasting errors at various time period ahead, the values of δ between 0.1 and 0.3 are used (on trial and error basis).

In summary, the elegance of EWR as a forecasting model lies primarily in the fact that this *general exponential smoothing* algorithm enables us to discount past observations exponentially in the least squares criterion. Additionally, it is easy to apply because the set of choices for δ values (as note above) is limited, and the method is easy to program and involves no matrix inversion.

c) Combining Forecasts and the Multi-process Models

Numerous approaches to forecasting economic variables are available. A number of authors including Makridakis (1986), advocate that forecasting errors could be minimised by combining various models and methods of forecasting[26]: Two unbiased forecasts can be combined to produce a new forecast which is more accurate than either of its components.

The idea behind the combination of forecasts or also known as *composite forecasting*, according to Bessler and Brandt (1981) is that oftentimes alternative

[26]A number of early works on combined forecasts - of notes, by Bates and Granger (1969), Newbold and Granger (1974) and Winkler (1984) - report some degree of success. For an excellent review of the literature on 'combining forecasts', see Holden *et.al* (1990), Chapter 3.

forecasts of the same random variable are available; each of them contains information which is independent of that contained in the others: "Researchers, using empirical data have demonstrated that composite forecasting can, in fact, give forecasts which are preferred to any of the individual forecasts. Thus, any forecasting effort ought to seriously consider using such methods"[27] (p. 513).

Further, Montgomery and Johnson (1976), have the view that in forecasting time series we may need to use different models during various stages - we may need to switch from a 'constant-process model' to a 'trend-process model', and vice versa. Harrison and Stevens (1971, 1976) introduce the idea of *multi-process models* or alternatively known as *mixture models* [West and Harrison (1989), p. 437] - an approach that involves the handling of uncertainty, not of the parameters within a model, but of the model itself. This idea was developed based on the assumption and practical experiences that in real socio-economic applications there may be uncertainty as to which model obtains at any given time; that the process level may suddenly and unexpectedly change over time [Harrison and Stevens (1976)].

As discussed earlier, for the purpose of our study, movements in stock prices (or returns) are represented by two models: the Steady Model (SM), and the Linear Growth Model (LGM) as an alternative. Given the assumption that the true model can change from period to period; that share price changes are random - and at times, systematic - it appears to be impossible for us to be certain which model will operate in any given time period.

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[27]In concluding his paper on "Combined Forecasts", Winkler (1984) notes,

"A combination of forecasts from two or more methods may well be more accurate than forecasts from individual methods. In general, the idea of combining forecasts has much to recommend it for use in actual forecasting practice. . . .

"Combining forecasts, then, seems to be a very promising approach that has not been studied extensively. Thus, it deserves further study" (p. 293).

At time t-1, consider for example, the forecasts that can be made for the observation for period t. If model 1 (i.e., the SM) had been correct at time t-1, it may continue in period t, or it may change to model 2 (i.e., the LGM). Similarly, if the LGM had been the correct model in period t-1, the correct model for period t might either be the LGM or the SM. These four possibilities are diagrammatically summarised below:

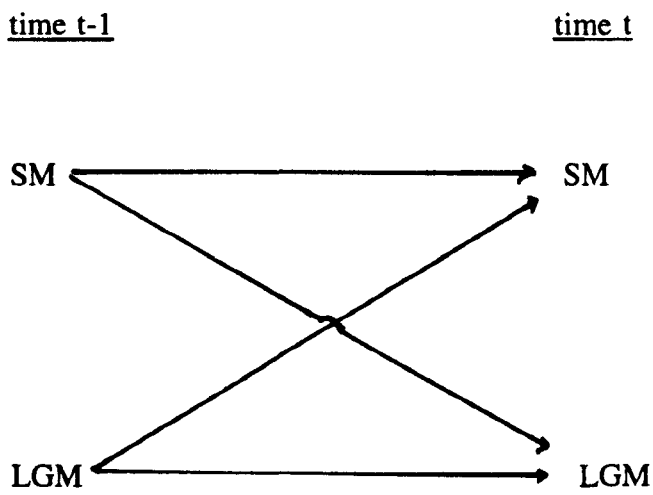

Figure 6.2 - *The Four Possibilities of the Correct Model at Time t*

Such an uncertainty necessitates *transition probabilities* (π) from one model to another. These transitions need not be equally likely, however.

For the purpose of our research, we require the transition probabilities that model 1 [i.e., $M^{(1)}_{t-1}$ or SM_{t-1}] which is the correct model at time t-1 will continue to be the correct model at time t [i.e., $\pi_{1\to1}$] or it will change to model 2 [i.e., $\pi_{1\to2}$]; and equivalently that model 2 [i.e., $M^{(2)}_{t-1}$ or LGM_{t-1}] which is the correct model at time t-1 will continue to be the correct model at time t [i.e., $\pi_{2\to2}$] or it will change to

model 1 [i.e., $\pi_{2\to1}$]. These four probabilities were predetermined intuitively[28] and are as follows:

$\pi_{1\to1}$: 0.95

$\pi_{1\to2}$: 0.05

$\pi_{2\to2}$: 0.95

$\pi_{2\to1}$: 0.05

The aforementioned transition probabilities were chosen/predetermined based on the assumption that when stock prices/returns are following a particular model (i.e., model 1 or SM)[29] at time t-1, it is most likely that it will follow the same model at time period t. Hence, we assign a probability of 0.95 to the '$\pi_{1\to1}$' process. Likewise, when stock prices are following LGM at time t-1, it is most likely that they will follow the same model at time t-1 and hence a probability of 0.95 is given to the '$\pi_{2\to2}$' process. It might also be plausible to use other combinations of transition probabilities, for example 0.90 and 0.10 instead of 0.95 and 0.05. However, this would require a more exhaustive study to ascertain better combinations of values, and optimisation of parameter values does not necessarily lead to generalisability of the results.

The implementation of forecasts using this multi-process models approach,

[28]As noted in Chopra and Lin (1996), one of the advantages of the Bayesian approach to forecasting is that it combines *data* with *intuition*: it enables the user to incorporate subjective beliefs into forecasts. See also Jacobs and Levy (1989), p. 26.

[29]As previously noted, in representing movements in stock prices/returns, the underlying assumption for the SM is that stock prices/returns follow a random walk.

involves the following operational steps:

Step 1: *Posterior view at the starting time - all states are equal*

We begin at time t-1 with the intuitively predetermined *transition probabilities* and *posterior probabilities* of model 1 and model 2 [i.e., $P(M^{(1)}_{t-1}|D_{t-1})$ and $P(M^{(2)}_{t-1}|D_{t-1})$].

Step 2: *Creating prior at time t*

With a knowledge of the *posterior probabilities* of the two models and the transition probabilities, we can assign a probability that at time t, we expect the system to be in a given state as follows:

$$P^*(M^{(1)}_t|D_{t-1}) = P(M^{(1)}_{t-1}|D_{t-1})\pi_{1\to1} + P(M^{(2)}_{t-1}|D_{t-1})\pi_{2\to1} \tag{6.28}$$

or,

$$P^*(M^{(2)}_t|D_{t-1}) = P(M^{(2)}_{t-1}|D_{t-1})\pi_{2\to2} + P(M^{(1)}_{t-1}|D_{t-1})\pi_{1\to2} \tag{6.29}$$

where $P^*(M^{(1)}_t|D_{t-1})$ is the *prior probability* (for the next step) that model 1 is the correct model at time t, given the data or information at time t-1. Similarly, $P^*(M^{(2)}_t|D_{t-1})$ is the prior probability that model 2 is the correct model at time t, given the data and information at time t-1. As these equations imply, each of these prior probabilities is just the sum of the two ways this state can be reached.

Step 3: *Making forecasts using the two models*

(The distributions of forecasts for model 1 ($M^{(1)}$) and model 2 ($M^{(2)}$) are

depicted in Figure 6.3).

Step 4: *Prior selection between model 1 and model 2*

If $P^*(M^{(1)}_t|D_{t-1}) \geq 0.5$, we choose model 1. Otherwise, model 2 will be chosen. This selected model is used to forecast the outcome at time t.

Step 5: *Getting the data - to observe Y_t*

Step 6: *Revising the new posterior view*

When the actual observation, Y_t, becomes known, the probabilities can be revised using the Bayesian method[30] in the following way:

$$P(M^{(1)}_t|Y_t \text{ and } D_{t-1}) = \frac{L(Y_t|M^{(1)}_t)P^*(M^{(1)}_t|D_{t-1})}{L(Y_t|M^{(1)}_t)P^*(M^{(1)}_t|D_{t-1}) + L(Y_t|M^{(2)}_t)P^*(M^{(2)}_t|D_{t-1})}$$

or,

$$P(M^{(1)}_t|Y_t \text{ and } D_{t-1}) \propto L(Y_t|M^{(1)}_t)P^*(M^{(1)}_t|D_{t-1}) \tag{6.30}$$

Equivalently,

---

[30]As discussed in Zellner (1971), Chapter 2, an essential element of the Bayesian approach is the Bayes's theorem, which is also referred to in the literature as the *principal of inverse probability*.

Bayes's theorem or Bayes's law on conditional probability can be represented by the following equation:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

where P(A|B) is the probability of A given event B. For a continuous distribution, the representation becomes

$$P(A|B) \propto L(B|A)P(A)$$

$$P(M^{(2)}_t|Y_t \text{ and } D_{t-1}) = \frac{L(Y_t|M^{(2)}_t)P^*(M^{(2)}_t|D_{t-1})}{L(Y_t|M^{(1)}_t)P^*(M^{(1)}_t|D_{t-1}) + L(Y_t|M^{(2)}_t)P^*(M^{(2)}_t|D_{t-1})}$$

or,

$$P(M^{(2)}_t|Y_t \text{ and } D_{t-1}) \propto L(Y_t|M^{(2)}_t)P^*(M^{(2)}_t|D_{t-1}) \tag{6.31}$$

where $\propto$ denotes proportionality[31], and L denotes the likelihood[32] or probability density. $P(M^{(1)}|Y_t \text{ and } D_{t-1})$ refers to the probability of model 1, given the observation, Y_t and information, D_{t-1}. Likewise, $P(M^{(2)}_t|Y_t \text{ and } D_{t-1})$ refers to the probability of model 2, given observation, Y_t and information, D_{t-1}. These are the new posterior probabilities for time t for the projection to t+1 observation.

L, which is the height of a normal curve, is given by

$$\frac{1}{\sigma\sqrt{(2\pi)}} e^{-(Y_t - \mu)^2/(2\sigma^2)} \tag{6.32}$$

where Y_t is the actual (observed) value, μ is the expected value based on the forecast and σ is the standard deviation of forecast error. For illustration, Figure 6.3 depicts the hypothetical distributions of forecasts for model 1, ($M^{(1)}$) and model 2, ($M^{(2)}$), respectively. If the observed value at time period t is Y_t, then L_1 would be the

[31]The constant of proportionality is such that the sum of the two posterior probabilities is unity.

[32]The *principle of maximum likelihood* is based on the intuitive notion that "an event occurred because it was most likely to" [Ramanathan (1992), p. 75].

likelihood or probability density for model 1 and L_2 would be the likelihood for model 2, and the Bayesian equation would increase the probability of $M^{(1)}$ accordingly.

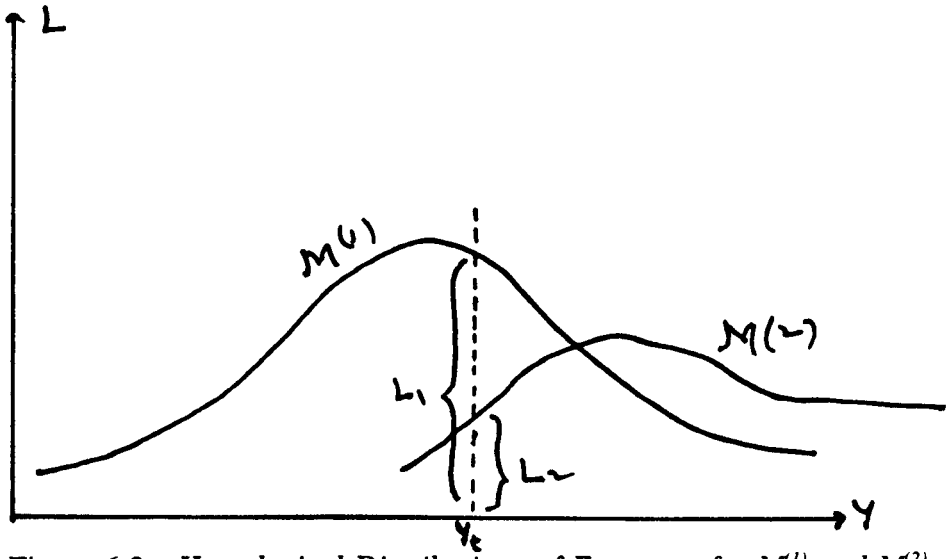

Figure 6.3 - *Hypothetical Distributions of Forecasts for $M^{(1)}$ and $M^{(2)}$*

Step 7: *Start with new posterior view*

Our revised probabilities obtained in Step 6 will now serve as the *new posterior probabilities* for forecasting next period's observation, Y_{t+1}. So, this step actually replaces Step 1 and the operational process will continue recursively.

By employing this multi-process models method as the approach for our 'combined forecasts', our procedure will be quite different from the *simple averages of forecasts* and the *weighted averages of forecasts* as discussed in Winkler (1984). Under our multi-process models procedure - also known as the Bayesian approach[33] to the 'combination of forecasts' - we revise the probabilities of the different models

[33]For a discussion on the superiority of the Bayesian approach over other methods as a tool in forecasting financial asset returns, see Chopra and Lin (1996). See also Jacobs and Levy (1989), p. 26.

throughout time[34]. The most likely model is then used to forecast the next observation, which, when it is received, is used to revise the probabilities as in equation (6.30) or (6.31).

For a detailed treatment of these so-called *mixture models, class II* or also labelled as the *multi-process, class II models* in Harrison and Stevens (1976), see West and Harrison (1989), Chapter 12.

(d) Methods of Error Measurement

Errors are an inherent part of any forecasting procedure[35]. As Hanke and Reitsch (1992, p. 1) put it, "Predictions as to future outcomes rarely are precisely on the mark; the forecaster can only endeavour to make the inevitable errors small". As such, the smaller the errors that a forecasting model or technique manages to produce, the more powerful it is.

In the literature of forecasting, several methods have been devised to measure and summarise the errors generated by a particular forecasting technique. As Hanke and Reitsch (1992, p. 113) point out, most of these measures involve averaging some function of the difference between an actual value and its forecast value.

As far as the present investigation is concerned, the standard statistical measures that will be used to measure and to compare the accuracy of the three

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[34]As previously mentioned, a subjective prior distribution of the values of weights is specified, and then, the evidence from the data modifies these weights. For details, see e.g., Bessler and Brandt (1981) and Gupta and Wilton (1987).

[35]In this complex and uncertain world, despite the inaccuracies of the process, forecasting is necessary because we need to make decisions that affect the future. While forecasting systems are often so complex that even the expected behaviour of the errors cannot be easily specified [McKenzie (1978, p. 449); while the purpose of forecasting is to reduce risk in decision making [Montgomery and Johnson (1976, p. 2], educated guesses about the future are more valuable than are uneducated guesses [Hanke and Reitsch (1992, p. 2].

forecasting procedures employed, are as follows:

(i) The Sum of Squared Errors (SSE)

As its name reflects, the SSE is computed by summing up the squared error terms (e_t) of the difference between the actual values and the forecast values. If Y_t is the actual datum for time period t and $\hat{Y}_t$ is the forecast (or fitted value) for the same period, then the SSE is defined as

$$SSE = \sum_{t=1}^{n} (Y_t - \hat{Y}_t)^2 = \sum_{t=1}^{n} e_t^2 \tag{6.33}$$

(ii) The Mean Squared Error (MSE)

Under this method, each error or residual is squared; they are then summed and divided by the number of observations (n):

$$MSE = \frac{\sum_{t=1}^{n} e_t^2}{n} \tag{6.34}$$

Similar to the SSE, the method of MSE provides a penalty for large forecasting errors because they are squared. This might be useful since a technique of forecasting that produces moderate errors may well be preferred to one that usually has smaller errors but occasionally produces large ones.

(iii) The Root Mean Square Error (RMSE)

The RMSE (or the standard error) is simply the square root of the MSE, defined by

$$\text{RMSE} = \left[\frac{\sum_{t=1}^{n} e_t^2}{n} \right]^{1/2} \tag{6.35}$$

6.3.4-Revisiting the Random Walk Hypothesis: Variance Ratio Test

While the standard academic view prominently expressed in 1970 by Granger and Morgenstern (1970) that by and large, stock prices follow a random walk and hence price changes are inherently unpredictable, reexamining the random walk hypothesis would be useful in light of the recent findings that stock returns, particularly over long horizon, are not following a random walk but they rather tend to exhibit mean reversion and/or mean aversion. If stock returns on developed exchanges are found to exhibit mean reversion/mean aversion rather than following a random walk, we also expect stock returns on emerging markets to behave in the same manner given the fact that they are relatively thinly traded and perceived to be less efficient.

Several recent studies, as discussed in Chapter Four, have tested the random walk theory using the variance ratio methodology[36]. Testing the random walk in gross national product (GNP), Cochrane (1988) was among the first researchers to apply this methodology.

The variance ratio test as defined by Poterba and Summers (1988), exploits the fact that if the logarithm of the stock price (including reinvested/cumulated dividends) follows a random walk, then the return variance should be proportional to the return

[36]A detailed discussion of the variance ratio test and the application of the test to examine mean reversion in a variety of economic contexts can be found, inter alia, in the works by Campbell and Mankiw (1987), Huizinga (1987), Cochrane (1988) and Lo and MacKinlay (1988, 1989).

horizon. That is, as clearly shown diagrammatically in Engel and Morris (1991), the variance of the return on k-year investment is just k times the variance of the return on one-year investment. If, for example, P_t is the logarithm of the dividend-inclusive price, the two-year return will be

$$(P_t - P_{t-1}) + (P_{t-1} - P_{t-2}) = P_t - P_{t-2} \tag{6.36}$$

Then, the variance of the two-year return will be

$$\begin{aligned} Var(P_t - P_{t-2}) = {} & Var(P_t - P_{t-1}) + Var(P_{t-1} - P_{t-2}) \\ & + 2Cov(P_t - P_{t-1}, P_{t-1} - P_{t-2}) \end{aligned} \tag{6.37}$$

If prices follow a random walk, the covariance between the current one-year and the lag one-year return is equal to zero. Thus, assuming that the variance of one-year returns is constant over time, the two-year variance of returns becomes

$$2Var(P_t - P_{t-1})$$

Based on the above argument, the variance ratio statistic for q period investment horizon - VR(q) - can be calculated in the following way:

$$VR(q) = \frac{Var[R(q)]}{qVar[R(1)]} \tag{6.38}$$

Under the assumption of a random walk, the expected value of Var(q) for any

investment horizon, q, is one. When the values of the variance ratio are less than one, returns are negatively correlated, and such a behaviour is consistent with the **mean reversion** model. One the other hand, a variance ratio of greater than one implies that returns are positively correlated and such a behaviour is known as **mean aversion**.

Lo and MacKinlay (1989) argue that Monte Carlo evidence suggests that the variance ratio test has reasonable power against a wide range of alternatives. The authors further claim that the simplicity, reliability and flexibility of the variance ratio test make it a valuable tool for inference.

In the present study, we examine the variance ratios of stock returns from the forecasting perspective. Here, the variances of stock returns are measured in terms of mean squared errors (MSEs) as given by equation (6.34).

In obtaining the forecasting errors and then the MSEs or the variances, the exponentially weighted moving average (EWMA) method of forecasting as discussed in Sub-section 5.3.2) is employed. Our forecasts are based on two 'types/categories of data:

(i) Data with overlaps. Under this category, in implementing our forecasts, the whole set of data is used. Since the same (whole) 'set' of data is used in making forecasts at 1, 2, 3 . . .n periods ahead, the problem of overlapping in the data could be considered as a shortcoming for this approach.

(ii) Data 'without overlaps'. Under this approach, we split the original data into several '20 data points' and use each of them to make the forecast at various horizons (i.e., 1, 2 , . . . 20 periods ahead). Errors (e) from the forecasts using each of these '20 data points', at a particular time period ahead, are then squared, added together and then divided by the number of these '20 data points' (n) - to get the MSE. For

example, the MSE for time periods 1 (MSE_1) and 2 (MSE_2) ahead, respectively, are calculated as follows [see equation (6.34)]:

$$MSE_1 = 1/n\Sigma e_1^2$$

$$MSE_2 = 1/n\Sigma e_2^2$$

It worth noting however, that the variance ratios obtained from the data 'without overlap' might be less reliable relatively, because the number of data points on which our forecasts are based is very small. For this reason, the results obtained from the first approach should be the preferred results.

The statistical significance of the variance ratios is determined by using the *F*-test as suggested in Walsh (1990)[37].

Should it be found by the variance ratio tests that the stock market is not consistently following a random walk, then the possibility that the market may at times be forecastable would gain plausibility.

6.4-Concluding Comment

The present study examines the behaviour of stock returns from both descriptive and prescriptive perspectives. We begin by examining the mean, standard deviation, skewness and kurtosis of stock return distribution. Then, we examine the interrelationships between national stock markets by employing cluster analysis,

[37]See Walsh (1990), pp. 132 - 134.

correlation analysis and partial correlation analysis. The "forecastability" of stock returns is tested by using three methods: the EWMA, EWR, and the multi-process models methods. Lastly, the presence of mean reversion/mean aversion in the KLSE's stock returns is investigated by using the variance ratio tests. The MSEs or the variances for these tests are obtained by employing the EWMA method.

For most calculations and statistical operations involved in this empirical investigation, two types of software are employed:

(i) The *Minitab* statistical package; and

(ii) Two programs written by Dr. F. R. Johnston, from the Operational Research and Systems Group, School of Industrial and Business Studies, the University of Warwick.

CHAPTER SEVEN

DATA, EMPIRICAL RESEARCH AND RESULTS

7.1-Introduction

The present chapter presents the results of our empirical work, which employs the methodology discussed in Chapter Six. It is composed of four sections.

The data used in our empirical investigations are itemised and given in Section 6.2. This section begins with a description of the two categories of data used in the study - share price indices and individual company share prices. Then the concept of returns and relative prices are defined.

Our empirical work involves examining some statistical properties of stock returns, stock market linkages, stock market "forecastability" and mean reversion/mean aversion in stock returns. Section 7.3 discusses the results of the study.

Concluding remarks for the chapter are provided in Section 7.4.

7.2-Data Set

The data on which the present study is based, can be divided into two parts. These data (obtained from *Datastream*), which are further described in the following

sub-sections, are as follows:

(i) daily, weekly and monthly share price indices from the various stock exchanges in other countries; and

(ii) daily share prices for fifty individual companies listed on the Kuala Lumpur Stock Exchange (KLSE).

Following the convention in the literature, in most cases, these indices and individual company share prices are converted into their natural logarithms[1].

7.2.1-Share Price Indices

The data on share price indices are employed in investigating the following aspects of the behaviour of share prices and returns:

a) Examining and comparing some statistical properties of stock returns on the

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[1]Natural logarithms are logarithms to the base 2.71828, which are generally denoted by the letter *e*, i.e., log_e (in honour of the famous Swiss mathematician, Euler) or more commonly, *ln* [to distinguish them from the common (base 10) logarithms].

Several authors have suggested a number of reasons for the use of natural logarithms in financial and economic applications. According to Makridakis *et.al* (1983, p. 436), a logarithmic or power transformation of the data is the main approach for achieving stationary in the variance [also see Newbold and Bos (1990, p. 79)]. Sharma (1983) asserts that log-transformation partly overcomes the problem of non-normality of the underlying series and therefore, enables the application of parametric tests of significance.

Fama (1965a) suggests the following reasons for transforming share price series (or share price changes) into log price series [see also Osborne (1959); D'Ambrosio (1980):

(i) The change in log price is the yield, with continuous compounding. Put differently, the change in log price is the return available to the investor for holding the security for that particular day.

(ii) While the variability of simple price changes for a given stock is an increasing function of the price level of the stock, taking logarithms would neutralise most of the price level effect.

(iii) For price changes less than ±15 per cent, the change in log price is very close to the percentage price change [see also Sharma and Kennedy (1977, p. 391)].

Gaynor and Kirpatrick (1994, p. 120), summarise the reasons for the importance and popularity of natural logarithms in time-series analysis and forecasting, in the following points:

(i) Natural logarithms are closely associated with any variable that is a function of time.

(ii) Natural logarithms are often used to make growth calculations for time-series data.

(iii) Natural logarithms are associated with a special class of functions that exhibit specific growth pattern known as exponential growth.

For an exposition of some desirable properties of natural logarithms (for financial and investment applications), see Kritzman (1992).

Malaysian stock market vis-a-vis the stock markets in the United States, the United Kingdom, Hong Kong and Australia. As mentioned in Chapter Five, the following daily, weekly and monthly indices (covering a period from 1984 through 1994) are used:

(i) Malaysia: the *KLSE Emas (All-share) Index (KLSEMAS)* and the *KLSE Composite Index (KLSECOMP),*

(ii) United States: the *New York Composite Index (NYSEALL)* and the *Dow Jones Composite 65 Index (DJCMP65),*

(iii) United Kingdom: the *Financial times All-share Index (FTALLSH)* and the *Financial Times 100-share Index (FTA100),*

(iv) Hong Kong: the *Datastream Total Market Index (TOTMKHK)* and the *Hang Seng Bank Index (HANGSENG);* and

(v) Australia: the *Australian Joint Stock Exchange (All ordinary) Index (AUSTALL).*

b) Studying the linkages between the KLSE and various stock exchanges around the world[2].

Whereas in the previous studies of comovements among international stock exchanges (using share price indices as the data base) some authors made adjustments for exchange rates and some did not, for the present study the indices used (on the whole) are not adjusted for exchange rates. The rationale behind following this approach are given below:

[2]For a list of countries/exchanges and their respective indices used in this study, see Table 7.1. In addition to the indices listed in this table, the weekly and monthly share price indices (measured in both local currencies as well as the U.S. dollars) - for the emerging stock markets - provided by the International Finance Corporation (IFC), are also employed in the study.

Table 7.1
SHARE PRICE INDICES USED IN THE STUDY

COUNTRY	PRICE INDEX
AUSTRALIA	*Australian Joint Stock Exchange All-Ordinary* [AUSTALL]
BELGIUM	*Bank Brussels Lambert* [BKBRLAM]
CANADA	*Toronto Stock Exchange Composite Index* [TTOCOMP]
DENMARK	*Copenhagen Stock Exchange Index* [CHAGENI]
FRANCE	a) *Paris CAC40* [FRCAC40] b) *Datastream Total Market Index* [TOTMKFR]
GERMANY	a) *Commerzbank Index* [FURTCOM] b) *Datastream Total Market Index* [TOTMKBD]
HONG KONG	a) *Hang Seng Bank Index* [HANGSENG] b) *Datastream Total Market Index* [TOTMKHK]
INDIA	*Bombay Stock Exchange 100* [IBOMBSE]
INDONESIA	*Jakarta Composite Index* [JAKCOMP]
ITALY	*Milan Banca Commerciale Italiana* [MILANBC]
JAPAN	a) *Nikkei Dow Jones Average Index* (225) [JAPDOWA] b) *Nikkei Stock Average Index (500)* [JAPA500] c) *Datastream Total Market Index* [TOTMKJP]
KOREA (SOUTH)	*Kores South Composite Index* [KORCOMP]

Table 7.1 (Continued)
SHARE PRICE INDICES USED IN THE STUDY

COUNTRY	PRICE INDEX
MALAYSIA	a) *KLSE Composite Index* **[KLSECOMP]** b) *KLSE Emas (All-share)* Index **[KLSEMAS]**
NORWAY	*Oslo Stock Exchange Index Companies* **[OSEINDX]**
PHILIPPINES	*Manila Stock Exchange Composite Index* **[MANCOMP]**
SINGAPORE	a) *Singapore Stock Exchange All-share Index* **[SNGALLS]** b) *Singapore Striaits Times (Industrial) Index* **[SNGPORI]**
SOUTH AFRICA	*Johanneaburg Stock Exchange (Industry) Index* **[JSEINDS]**
SPAIN	*Madrid Stock Exchange Index* **[MADRIDI]**
SWEDEN	*Veckans Affarer Weighted (All-share) Index* **[VECWALL]**
SWITZERLAND	a) *Swiss Bank Corporation General Index* **[SWBKGEN]** b) *Vontobel/Datastream Total Market Index* **[TOTMKSW]**
TAIWAN	*Taiwan Stock Exchange Weighted Index* **[TAIWGHT]**
THAILAND	*Securities Exchange of Thailand Index* **[BNGKSET]**
UNITED KINGDOM	a) *Financial Times All-share Index* **[FTALLSH]** a) *Financial Times 500-share Index* **[FTA500I]** c) *FT-SE 100-share Index* **[FTSE100]**
UNITED STATES	a) *New York Stock Exchange Composite Index* **[NYSEALL]** b) *Dow Jones Composite 65 Index* **[DJCMP65]**

(i) A number of previous researches have documented that exchange rates have little effect on the degree of correlation of returns among stock exchanges - that the currency fluctuation problem is not critical in terms of its effect on overall (international) portfolio diversification[3]:

A study by Grubel and Fadner (1971) indicates that the standard deviation of returns from holding foreign assets with and without exchange rate adjustments are statistically not different. These authors who assert that theoretically, the effect of exchange rates on the stability of the value of foreign assets is indeterminate, found further that the correlation of returns between United States (U.S.) and foreign assets with and without the exchange rate adjustment are statistically not different. The impact of flexible exchange rates on the correlation coefficients among a number of equity markets has also been shown to be rather low in a study by Bertoneche (1979). Similarly, in trying to quantify the effect that currency fluctuation has on the correlations between emerging markets and U.S. securities, Errunza and Padmanabhan (1988) have found that the correlations in local currency terms are very similar to those based on U.S. dollars.

Whereas an argument that has often been advanced against international diversification is that currency risks (or exchange risks) more than offset the reduction in security risks achieved by international diversification, Solnik (1996) contends that currency risk is not so large/important that investors should avoid foreign investments[4]. Stemming from the fact that the depreciation of one currency is often

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[3]See Errunza and Padmanabhan (1988), p. 77.

[4]Solnik's (1996) view is supported by the work of Jorion (1989) that the contribution of currency risk to the total risk of a portfolio that includes only a small portion of foreign assets, is insignificant. See also the argument put forward by Errunza and Padmanabhan (1988, p. 77).

offset by the appreciation on another, according to the author, currency fluctuation has never been the major component of total return on a diversified portfolio over a long period of time. The author offers three reasons (which are abridged below) to support his contention[5]:

- Market risks and currency risks are not additive; there is only a weak - and sometimes negative - correlation between currency and market movements.
- The exchange risk of an investment may be hedged for major currencies by selling futures or forward currency contracts, buying put currency options, or even borrowing foreign currency to finance the investment.
- The contribution of currency risk should be measured for the total portfolio rather than for individual markets or securities.

(ii) Our 'experiments' as discussed in Sub-section 7.3.2, indicate that exchange rate adjustments are not critical in determining the magnitude of covariations between and among stock exchanges. Whether the indices employed are measured in local currencies or in the U.S. dollar, the results (in terms of stock markets which are highly and lowly correlated with the KLSE) are detected to be not much different[6].

(iii) If we are really considering the factors that determine the returns to be received by international investors, adjustment for exchange rates alone do not appear to be sufficient. Other factors such as dividends, taxes on both dividends and capital gains, transactions costs and inflation rates in respective countries are also equally important to be taken into account.

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[5]Chapter Five of Solnik's (1996) book features a discussion of the theoretical relationship between asset prices and exchange rates.

[6]See Table A2.21 and Table A2.22 as well as Figures A3.8a through A3.9b, for the summaries of results.

(iv) Normally, an investor will convert his/her income from foreign investment at the end of his/her investment period, and not throughout his/her investment period. These considerations support that in studying comovement relationships between and among international equity markets (for the purpose of planning investment strategies/decisions), adjustment for exchange rates does not appear to be necessary.

7.2.2-Individual Company Share Prices

A sample of fifty individual company shares listed on the KLSE[7] is used in examining the forecastability of stock prices and returns. In addition, these daily share price data are employed in investigating the presence of mean reversion and/or mean aversion in the KLSE's stock returns.

Almost all of these fifty stocks included in the sample are among the 100 stocks that constitute the KLSE Composite Index. These companies are not only among the biggest companies listed on the KLSE, but they are also among the most actively traded stock (in terms of trading volume) in 1993 and 1994 as reported in the *Investors Digest*, a monthly publication of the KLSE[8]. Here, trading volume and company size[9] are preferred over random sampling in order to alleviate problems

[7]For the names of these companies - their industry classifications (or the economic sectors in which they are operating) as well as their rankings (in terms of market capitalisation) - see Table 7.2.

[8]See *Investors Digest*, Mid-January 1994 and Mid-January 1995.

[9]Errunza and Losq (1985) posit that investors and hence funding organisations were interested in researching securities from the emerging stock markets that were currently most liquid.

Table 7.2
MALAYSIAN COMPANY SHARES USED IN THE STUDY

COMPANY NAME	COMPANY CLASSIFICATION	RANK (Market Cap.)	
		1993	1994
Aokam Perdana Bhd.	Industrial Products	31	28
Arad-Malaysian Development Bhd.	Properties	83	90
Asia Pacific Land Bhd.	Properties	101	96
Bandar Raya Developments Bhd.	Properties	118	85
Berjaya Industrial Bhd.	Consumer Products	69	98
Boustead Holdings Bhd.	Trading/Services	77	88
Chemical Company of Malaysia Bhd.	Industrial Products	214	152
Development & Commercial Bank Bhd.	Finance.	21	19
Diversified Resources Bhd.	Industrial Products	53	72
Genting Bhd.	Trading/Services	4	5
Golden Hope Plantations Bhd.	Plantations	16	17
Golden Plus Holdings Bhd.	Mining	78	77
Guinness Anchor Bhd.	Consumer Products	84	81
Hume Industries (Malaysia) Bhd.	Industrial Products	55	31
Kuala Lumpur Kepong Bhd.	Plantations	37	25
Landmarks Bhd.	Hotels	33	64
Lingui Development Bhd.	Plantations	52	29
Lion Corporation Bhd.	Industrial Products	224	250
Magnum Corporation Bhd.	Trading/Services	8	18
Malakoff Bhd.	Plantations	156	83
Malayan Banking Bhd.	Finance	5	3
Malayan Cement Bhd	Industrial Products	76	74
Malayan United Industries Bhd.	Industrial Products	27	34
Malaysian Airline System Bhd.	Trading/Services	18	11
Malaysian International Shipping Corporation Bhd.(MISC)	Trading/Services	11	8

Table 7.2 (Continued)

MALAYASIAN COMPANY SHARES USED IN THE STUDY

COMPANY NAME	COMPANY CLASSIFICATION	RANK (Market Cap.)	
		1993	1994
Malaysian Mining Corporation) Bhd.	Mining	65	52
Malaysian Oxygen Bhd.	Industrial Products	113	119
MBF Capital Bhd.	Finance	45	47
Metroplex Bhd.	Properties	47	63
Mulpha International Trading Corporation Bhd.	Trading/Services	51	48
Multi-Purpose Holdings Bhd.	Trading/Services	17	33
Palmco Holdings Bhd.	Industrial Products	191	215
Pelangi Bhd.	Properties	108	114
Perlis Plantations Bhd.	Consumer Products	36	36
Pilecon Engineering Bhd.	Construction	107	165
Promet Bhd.	Construction	67	79
Public Bank Bhd.	Finance	14	13
Renong Bhd.	Construction	12	12
Rothmans of Pall Mall (Malaysia) Bhd.	Consumer Products	10	14
Shell Refining Company (FOM).Bhd.	Industrial Products	50	39
Sime Darby Bhd.	Trading/Services	6	6
Sungei Way Holdings Bhd.	Construction	162	70
Tan Chong Motor Holdings Bhd.	Consumer Products	42	51
Tanjong PLC	Trading/Services	13	30
Telekom Malaysia Bhd.	Trading/Services	2	1
Tenaga Nasional Bhd.	Trading/Services	1	2
The New Straits Times Press (Malaysia) Bhd..	Trading/Services	87	73
United Engineers (Malaysia) Bhd.	Construction	9	7
UMW Holdings Bhd.	Consumer Products	68	67
Yeo Hiap Seng (Malaysia) Bhd.	Consumer Products	216	170

characteristics of thin market and discontinuity in trading[10] [see e.g., Ariff and Lee (1993)].

Another criterion applied in selecting the stocks to be included in the sample is 'variety': While most companies in the sample are big companies, some medium-size companies are also included. These fifty companies as shown in Table 7.2, represent all the nine industry sectors[11] as classified by the KLSE. For the sake of variety, the sample also includes the two newly corporatised giant companies - the *Telekom Malaysia Bhd.* and the *Tenaga Nasional Bhd.* - as well as a U.K. incorporated company (i.e., the *Tanjong Plc.*)[12].

The sample period for these daily individual company share price data is - in general - 1988:01 through 1994:12. The reason for favouring this period is threefold. First, 1988 is chosen as the starting year for the study because it is the year that the market appears to be more stable (after the October 1987 world-wide stock market crash). Secondly, as we have examined in Chapter Two, the periods of 1980s (especially the second half of the 1980s) and 1990s are significant decades in the growth, development and activity (i.e., trading volume) history of the KLSE. Thirdly,

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[10]Heinkel and Kraus (1988) suggest a number of approaches to mitigate the problem of discontinuity in trading (i.e., days or weeks with no transaction). These include, first, ignore the days with no trading and use only return data for trading days. Secondly, assign zero return for days with no trading.

In the present study, the problem of discontinuity in trading, is handled by using two categories of data:

(i) Data which ignore the days with no trading. That is, in this set of data, prices which do not change (i.e., the 'no trading days') are deleted from the data.

(ii) Original data; that is, data which we do not delete the 'non-changes in price' (or prices for the 'no trading days').

The results that we have got for both categories of data are almost the same. Therefore, only the results based on the first category of data are reported in the thesis.

[11]These industry/economic sectors are: *consumer products, industrial products, construction, trading/services, finance, hotels, properties, plantations and mining.*

[12]The sample period for the *Telekom Malaysia Bhd.*, the *Tenaga Nasional Bhd.* and the *Tanjong Plc.* respectively, is only 1991:01 through 1995:06, 1992:07 through 1995:06 and 1991:12 through 1996:01.

this is a most recent period and therefore, the stock return behaviour obtained therefrom would be more relevant for future projection.

7.2.3-Defining Returns

In the preceding chapter, stock returns (R_{it}) based on stock price indices (I_t) have been defined (see equation 6.1) as

$$R_{it} = \ln(I_t) - \ln(I_{t-1})$$

or, equivalently, it may be written as

$$R_{it} = \ln\left[\frac{I_t}{I_{t-1}}\right] \tag{7.1}$$

For the individual company share price data, the concept of the cumulative logarithm of returns (R^*_t) is used. It is defined as follows:

$$R^*_t = \sum_{n=1}^{t} R_n \tag{7.2}$$

where R_n, stock returns in period n, is given by

$$R_n = \ln\left[\frac{P_n + D_n}{P_{n-1}}\right] \tag{7.3}$$

and

P_n = stock price in time period n;

D_n = cash dividend in time period n.

These prices, as defined in the *Datastream Definitions Manual*, are adjusted for capital actions, and become "the default prices offered on all research programs" (p. EQ-14). As noted in Appendix A (of the *Datastream Definitions Manual*), in addition to rights and scrip issues, "adjustments to historical data are made as a result of material capital distributions and large one-off dividend payments".

7.3-Analysis of Results

The objective of this section is to report and discuss the results of our empirical investigations. These findings are annotated and analysed in the following sub-sections.

7.3.1-Some Statistical Properties of Stock Returns

a) Means and Standard Deviations of Returns

As discussed in Chapter Six, the present empirical work begins with some comparisons of the statistical properties of stock returns on the KLSE vis-a-vis a number of selected well-established exchanges. The outcomes of these statistical analyses are exhibited in Tables 7.3 through 7.12.

In Table 7.3, the daily, weekly and monthly means as well as standard

deviations of stock returns on the KLSE (for the whole period of 1984 through 1994) are compared with those on the NYSE, LSE, HKSE and the AJSE. We find that the means of stock returns (i.e., columns 3, 4 and 5) on the KLSE were not significantly different from the means of returns on these actively traded exchanges. As such, the null hypothesis that the means of stock returns on the KLSE have not been significantly different from those on the developed exchanges - the NYSE, LSE, HKSE and the AJSE - cannot be rejected at 5% level (using the *Z*-tests).

Columns 6, 7, and 8 of Table 7.3 compare the standard deviations of stock returns on the KLSE and those on the NYSE, LSE, HKSE and the AJSE. The standard deviations of the daily, weekly and monthly stock returns on the KLSE appear to be much higher than those on other exchanges *except* for the HKSE. Using the *F*-tests, the standard deviations of returns on the KLSE are found to be significantly different compared to those on the other exchanges. Therefore, the null hypothesis that the standard deviations of returns on the KLSE are not significantly different from those on the developed exchanges should be rejected at the 5% level. With these results, the general impression that investments in the thinly traded emerging exchanges (such as the KLSE) are relatively risky (at least from the view point of standard deviations or dispersions of returns[13]) could be justified, at least in this case.

[13]According to Solnik (1996), the standard deviation of returns which is traditionally used to indicate the risk of a market or an asset, is the simplest statistical measure of volatility of a market or an asset. Further, Speidell and Sappenfield (1992, p. 60) point out that most discussions of risk begin and end with standard deviation of returns. The square of the standard deviation is the variance. Errunza and Rosenberg (1982) have the view that variance of returns to investment in common stocks provides a natural measure of investment risk. They use this measure in their work to compare the investment risk between the developing and developed countries. See also Errunza and Losq (1985), p. 568; Errunza (1994), p. 83.

Table 7.3

MEANS AND STANDARD DEVIATIONS OF THE DAILY, WEEKLY AND MONTHLY STOCK RETURNS (Log) FOR THE KLSE, NYSE, LSE, HKSE AND THE AJSE: 1984-1994

STOCK EXCHANGE	PRICE INDICEX	MEANS OF STOCK RETURNS			STANDARD DEVIATIONS OF STOCK RETURNS		
		DAILY	WEEKLY	MONTHLY	DAILY	WEEKLY	MONTHLY
KLSE	KLSEMAS	0.00030	0.00149	0.00666	0.01257	0.03161	0.07949
	KLSECOMP	0.00031	0.00154	0.00672	0.01438	0.03357	0.08274
NYSE	NYSEALL	0.00034	0.00169	0.00725	0.00912*	0.01881*	0.04196*
	DJCMP65	0.00032	0.00162	0.00688	0.00973*	0.02061*	0.04448*
LSE	FTALLSH	0.00041	0.00204	0.00891	0.00862*	0.02235*	0.05523*
	FTSE100	0.00039	0.00195	0.00849	0.00956*	0.02339*	0.05469*
HKSE	TOTMKHK	0.00074	0.00370	0.01607	0.01704*	0.03922*	0.09026
	HANGSENG	0.00078	0.00390	0.01729	0.01709*	0.03795*	0.09090
AJSE	AUSTALL	0.00031	0.00157	0.00684	0.01054*	0.02555*	0.06423*

NB:

*Significantly different [i.e., lower than the KLSE's standard deviation of returns (except for the HKSE's which are higher)] at 5% level (using the F-test).

b) Skewness and Kurtosis

An additional two statistical properties of stock returns examined in this comparative study are skewness and kurtosis in the data[14]. According to Walsh (1990), *skewness* refers to the *symmetry* or *asymmetry* of a distribution. The more asymmetrical the distribution, the more it deviates from the normal distribution. While a positive value of skewness indicates a positive (rightward) skew, a negative value of skewness indicates a negative (leftward) skew.

As shown in Table 7.4, the logarithm of stock returns (for all the daily, weekly and monthly data) are in general, similar across all stock exchanges under this comparison: they are all negatively skewed[15]. Nonetheless, whilst the values or coefficients of skewness for stock returns on the KLSE are relatively low, the values of skewness of stock returns (for the daily data) on the AJSE, HKSE and the NYSE are higher[16].

Again, the weekly and monthly stock returns on the AJSE exhibit the most negative values of skewness. The values or coefficients of skewness are also relatively highly negative for the weekly stock returns on the HKSE as well as the LSE. Beside the AJSE, the HKSE also exhibits high negative values of skewness for the monthly

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[14]As pointed out by Levin and Rubin (1994), beside *dispersion* (i.e., the spread of the data in a distribution) two other characteristics of data sets that provide useful information are *skewness* and *kurtosis*.

[15]For a negatively skewed distribution, *mode* > *median* > *mean*. For a symmetrical (*unimodal*)/normal distribution, the mean, median and mode are equal . See e.g., Salvatore (1982), p. 14.

[16]A normal distribution, being perfectly symmetrical, has a skewness equal to zero [Walsh (1990), p. 68]. Since a normal distribution is symmetrical about its mean - not at all skewed - folding the curve at the centre creates two identical halves.

Whereas a normal distribution contains the same number of extreme values in both directions - high and low - a negatively skewed distribution has a much longer tail to the left than to the right. In other words, values in a negatively skewed distribution are concentrated at the higher end of the measuring scale on the horizontal axis [see Levin and Rubin (1994), p. 71].

Table 7.4

SKEWNESS AND KURTOSIS OF THE DAILY, WEEKLY AND MONTHLY STOCK RETURNS (Log) FOR THE KLSE, NYSE, LSE, HKSE AND THE AJSE: 1984 - 1994

STOCK EXCHANGE	PRICE INDICEX	SKEWNESS			KURTOSIS		
		DAILY	WEEKLY	MONTHLY	DAILY	WEEKLY	MONTHLY
KLSE	KLSEMAS	-1.17188	-1.99580	-0.0686497	14.9186	19.0550	2.93827
	KLSECOMP	-1.53308	-1.26112	-0.0967092	22.0748	10.7212	4.57105
NYSE	NYSEALL	-4.90096	-1.13404	-1.654	115.434	6.2302	9.48084
	DJCMP65	-4.50574	-0.94728	-1.63875	105.133	6.13928	7.90708
LSE	FTALLSH	-1.72320	-2.25587	-1.71249	23.6208	23.339	8.83678
	FTSE100	-1.55821	-2.11770	-1.59943	22.7203	22.3463	8.34888
HKSE	TOTMKHK	-6.78298	-3.13071	-2.49726	146.777	30.9835	16.6810
	HANGSENG	-6.09189	-2.58645	-2.04902	128.534	24.2258	13.3180
AJSE	AUSTALL	-7.74705	-4.86659	-3.44327	198.664	61.8532	24.9471

NB:
A normal distribution has a skewness equal to zero and a kurtosis equal to three.

data.

The peakedness or height of a distribution is called *kurtosis*. A normal distribution has a kurtosis value equal to three [see e.g., Kritzman (1994)] and is known as *mesokurtic*. A distribution is referred to as *platkurtic* (flat distribution) when it has negative kurtosis, whereas a distribution which exhibits positive kurtosis is labelled as *leptokurtic* (narrow distribution)[17]. A leptokurtic distribution has wide tails and a tall, narrow peak, with its kurtosis value exceeding three.

In reviewing columns 6, 7, and 8 of Table 7.4, one sees that in general, stock returns on the KLSE, NYSE, LSE, HKSE and the AJSE are similar in that their distributions are *leptokurtic*. Moreover, as noted earlier, the distributions of stock returns from these markets are negatively skewed: their distributions appear to have more values or observations at the higher end of the scale on the horizontal axis - i.e., on the right hand side of the curve - (than does a normal distribution) and have longer tails to the left than to the right.

A long history of research on the distributions of stock returns - reaching back at least to Fama (1965a) - has documented that stock returns are not symmetric. In general, past researches on stock returns have found that the distributions of stock returns or price changes are leptokurtic[18]. Recent evidence suggesting that stock returns distributions are not symmetric, can be found in Richardson and Smith (1993) for U.S. stocks, Harvey and Zhou (1993) and Ratner (1996) for other developed markets and Harvey (1995) for emerging markets assets.

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[17]See e.g., Walsh (1990), p. 68; Ramanathan (1992), p. 24.

[18]See e.g., Fama (1965a), Praetz (1969), Solnik (1973), Ang and Pohlman (1978) and Laurence (1986).

For the Malaysian stock market, Mansor Md Isa (1989) whose study was based on a sample of daily closing prices for 26 companies (January 1980 to August 1986) found that the daily stock returns are not normally distributed. Similarly, Othman Yong (1990) who examined the daily KLSE Industrial Index for the period 1984 to 1988, concluded that, "Longer time spans result in stock prices behave not according to normal distribution" (p. 54).

So, our results substantiate the results of previous studies that nonnormality in stock returns is a worldwide phenomenon: it occurs both in the actively traded markets and the relatively thinly markets such as the KLSE.

c) Further Examination of the Means and Standard Deviations of Stock Returns

As previously noted, for the entire period of 1984 through 1994, the data for the daily, weekly and monthly stock returns do not indicate that the means of stock returns on the KLSE were significantly different[19] from those on the NYSE, LSE, HKSE and the AJSE. On the other hand, the standard deviations of stock returns on the KLSE are found to have been significantly different from those on these developed exchanges. Using the daily and weekly data we explore these findings further, with the intention of identifying whether such features are true and stable over time. We do so by examining the data on a yearly basis. Tables 7.5 through 7.12 report the outcomes.

As shown in Tables 7.5, 7.6, 7.7 and 7.8, both the daily and weekly data - even when they are analysed on a yearly basis - by and large, still do not indicate that the means of stock returns on the KLSE were significantly different from the means

[19]That is, greater than those on these developed exchanges, except the HKSE.

of stock returns on the NYSE, LSE, HKSE and the AJSE. Only in 1993, when the KLSE performed more positively[20], the means of returns on the KLSE are significantly different (i.e., relatively higher) than for all of these exchanges [see columns 4 through 7 (Tables 7.5 and 7.7)], except for the HKSE [see columns 4 and 5 (Tables 7.6 and 7.8)] .

In 1984 and 1985, when the KLSE performed negatively[21], only the means of returns for certain indices[22] are significantly different from the means of returns for the Malaysian indices. In general, based on the statistics displayed in Tables 7.5, 7.6, 7.7 and 7.8, the null hypothesis that the means of stock returns on the KLSE are not significantly different from those on its counterparts in the developed part of the world - the NYSE, LSE, HKSE and the AJSE - still cannot be rejected.

Tables 7.9, 7.10, 7.11 and 7.12 compare the standard deviations of returns on the KLSE with those on the NYSE, LSE, HKSE and the AJSE (when the data are analysed on a yearly basis). We still find that the standard deviations of stock returns for the KLSE are significantly greater than those for these exchanges, except the for the HKSE [see columns 4 and 5 (Tables 7.10 and 7.12)]. Correspondingly, the null hypothesis that the standard deviations of stock returns on the KLSE and those on the actively traded exchanges are the same, have to be rejected at 5% level of significance (using the Z-tests).

As disclosed by Tables 7.9 through 7.12, in most cases, the standard deviations

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[20]For explanation, see Chapter Two.

[21]As can be seen in Table A2.1, Malaysia suffered a negative annual economic growth rate in 1985.

[22]They are: the FTALLSH and FTSE100 for 1984; the NYSEALL, TOTMKHK and the AUSTALL (or AJSE) for 1985.

Table 7.5
MEANS OF THE DAILY STOCK RETURNS (Log) FOR THE KLSE, NYSE AND THE LSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		NYSE		LSE	
	KLSEMAS	KLSECOMP	NYSEALL	DJCMP65	FTALLSH	FTSE100
1984-1994	0.00030	0.00031	0.00034	0.00032	0.00041	0.00039
1984	-0.00113	-0.00107	0.00005	-0.00010	0.00089*	0.00080*
1985	-0.00092	-0.00101	0.00089*	0.00088	0.00054	0.00052
1986	0.00028	0.00030	0.00050	0.00068	0.00077	0.00066
1987	0.00009	0.00013	-0.00001	-0.00012	0.00016	0.00008
1988	0.00093	0.00120	0.00047	0.00056	0.00024	0.00018
1989	0.00153	0.00174	0.00085	0.00087	0.00101	0.00116
1990	-0.00044	-0.00040	-0.00030	-0.00045	-0.00059	-0.00047
1991	0.00027	0.00036	0.00092	0.00088	0.00054	0.00058
1992	0.00055	0.00056	0.00018	0.00015	0.00053	0.00051
1993	0.00330	0.00262	0.00029*	0.00052*	0.00080*	0.00070*
1994	-0.00116	-0.00105	-0.00012	-0.00031	-0.00039	-0.00042

NB:
*Significantly different (i.e., lower than the KLSE's mean of returns) at 5% level (using the Z-test).

Table 7.6
MEANS OF THE DAILY STOCK RETURNS (Log) FOR THE KLSE, HKSE AND THE AJSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		HKSE		AJSE
	KLSEMAS	KLSECOMP	TOTMKHK	HANGSENG	AUSTALL
1984-1994	0.00030	0.00031	0.00074	0.00078	0.00031
1984	-0.00113	-0.00107	0.00120	0.00121	-0.00025
1985	-0.00092	-0.00101	0.00132*	0.00145	0.00125*
1986	0.00028	0.00030	0.00143	0.00146	0.00148
1987	0.00009	0.00013	-0.00039	-0.00042	-0.00043
1988	0.00093	0.00120	0.00062	0.00059	0.00046
1989	0.00153	0.00174	0.00018	0.00021	0.00040
1990	-0.00044	-0.00040	0.00012	0.00025	-0.00098
1991	0.00027	0.00036	0.00133	0.00135	0.00098
1992	0.00055	0.00056	0.00093	0.00095	-0.00024
1993	0.00330	0.00262	0.00289	0.00294	0.00130*
1994	-0.00116	-0.00105	-0.00151	-0.00143	-0.00049

NB:
*Significantly different (i.e., higher/lower than the KLSE's mean of returns) at 5% level (using the Z-test).

Table 7.7
MEANS OF THE WEEKLY STOCK RETURNS (Log) FOR THE KLSE, NYSE AND THE LSE: 1984-1994

PRICE INDEX / YEAR	KLSE		NYSE		LSE	
	KLSEMAS	KLSECOMP	NYSEALL	DJCMP65	FTALLSH	FTSE100
1984-1994	0.00149	0.00154	0.00169	0.00162	0.00204	0.00195
1984	-0.00593	-0.00538	0.00014	-0.00064	0.00434*	0.00391
1985	-0.00483	-0.00505	0.00441*	0.00448	0.00263	0.00254
1986	0.00180	0.00156	0.00302	0.00383	0.00392	0.00335
1987	0.00109	0.00111	-0.00004	-0.00042	0.00169	0.00140
1988	0.00385	0.00541	0.00196	0.00225	0.00044	0.00002
1989	0.00763	0.00872	0.00426	0.00434	0.00505	0.00579
1990	-0.00234	-0.00222	-0.00158	-0.00226	-0.00286	-0.00220
1991	0.00129	0.00187	0.00422	0.00391	0.00208	0.00217
1992	0.00308	0.00304	0.00145	0.00134	0.00304	0.00300
1993	0.01610	0.01282	0.00135*	0.00250*	0.00408*	0.00358*
1994	-0.00581	-0.00524	-0.00061	-0.00155	-0.00193	-0.00210

NB:
*Significantly different (i.e., higher/lower than the KLSE's mean of returns) at 5% level (using the Z-test).

of returns are higher on the KLSE than on other exchanges except for the HKSE. In fact these tables reveal that the KLSE and the HKSE are similar in the sense that their standard deviations of returns are much higher compared to the two well-established exchanges[23]: the NYSE and the LSE.

Aside from the fact that we are unable to reject the null hypothesis of similar means of stock returns between the KLSE and other selected exchanges - and that the null hypothesis of similar standard deviations of stock returns has to be rejected - our comparative analysis of these means and standard deviations on a yearly basis (for the period of 1984 through 1994) has produced two interesting results. These two related preliminary findings might perhaps, have some ramifications for investment decisions and therefore, deserve further investigation:

(i) The standard deviations of returns on all exchanges under investigation are not inter-temporally constant/stable. This finding is consistent with the results of several previous studies - for example by Praetz (1969) for Australian data and Othman Yong (1990) for the Malaysian data - that standard deviations/variances are not constant over time.

Such heteroscedasticity might be attributed to various events and developments that have taken place at national and/or international levels. Such a phenomenon might be explained by major changes in market forces - major changes in the socio-political/economic scene that could cause structural shifts in demand and/or supply

[23]A study by Roll (1992) has established that HKSE is one of the most volatile market in the world. Solnik (1996) also found that the HKSE is, as are some of the smaller markets (Singapore and Italy), much more volatile than other developed markets.

Table 7.8
MEANS OF THE WEEKLY STOCK RETURNS (Log)
FOR THE KLSE, HKSE AND THE AJSE:
1984 - 1994

PRICE INDEX / YEAR	KLSE		HKSE		AJSE
	KLSEMAS	KLSECOMP	TOTMKHK	HANGSENG	AUSTALL
1984-1994	0.00149	0.00154	0.00370	0.00390	0.00157
1984	-0.00593	-0.00538	0.00574	0.00584	-0.00126
1985	-0.00483	-0.00505	0.00666*	0.00727	0.00635*
1986	0.00180	0.00156	0.00708	0.00726	0.00706
1987	0.00109	0.00111	-0.0010	-0.00114	-0.00244
1988	0.00385	0.00541	0.00241	0.00230	0.00231
1989	0.00763	0.00872	0.00088	0.00104	0.00215
1990	-0.00234	-0.00222	0.00077	0.00142	-0.00569
1991	0.00129	0.00187	0.00624	0.00629	0.00491
1992	0.00308	0.00304	0.00468	0.00482	-0.00151
1993	0.01610	0.01282	0.01455	0.01474	0.00650*
1994	-0.00581	-0.00524	-0.00755	-0.00716	-0.00262

NB:
*Significantly different (i.e., higher/lower than the KLSE's mean of returns) at 5% level (using the Z-test).

Table 7.9
STANDARD DEVIATIONS OF THE DAILY STOCK RETURNS (Log) FOR THE KLSE, NYSE AND THE LSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		NYSE		LSE	
	KLSEMAS	KLSECOMP	NYSEALL	DJCMP65	FTALLSH	FTSE100
1984-1994	0.01257	0.01438	0.00912*	0.00973*	0.00862*	0.00956*
1984	0.00729	0.01081	0.00725*	0.00838*	0.00808*	0.00983*
1985	0.01043	0.01631	0.00585*	0.00625*	0.00639*	0.00742*
1986	0.01156	0.01499	0.00843*	0.00876*	0.00738*	0.00846*
1987	0.01914	0.02504	0.01958*	0.02001*	0.01610*	0.01740*
1988	0.01017	0.01156	0.00946*	0.01020*	0.00723*	0.00778*
1989	0.00995	0.01221	0.00737*	0.00802*	0.00760*	0.00818*
1990	0.01415	0.01388	0.00906*	0.00954*	0.00843*	0.00917*
1991	0.01177	0.01119	0.00808*	0.00896*	0.00741*	0.00817*
1992	0.00709	0.00743	0.00546*	0.00648*	0.00908*	0.00967*
1993	0.01032	0.00986	0.00479*	0.00552*	0.00534*	0.00619*
1994	0.01913	0.01682	0.00567*	0.00659*	0.00718*	0.00834*

NB:
*Significantly different (i.e., in general, lower than the KLSE's standard deviation of returns) at 5% level (using the F-test). In this comparison, the KLSEMAS is compared with the NYSEALL and the FTALLSH; the KLSECOMP is compared with the DJCMP65 and the FTSE100.

Table 7.10
STANDARD DEVIATIONS OF THE DAILY STOCK RETURNS (Log) FOR THE KLSE, HKSE AND THE AJSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		HKSE		AJSE
	KLSEMAS	KLSECOMP	TOTMKHK	HANGSENG	AUSTALL
1984-1994	0.01257	0.01438	0.01704**	0.01709**	0.01054*
1984	0.00729	0.01081	0.01787**	0.01827**	0.00786**
1985	0.01043	0.01631	0.01332**	0.01352*	0.00638*
1986	0.01156	0.01499	0.01041*	0.01073*	0.00831*
1987	0.01914	0.02504	0.03194**	0.03120**	0.02373**
1988	0.01017	0.01156	0.01054**	0.01051*	0.00939*
1989	0.00995	0.01221	0.02333**	0.02261**	0.00898
1990	0.01415	0.01388	0.01192*	0.01178*	0.00827*
1991	0.01177	0.01119	0.01078*	0.01102*	0.00875*
1992	0.00709	0.00743	0.01362**	0.01394**	0.00694*
1993	0.01032	0.00986	0.01310**	0.01394**	0.00722*
1994	0.01913	0.01682	0.01724*	0.01838**	0.00866*

NB:
*Significantly different (i.e., lower than the KLSE's standard deviation of returns) at 5% level (using the F-test).
**Significantly different (i.e., higher than the KLSE's standard deviation of returns) at 5% level (using the F-test).
In this comparison, the KLSEMAS is compared with the TOTMKHK and the AUSTALL; the KLSECOMP is compared with the HANGSENG.

Table 7.11
STANDARD DEVIATIONS OF THE WEEKLY STOCK RETURNS (Log) FOR THE KLSE, NYSE AND THE LSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		NYSE		LSE	
	KLSEMAS	KLSECOMP	NYSEALL	DJCMP65	FTALLSH	FTSE100
1984-1994	0.03161	0.03357	0.01881*	0.02061*	0.02235*	0.02339*
1984	0.01671	0.02710	0.01897**	0.02269	0.02200**	0.02512*
1985	0.02711	0.03679	0.01365*	0.01409*	0.01493*	0.01600*
1986	0.03032	0.03487	0.02149*	0.02147*	0.02057*	0.02193*
1987	0.05572	0.05832	0.03314*	0.03479*	0.04408*	0.04454*
1988	0.02359	0.02681	0.01860*	0.02066*	0.01714*	0.01779*
1989	0.02010	0.02287	0.01744	0.01980	0.01852	0.01964
1990	0.04182	0.04061	0.02062*	0.02247*	0.02175*	0.02332*
1991	0.02514	0.02495	0.01770*	0.01981*	0.01883*	0.01947*
1992	0.01629	0.01640	0.01193*	0.01467	0.02234**	0.02265**
1993	0.02550	0.02503	0.01044*	0.01193*	0.01253*	0.01363*
1994	0.03824	0.03407	0.01326*	0.01545*	0.01857*	0.02002*

NB:
*Significantly different (i.e.,lower than the KLSE's standard deviation of returns) at 5% level (using the F-test).
**Significantly different (i.e., higher than the KLSE's standard deviation of returns) at 5% level (using the F-test).
In this comparison, the KLSEMAS is compared with the NYSEALL and the FTALLSH; whereas the KLSECOMP is compared with the DJCMP65 and the FTSE100.

Table 7.12

STANDARD DEVIATIONS OF THE WEEKLY STOCK RETURNS (Log) FOR THE KLSE, HKSE AND THE AJSE: 1984 - 1994

PRICE INDEX / YEAR	KLSE		HKSE		AJSE
	KLSEMAS	KLSECOMP	TOTMKHK	HANGSENG	AUSTALL
1984-1994	0.03161	0.03357	0.03922**	0.03795**	0.02555*
1984	0.01671	0.02710	0.04933**	0.04777**	0.02066**
1985	0.02711	0.03679	0.02933**	0.03001	0.01666*
1986	0.03032	0.03487	0.02698	0.02783	0.02033*
1987	0.05572	0.05832	0.07550**	0.06813	0.06035
1988	0.02359	0.02681	0.02290	0.02289	0.02233
1989	0.02010	0.02287	0.04133**	0.03933**	0.01841
1990	0.04182	0.04061	0.03123*	0.02977*	0.02014*
1991	0.02514	0.02495	0.02047	0.02071	0.01593*
1992	0.01629	0.01640	0.03387**	0.03402**	0.01699
1993	0.02550	0.02503	0.03271**	0.03439**	0.01611*
1994	0.03824	0.03407	0.03694	0.03870	0.01903*

NB:

*Significantly different (i.e., lower than the KLSE's standard deviation of returns) at 5% level (using the F-test).

**Significantly different (i.e., higher than the KLSE's standard deviation of returns) at 5% level (using the F-test).

In this comparison, the KLSEMAS is compared with the TOTMKHK and the AUSTALL; the KLSECOMP is compared with the HANGSENG.

parameters[24]. As advocated by Hsu (1984), stock market return variability is frequently on the move, reacting to shifts of the general economic conditions or occurrences of some special political-economic events.

(ii) Fluctuations in the means and standard deviations - or more generally, the behaviour - of stock returns on the KLSE are inclined to correlate with the movements of returns on the developed exchanges[25]. For example, in 1984 and 1994[26], the KLSE performed badly (negative means of returns) when other exchanges also did not

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[24]For example, the 'negative' performance of the Malaysian stock market in 1984 might be explained by a number of political economic events that had taken place in Malaysia and overseas. Among these events as recorded in the *Keesing's Contemporary Archives: Record of World Events*, Volume XXX (1984), Longman, are as follows:

(i) The five-month constitutional crisis in Malaysia (which started on August 1, 1983 and ended on January 10, 1984);

(ii) The general assembly of *UMNO*, the dominant party in the ruling coalition Government of Malaysia (which was held on May 25, 1984). "The election campaign had been particularly intense and divisive" (p. 33029).

(iii) The banking scandal which involved the *Bank Bumiputera Malaysia*, the Malaysia's largest Bank. The scandal was revealed in October, 1983.

(iv) The uncertainty over the political future of Hong Kong led to a continued decline in the value of the Hong Kong dollar. "...; the lack of progress in the Peking talks led to a crisis of confidence in the stock market in September, however, and the index fell from 1,000.23 on August 22 to 690.06 on Oct. 4, the lowest level of the year" (p. 32626). In 1984, the Hong Kong financial markets were reported as "remained highly volatile during the period of talks between Britain and China over Hong's future" This general political and economic uncertainties in 1984 "subsequently brought the index down to 746.02 on July 13, although by early August it had recovered to around 900" (p. 33097). (iv) The United States presidential election in November, 1984 [see e.g., Neiderhoffer *et.al* (1970)].

[25]It is expected that, being a very open economy, the Malaysian economy and hence the performance of the KLSE would be easily affected by the business cycles of the developed nations. Moreover, Solnik (1996) postulates that, in some periods when developed markets drop, emerging markets also drop and by a large amount, because of their high volatility. He refers to 1974 - the year of oil shock - as an example.

[26]As reported in the *World Economic and Financial Surveys: Private Market Financing for Developing Countries*, International Monetary Fund, Washington, DC (November, 1995, p. 2), in 1994 private market financing to developing countries declined from the level reached in 1993 - reflecting in part a less favourable external environment:

(i) "The tightening of monetary policy in the United States early in 1994 set off considerable turbulence in world financial markets".

(ii) "The Mexican financial crisis in December 1994 prompted a relatively broad sell-off of developing country securities in late December and early January 1995" [see also the *IMF Survey* (February 19, 1996)].

See also *The Economist* (January 28th, 1995), p. 92; (May 13th, 1995), p. 109.

perform well. In 1993, the KLSE performed extremely well[27] (high means of returns) when the HKSE also did extremely well. More glaringly is the market performance in 1987: Due to the stock market crash of 1987, following other exchanges, the means of stock returns on the KLSE were very low while the standard deviations were very high[28]. Similar observations suggesting a tendency of stock markets to move together (as indicated in Tables 7.9 through 7.12) can be identified in 1990 - the year of Gulf crisis[29]. In this year, all of these exchanges (except the HKSE) exhibited negative means of returns.

Based on these preliminary observations, it appears that national stock markets tend to move similarly. It is at least plausible that stock markets are inclined to move together more closely with the occurrence of special international political-economic events. This subject of international stock market covariation is considered in further detail in Sub-section 7.3.2

7.3.2-Correlations Between the KLSE and Other Exchanges

The present sub-section discusses the results of our tests in trying to quantify as well as qualify the extent to which the KLSE is integrated with the overseas exchanges. In these inspections, stock markets around the world are in general, categorised into the following groups:

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[27]Some explanations for this actuality are provided in Chapter Two.

[28]Several studies using high-frequency data surrounding the crash of 1987, have found that international stock market correlation tends to increase in periods of high turbulence. See e.g., Bertero and Mayer (1990), King and Wadhwani (1990), King *et.al* (1994) and Longin and Solnik (1995).

[29]This approximately eight months period of Kuwait Invasion/Desert Storm started on August 2, 1990. Additionally, as noted in Roll (1992), a large Japanese market decline occurred in early 1990.

(i) well-established/developed exchanges (or stock markets in the developed countries);

(ii) stock exchanges in the Asia-Pacific region; and

(iii) emerging stock exchanges (or stock markets in the developing countries).

As featured in Chapter Six, this investigation of stock market linkages involves three procedures: cluster analysis, correlation analysis and partial correlation analysis.

a) Cluster Analysis

Our purpose in employing cluster analysis here is, to get a visual impression of how stock markets around the world could be grouped based on the similarity of their price and/or returns movements[30]. More specifically, we use the cluster procedure with the objective of identifying which stock markets are 'close'[31] to the KLSE in terms of the comovement in their prices/returns.

Results of our cluster analysis[32] are depicted in Figures 7.1 through 7.5. In words, these results are outlined below:

(i) *The KLSE and Developed Exchanges (1984 - 1994)*: As displayed in Figure 7.1, the KLSE is moving (relatively speaking) in tandem with the HKSE. In other words, the KLSE and the HKSE form a *primary cluster*, which is defined by Panton *et.al* (1976) as a two-market cluster. Other markets which appear to be very 'close'

[30]As underlined in Chapter Five, employing the procedure of cluster analysis would involve an extensive use of dendrograms in analyzing structural properties of the comovement data. Panton *et.al* (1976) emphasize that the opportunity afforded for visual inspection, is the appealing feature of dendrograms.

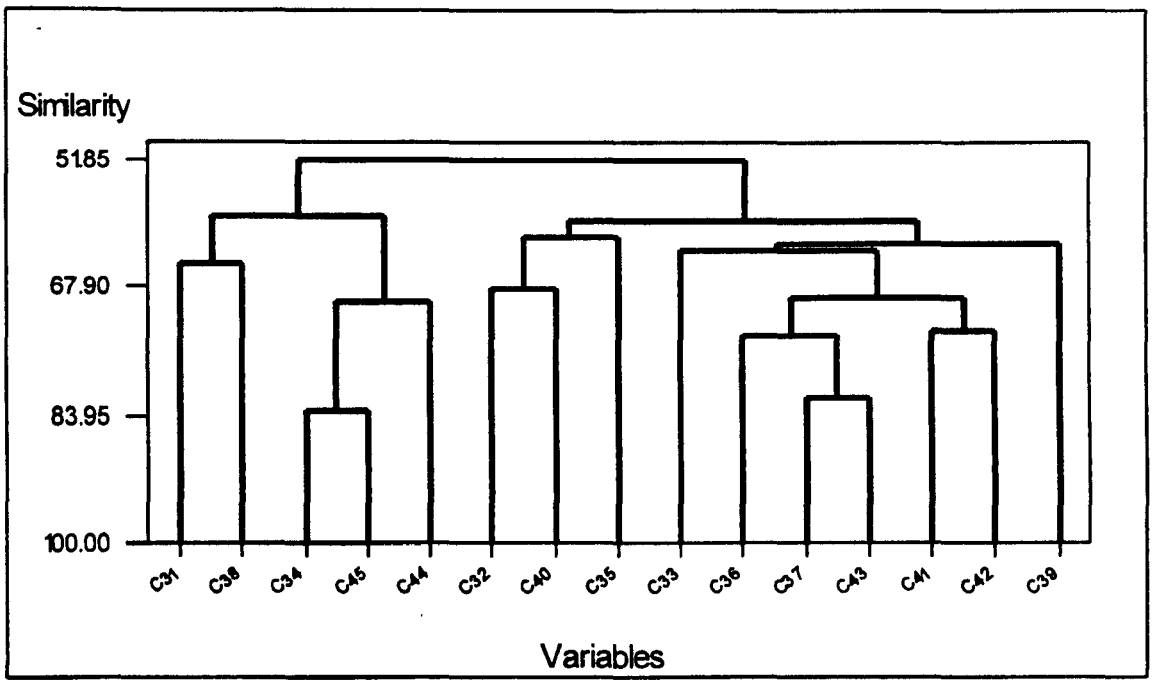
[31]As noted in Chapter Six, since we are using *Minitab* in impelemnting our clustering process, we use correlation (as given in *Minitab*) to measure closeness.

[32]In this analysis, the data that we use are changes in the logarithm of share price indices. The names of share price indices (for all of the countries) involved in this study are given in Table 7.1.

Figure 7.1

THE KLSE AND DEVELOPED MARKETS

A Hierarchical Cluster Analyasis of Stock Markets Based on the Daily Logarithm of Returns, 1984 - 1994



LEGEND

VARIABLE	COUNTRY (PRICE INDEX)
C31	Malaysia (KLSEMAS)
C32	Australia (AUSTALL)
C33	Belgium (BXBRLAN)
C34	Canada (TTOCOMP)
C35	Denmark (CHAGENI)
C36	France (TOTMKFR)
C37	Germany (FURTCOM)
C38	Hong Kong (TOTMKHK)
C39	Italy (MILANBC)
C40	Japan (TOTMKJP)
C41	Norway (OSEINDX)
C42	Sweden (VECWALL)
C43	Switzerland (SWEKGEN)
C44	United Kingdom (FTALLSH)
C45	United States (NYSEALL)

to the Malaysian stock market are in Canadian, United States and United Kingdom. The Japanese stock market, which is in the same (broad) geographical region with the Malaysian market, surprisingly, is 'located' in these terms, quite far from the KLSE.

(ii) *The KLSE and Some Selected Developed and Emerging Markets (1988 - 1994)*[33]: Referring to Figure 7.2, when data from both developed and emerging markets are analysed, stock markets are classified into two major (regional) groups. The first group comprises the countries in the Asia-Pacific region, with the exception of Japan and South Korea. These countries are Malaysia, Hong Kong, Australia, Thailand, the Philippines and Taiwan. Here, once again, Malaysia and Hong Kong are in the same primary cluster.

The second major group is made up of countries in the developed world, the majority of which are European countries. Japan is found to be in this group.

(iii) *The KLSE and Other Markets in the Asia-Pacific Region (1990 - 1994)*: In our foregoing cluster analysis (the results of which are depicted in Figure 7.2), some of the countries in the Asia-Pacific Basin are not included. Now, we concentrate on the Asia-Pacific Basin by including all the countries in this part of the world. Being among the world's biggest and most influential stock markets, the United States and United Kingdom markets are also included in the sample - in order to visualise their 'locations' and 'influence' among the markets in the Asia-Pacific countries.

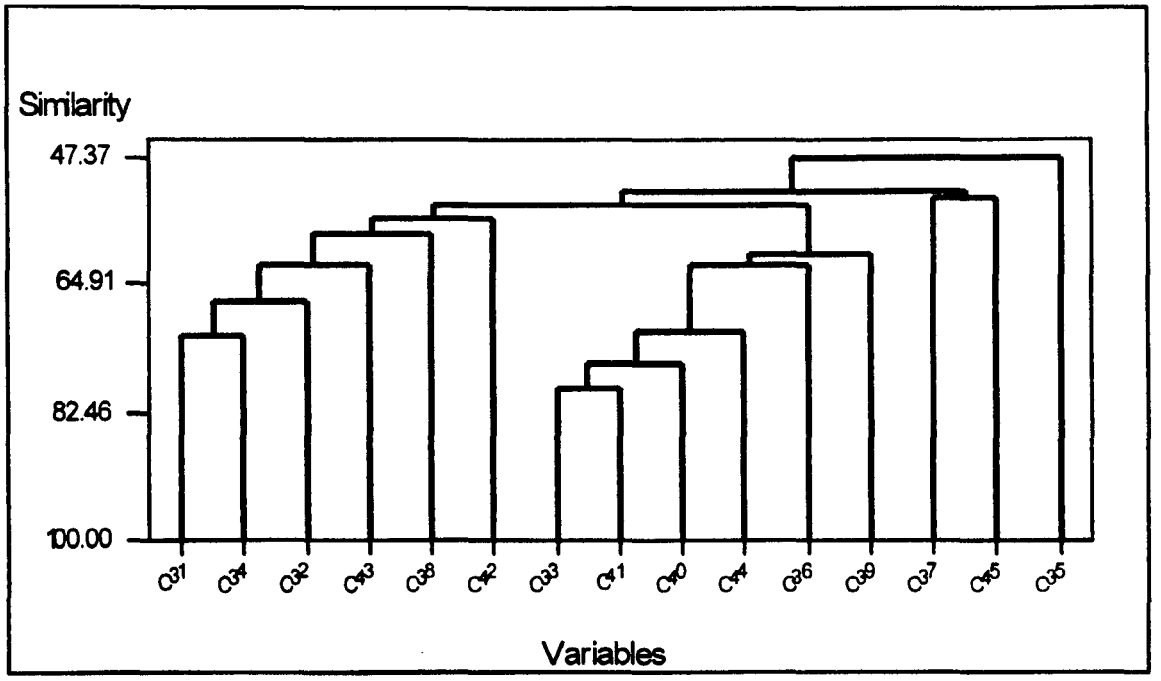
Our sample period here is only 1990 through 1994. We have to choose 1990 as the starting year in order to include Singapore in the sample. As discussed in Chapter Two, prior to the 1990, the Malaysian and Singaporean stock markets were

[33]Note that even though some of the countries included here are similar to those used in Figures A3.5a and A3.5b, different indices are employed. Additionally, our analyses here (i.e., Figures A3.6a and A3.6b) involve a different sample period (i.e., after 1987).

Figure 7.2

DEVELOPED AND EMERGING MARKETS

A Hierarchical Cluster Analysis of Stock Markets Based on the Daily Logarithm of Returns, 1988 - 1994



LEGEND

VARIABLE	COUNTRY (PRICE INDEX)
C31	Malaysia (KLSECOMP)
C32	Australia (AUSTALL)
C33	France (FRCAC40)
C34	Hong Kong (HANGSENG)
C35	India (IBOMBSE)
C36	Japan (JAPA500)
C37	Korea (KORCOMP)
C38	Philippines (MANCOMP)
C39	South Africa (JSEINDS)
C40	Spain (MADRIDI)
C41	Switzerland (TOTMXSW)
C42	Taiwan (TAIWGHT)
C43	Thailand (BNGXSET)
C44	United Kingdom (FTA500I)
C45	United States (DJCMPES)

twin markets.

As shown in Figure 7.3, Malaysia is now in same group with Japan, even though they are recorded not to be very 'close'. As expected, Singapore which is geographically a neighbour of Malaysia, is depicted here as the 'nearest' country to Malaysia (i.e., in the same primary cluster), followed by Hong Kong, Australia and Japan.

In this dendrogram (Figure 7.3), the U.S. and U.K. markets are depicted together as a 'special family' (primary cluster) - a 'family' which seems to have no close relationship with other 'families'. The Philippines, Thailand and Taiwan are depicted here as members of one more family of stock markets; whereas South Korea and Indonesia in this mapping, come out as two 'outliers': they do not belong to any group of markets.

(iv) *The KLSE and Other Emerging Markets (1990 - 1994)*[34]: This part of our cluster study of stock markets involves data which are different from the previous ones. They are different in a number of important ways. First, the data that we use here are the price indices provided by the International Finance Corporation (IFC), whereas the previously used data are local stock price indices. Secondly, all the stock markets included in this sample are emerging markets: They come from five parts of the globe (continents) - Asia, Africa, Europe, Latin America and Central America. Thirdly, the results of cluster analysis using local price indices reported above, are based on the daily prices data[35]. On the other hand, for the IFC indices we have to

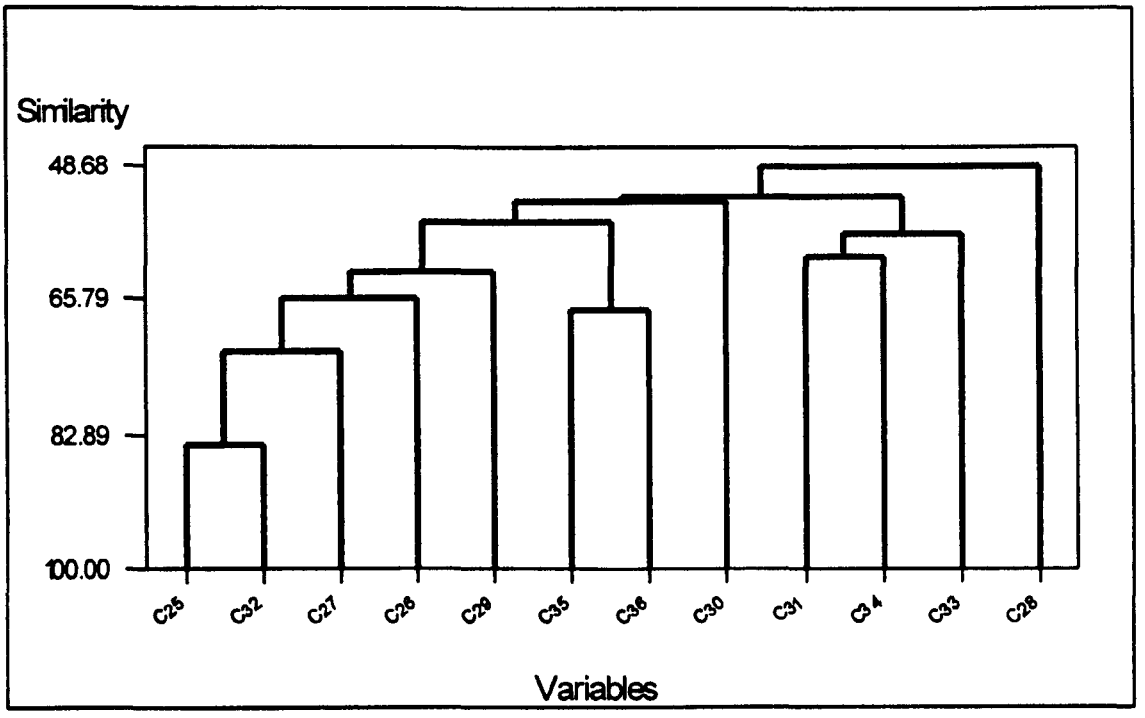
[34]Here, in order to include as many emerging markets as possible, we have to begin our sample period with the 1990.

[35]Indeed, in these investigations we have also employed weekly data. However, since the results are not much different from the ones based on daily data - and to conserve space - they are not reported here.

Figure 7.3

THE KLSE AND OTHER MARKETS IN THE ASIA-PACIFIC REGION

A Hierarchical Cluster Analysis of Stock Markets Based on the Daily Logarithm of Returns, 1990 - 1994



LEGEND

VARIABLE	COUNTRY (PRICE INDEX)
C25	Malaysia (KLSECOMP)
C26	Australia (AUSTALL)
C27	Hong Kong (HANGSENG)
C28	Indonesia (JAKCOMP)
C29	Japan (JAPADCMA)
C30	Korea (KORCOMP)
C31	Philippines (MANCOMP)
C32	Singapore (SNGALLS)
C33	Taiwan (TAIWGHT)
C34	Thailand (BNGKSET)
C35	United Kingdom (FTASDOI)
C36	United States (DJCMP65)

use the weekly data because the daily data are not available.

Another important difference is that, two categories of indices are employed. They are, the indices which measure prices in local currencies, and the ones which measure prices in U.S. dollars. The purpose of using price indices which are measured in U.S. dollars here (in addition to the ones measured in local currencies) is to investigate whether exchange rates are influential in determining the covariations or the 'closeness' between and among stock markets.

Figures 7.4 display the results of our hierarchical cluster analyses based on price indices which are in local currencies. As expected, Malaysian stock market is shown to be moving very closely together with the stock markets in Thailand, Indonesia and the Philippines.

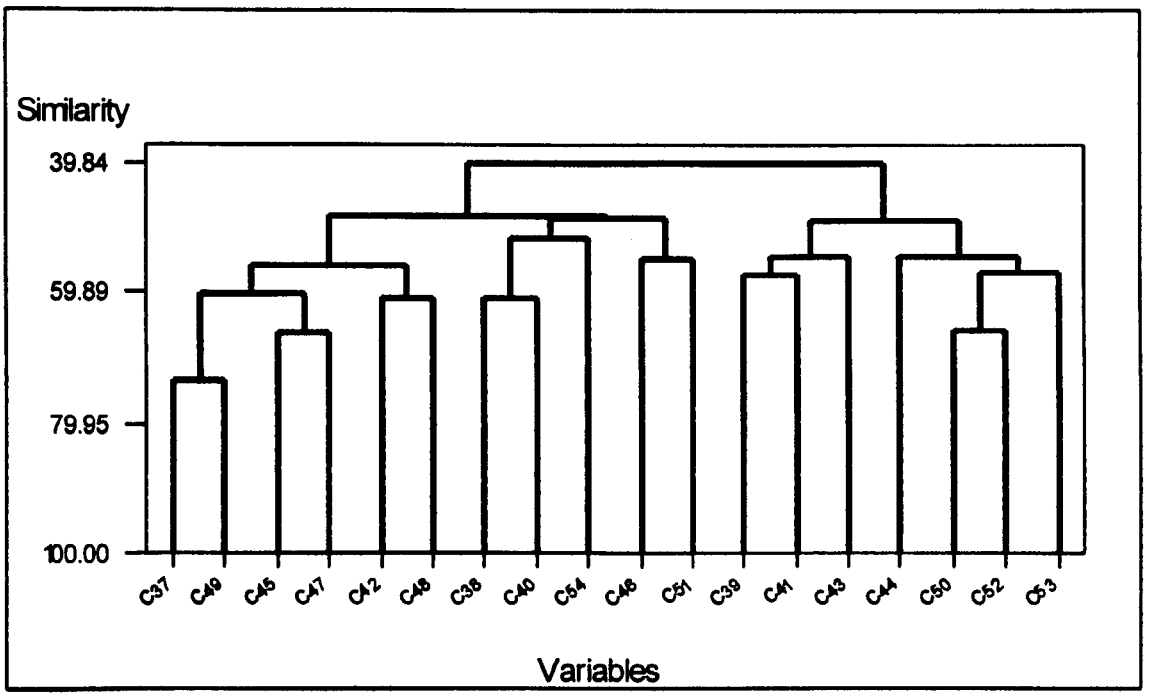
Stock markets are clustered in quite different ways or configurations (arrangements) when the data used are in U.S. dollars. They are portrayed in Figure 7.5. Nevertheless, we can still find that several stock markets which are in the same group when the data are based on local currencies, are also in the same group when the data are based on the U.S. dollars. Comparing Figures 7.4 and 7.5, one will find that in both figures, the Malaysian market is in the same group with Thailand, Indonesia and the Philippines. Similarly, Korea and Jordan which are in the same group in Figure 7.4, are also placed in the same group in Figure 7.5. Another example is that Greece and Portugal which form a primary cluster in both Figures 7.4 and 7.5. In a nutshell, the evidence detected and collected from these results corroborates the fact that the influence of exchange rates in determining the group or the covariations between and among national stock exchanges, is not great.

To generalise, our empirical investigation on stock market linkages applying

Figure 7.4

THE KLSE AND OTHER EMERGING MARKETS

A Hierarchical Cluster Analysis of Stock Markets Based On the IFC Weekly Logarithm of Returns (Local Currency), 1990 - 1994



LEGEND

VARIABLE	COUNTRY	VARIABLE	COUNTRY
C37	Malaysia	C46	Korea
C38	Argentina	C47	Philippines
C39	Brazil	C48	Taiwan, China
C40	Chile	C49	Thailand
C41	Colombia	C50	Greece
C42	Mexico	C51	Jordan
C43	Venezuela	C52	Portugal
C44	India	C53	Turkey
C45	Indonesia	C54	Zimbabwe

the hierarchical cluster procedure, has produced a number findings which can be summarised as follows:

(i) The regional factor is crucial in determining the magnitude of stock market covariations[36] [see e.g.,Figure 7.2]. The Malaysian stock market for example, is moving closely together with its counterparts in the same region: Hong Kong, Singapore, Thailand and the Philippines.

(ii) Given the present era of information technology, it is not very clear whether the time zone is an important element in affecting the tendency of stock markets to be regionally integrated. The Japanese stock market for example, is found not to be consistently moving closely together with its neighbours in the same time zone.

(iii) The impact of movements in exchange rates on stock market interrelatedness is not likely to be profound.

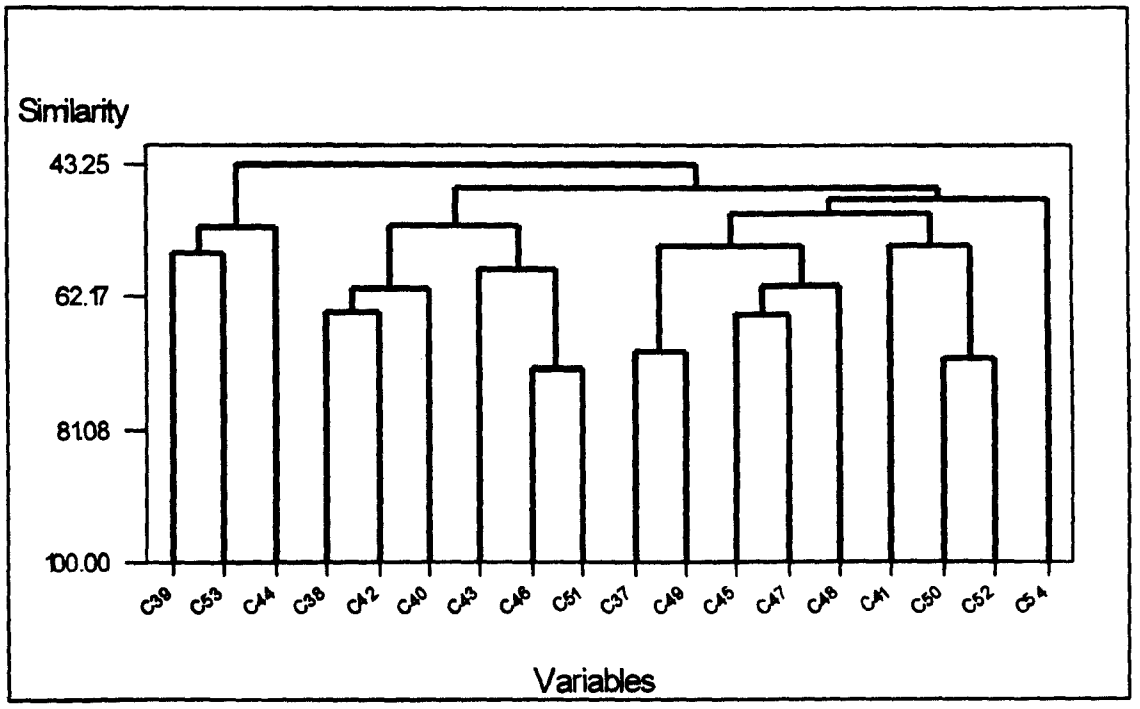
Lastly, our survey of literature on the application of cluster analysis in studying stock market, reveals that there has been only one published study which applied this method to study Asian stock markets. The study was conducted by Cheung and Ho to examine the stability of relationships Asian equity markets and some developed markets. Examining these relationship on a yearly basis, among others, they found that the "Malaysian and Singapore markets form primary clusters in ten out of twelve years and the Japan and US markets form primary clusters in seven out of twelve years" (p. 248). Their results are similar with our results in the sense that the Japanese stock market is not moving very closely together with its counterpart in Asia, and that the

[36]This finding aligns with the finding demonstrated in Solnik (1996) that national stock markets tend to exhibit strong regional links.

Figure 7.5

THE KLSE AND OTHER EMERGING MARKETS

A Hierarchical Cluster Analysis of Stock Markets Based On the IFC Weekly Logarithm of Returns (US$), 1990 - 1994



LEGEND

VARIABLE	COUNTRY	VARIABLE	COUNTRY
C37	Malaysia	C46	Korea
C38	Argentina	C47	Philippines
C39	Brazil	C48	Taiwan, China
C40	Chile	C49	Thailand
C41	Colombia	C50	Greece
C42	Mexico	C51	Jordan
C43	Venezuela	C52	Portugal
C44	India	C53	Turkey
C45	Indonesia	C54	Zimbabwe

Malaysian stock market is moving very closely together with the Singapore stock market.

However, as far as the Malaysian stock market and the Singapore stock markets are concerned, Cheung and Ho's (1991) results appear to be biased because, as noted in Chapter Six, the sample period for their study is from January 1977 to June 1988. During this period, as highlighted in Chapter Two, the Malaysian stock market and the Singaporean stock market were twin markets. Shares from the same companies (i.e., Malaysian companies and Sigaporean companies) were listed on both exchanges.

b) Correlation Analysis

The method of cluster analysis provides us a procedure to identify visually which groups of stock markets are more integrated and which ones are relatively segmented. However, using this method, we are unable to quantify the amplitude of stock market covariations. Given this shortcoming, the method of correlation analysis is used as a complement.

The results of our study on stock market linkages applying the correlation procedure are offered in Tables 7.13 through 7.23.

Whilst Table 7.13 details the correlation coefficients between the KLSE and developed markets, Table 7.14 and Table 7.15 show the size or dimension of correlations between the KLSE and its counterparts in the developing countries. The linkages between the KLSE and its neighbours in the Pacific Basin are detailed in Table 7.16. Our findings derived from these four tables are summed up below:

(i) The KLSE is significantly (positively) correlated with all developed

Table 7.13
CORRELATIONS (log) OF THE KLSE AND DEVELOPED EXCHANGES: 1984 - 1994

COUNTRY	PRICE INDEX	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
		SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)
Belgium	BKBRLAM	0.163*	0.124*	0.111*	0.300*	0.070	0.162*	0.397*	0.058	0.062
Canada	TTOCOMP	0.208*	0.295*	0.045	0.327*	0.180*	0.051	0.485*	0.113	0.078
Denmark	CHAGENI	0.211*	0.081	0.045	0.209*	0.060	0.102**	0.273*	0.098	0.072
France	RFCAC40***	0.211*	0.123*	-0.036	0.227*	0.153*	-0.015	0.297*	0.192	-0.092
	TOTMKFR	0.195*	0.110*	0.042	0.232*	0.120*	0.018	0.259*	0.116	0.001
Germany	FURTCOM	0.254*	0.103*	0.011	0.345*	0.112*	0.019	0.324*	0.026	0.108
	TOTMKBD	0.275*	0.072	0.043	0.356*	0.107**	0.045	0.362*	0.039	0.102
Italy	MILANBC	0.190*	0.058	0.046	0.205*	0.048	0.014	0.234*	-0.047	-0.147
Japan	JAPADOWA	0.264*	0.059	0.050	0.312*	0.005	-0.008	0.256*	0.082	-0.012
	TOTMKJP	0.254*	-0.006	0.087	0.314*	-0.024	-0.011	0.215**	0.136	0.021
Norway	OSEINDX	0.290*	0.117*	0.077	0.406*	0.101**	0.197*	0.503*	-0.033	0.198**
South Africa	JSEINDS	0.193*	0.011	0.097	0.007	0.005	0.026	0.471*	0.054	0.104
Spain	MADRIDI	0.245*	0.079	0.112*	0.306*	0.103**	0.052	0.347*	0.037	0.029
Sweden	VECWALL	0.270*	0.075	0.067	0.323*	0.086	0.122*	0.415*	0.034	0.189**
Switzer-land	SWBKGEN	0.318*	0.166*	0.022	0.407*	0.157*	0.071	0.396*	0.035	0.139
	TOTMKSW	0.333*	0.132*	0.045	0.409*	0.125*	0.071	0.404*	0.073	0.170
United Kingdom	FTSE100	0.216*	0.214*	0.042	0.379*	0.197*	0.097	0.576*	0.030	0.006
	FTA500I	0.223*	0.211*	0.053	0.382*	0.194*	0.132*	0.575*	0.022	0.015
	FTALLSH	0.270*	0.166*	0.079	0.436*	0.150*	0.101**	0.551*	0.077	0.013
United States	DJCMP65	0.157*	0.337*	-0.020	0.323*	0.217*	-0.021	0.510*	0.062	-0.072
	NYSEALL	0.177*	0.310*	-0.007	0.306*	0.224*	-0.005	0.488*	0.035	0.034

NB:
*Significantly different from zero at 1% level (i.e., two-tailed t-test).
**Significantly different from zero at 5% level (i.e., two-tailed t-test).
***The data are only for the period of 1988 through 1994.

Table 7.14

THE IFC STOCK PRICE INDICES (LOCAL CURRENCY): CORRELATIONS (log) OF THE KLSE AND OTHER EMERGING EXCHANGES (1988 - 1994)

COUNTRY	WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)
Argentina	0.050	-0.016	-0.022	0.093	-0.053	0.100
Brazil	0.133**	-0.026	0.042	0.293*	0.006	-0.344*
Chile	0.122**	0.041	0.031	0.179	-0.175	0.213
Colombia	-0.012	0.029	0.046	0.045	0.010	0.031
Mexico	0.175*	0.031	0.048	0.223**	0.017	0.203
Venezuala	0.010	-0.035	-0.057	-0.097	-0.283**	-0.075
India	0.077	-0.047	-0.075	0.010	-0.081	0.105
Indonesia	0.310*	-0.003	0.194*	0.448*	-0.014	0.358*
Korea	0.242*	0.082	0.003	0.292*	-0.020	-0.039
Pakistan	-0.133	-0.043	0.039	0.145	-0.059	0.020
Philippines	0.360*	0.003	0.094	0.568*	-0.036	0.107
Taiwan	0.170*	0.002	0.035	0.328*	0.035	0.123
Thailand	0.521*	0.044	-0.047	0.630*	0.045	0.097
Greece	0.079	-0.045	-0.024	0.025	0.079	0.099
Jordan	0.156*	0.042	0.046	0.165	0.149	0.050
Portugal	0.242*	0.016	-0.034	0.221**	-0.047	0.068
Nigeria	N.A.	N.A.	N.A.	0.043	0.021	0.265**
Turkey	0.186*	0.011	-0.065	0.197	0.089	0.117
Zimbabwe	0.012	-0.139*	0.102	0.056	-0.145	0.124

NB: *Significantly different from zero at 1% level (i.e., two-tailed t-test).
**Significantly different from zero at 5% level (i.e., two-tailed t-test).
N.A: Data are not available. The data for Indonesia are only for a period of 1990 - 1994. The weekly data for Pakistan are only for a period of 1992 - 1994.

exchanges [see Table 7.13]. Thus, as far as developed exchanges are concerned, the null hypothesis of zero correlation between the KLSE and other national exchanges can be rejected (even at the 1% level using the *t*-test).

(ii) The stock markets in the U.S, U.K., Switzerland, Canada and (surprisingly) Norway and Sweden[37] are among those markets in the developed world which are relatively highly correlated with the Malaysian market.

(iii) While the contemporaneous correlation coefficients between the KLSE and developed exchanges are significantly positive, correlations (in general) fade away when they are examined on a lead-lag basis[38]. As shown in the column four of Table 7.13, for a number of countries such as the U.S., Canada, U.K., Switzerland and France, however, the daily lagged correlation coefficients (with the KLSE) are still significantly different from zero. In fact, it is interesting to note that the lagged daily correlation coefficients are higher than the contemporaneous ones for the U.S. and Canadian Stock markets. These findings suggest that, to some extent, the Malaysian stock market is being lead by some stock markets in the developed countries such as the U.S., Canada, U.K. and Switzerland.

In his study, Roll (1992) also found lagged correlation between the Malaysian market and the U.S. market. He attributed such a lagged correlation to time zone locations. This is because, according to the author, unexpected events during the

[37]Given the fact that New York, London and Zurich are influential international financial centres, one might expect the Malaysian capital market to be relatively highly correlated with those in the U.S., U.K., and Switzerland. However, we did not expect the Malaysian market to be highly correlated with the stock markets in Norway and Sweden because these countries do not appear to have close economic relations with Malaysia. Perhaps, such relatively high correlations could be explained by the 'global factors' that over time, might provide the impetus for global stock market covariations. Alternatively, the apparent correlations could be due to coincidental relationships in the data.

[38]Due to limited space, only the correlation coefficients at lag one are reported in the thesis.

Table 7.15

THE IFC STOCK PRICE INDICES (U.S. DOLLARS): CORRELATIONS (log) OF THE KLSE AND OTHER EMERGING EXCHANGES (1988 - 1994)

COUNTRY	WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)
Argentina	-0.046	-0.029	-0.023	-0.052	-0.031	0.038
Brazil	0.149*	-0.036	-0.009	0.104	0.242**	0.109
Chile	0.120**	-0.015	0.021	0.092	-0.108	0.228**
Colombia	0.031	0.003	0.010	0.078	0.032	0.045
Mexico	0.137*	0.008	0.002	0.211	-0.002	0.193
Venezuala	0.059	-0.043	-0.065	-0.081	-0.273**	-0.058
India	0.071	-0.012	-0.076	0.021	-0.062	0.122
Indonesia	0.330*	-0.010	0.150**	0.453*	-0.025	0.359*
Korea	0.361*	-0.070	-0.084	0.262**	-0.054	-0.056
Pakistan	0.044	-0.165**	0.153	0.095	-0.070	-0.019
Philippines	0.362*	0.009	0.065	0.558*	-0.039	0.136
Taiwan	0.023	0.045	0.072	0.296*	0.012	0.015
Thailand	0.503*	0.003	-0.043	0.617*	0.029	0.074
Greece	0.146*	-0.088	-0.074	-0.012	0.072	0.017
Jordan	0.200*	-0.028	0.005	0.137	0.110	-0.040
Portugal	0.135*	-0.016	-0.072	0.141	-0.073	-0.060
Nigeria	N.A.	N.A.	N.A.	-0.188	0.067	0.062
Turkey	0.000	0.136*	0.081	0.168	0.080	0.166
Zimbabwe	0.018	0.030	0.072	0.173	-0.177	0.000

NB: *Significantly different from zero at 1% level (i.e., two-tailed t-test).
**Significantly different from zero at 5% level (i.e., two-tailed t-test).
N.A.: Data are not available. The data for Indonesia are only for a period of 1990 - 1994. The weekly data for Pakistan are only for a period of 1992 - 1994.

Table 7.16
CORRELATIONS (log) OF THE KLSE AND OTHER EXCHANGES IN THE ASIA-PACIFIC REGION: 1988 - 1994

COUNTRY	PRICE INDEX	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
		SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (OTHER MARKE)	LAG 1 (KLSE)
Australia	AUSTALL	0.332*	-0.009	0.067	0.322*	0.085	0.017	0.372*	-0.023	0.179
Hong Kong	HANGSENG	0.441*	0.088	0.030	0.474*	0.114**	-0.018	0.573*	-0.060	0.077
	TOTMKHK	0.420*	0.075	0.060	0.456*	0.122**	0.004	0.102	0.599*	-0.122
Indonesia++	JAKCOMP	0.157*	-0.015	0.213*	0.135*	-0.021	0.071	0.205	0.165	0.253**
Japan	JAPA500	0.309*	0.038	0.068	0.370*	0.006	-0.016	0.346*	0.104	-0.057
Philippines	MANCOMP	0.193*	0.015	0.145*	0.233*	0.072	0.146*	0.648*	0.093	0.135
Singapore++	SNGPORI.	0.677*	0.187*	0.156*	0.346*	0.100	0.550*	0.764*	0.022	0.002
	SNGALLS	0.668*	0.189*	0.179*	0.336*	0.121**	0.603*	0.799*	0.050	0.011
South Korea	KORCOMP	0.120*	0.040	0.048	0.183*	0.040	0.026	0.285*0	-0.038	-0.014
Taiwan	TAIWGHT	0.161*	-0.001	0.119*	0.177*	-0.041	0.097	0.337*	0.044	0.163
Thailand	BNGKSET	0.406*	0.064	0.178*	0.426*	0.062	0.156*	0.648*	0.093	0.135

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Singnificantly different from zero at 5% level (i.e., two-tailed t-test).

++The data cover the period of only 1990 through 1994.

trading day in the U.S., could not possibly be reflected in Far Eastern markets until the next calendar day.

On weekly basis, as shown in column seven of Table 7.13, the KLSE is again being (significantly) led by most markets in developed countries. The exceptions here are Belgium, Denmark, Italy, Japan, Sweden. Again, the interesting issue here whether this is an indication of market inefficiency or just a time zone effect.

According to Bailey an Stulz (1990), for weekly and monthly returns, the time differences between markets are not important. Moreover, if the time zone effect is the important factor, why is the Malaysian market not being (significantly) led by stock markets in Belgium, Denmark, Italy and Sweden? Perhaps, this issue deserves further investigation

(iv) Whilst, under the cluster analysis we have found that the Japanese stock market is not in the same group with the KLSE, under the correlation analysis we have found that there is no significant lagged correlation between the Japanese market and the Malaysian stock market. Of course, the Japanese and Malaysian markets are located in similar time zone.

A study by Cheung and Mark (1992) has also documented similar results: Unlike the U.S. market, the Japanese market plays a less important leading role in the Asia-Pacific region. Similarly, Bailey and Stulz (1990) in their work claim that the American markets led the Pacific Basin markets.

(v) Tables 7.14 and 7.15 display the results of correlation analysis between the Malaysian stock market and other emerging markets, based on share price indices in local currencies and in U.S. dollars, respectively. These tables reveal that, in general,

Table 7.17

CORRELATIONS (log) OF THE KLSE EMAS (ALL-SHARE) INDEX AND THE AUSTRALIAN JOINT STOCK EXCHANGE (AJSE) ALL-ORDINARY INDEX (Examined on a Yearly Basis): 1984 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (AJSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (AJSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (AJSE)	LAG 1 (KLSE)
1984-1994	0.325*	-0.033	0.325*	0.453*	0.120*	0.161*	0.494*	0.067	0.053
1984	0.219*	0.001	0.009	0.079	-0.019	0.131	0.348	0.418	-0.342
1985	0.096	0.012	0.074	0.218	0.140	0.014	0.609**	-0.162	-0.312
1986	-0.020	-0.017	0.042	0.090	0.126	-0.108	0.018	-0.282	-0.436
1987	0.481*	-0.091	0.386*	0.805*	0.199	0.433*	0.869*	0.231	0.124
1988	0.453*	0.050	0.112	0.339**	0.260	0.016	0.135	0.460	0.030
1989	0.553*	-0.209*	-0.236*	0.186	-0.099	0.089	0.339	-0.482	-0.025
1990	0.370*	0.089	0.212*	0.505*	0.080	-0.147	0.732*	-0.158	0.139
1991	0.348*	-0.079	0.028	0.337**	0.033	0.266	0.457	0.413	-0.082
1992	0.206*	0.060	-0.007	0.010	-0.106	-0.274**	-0.107	-0.521*	0.040
1993	0.121**	0.082	0.044	0.380*	-0.111	0.103	0.399	-0.332	-0.496
1994	0.273*	-0.062	0.138**	0.199	0.088	-0.132	0.033	0.307	0.320

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed test).

Table 7.18

CORRELATIONS (log) OF THE KLSE COMPOSITE INDEX AND THE HKSE HANG SENG INDEX (Examined on a Yearly Basis): 1984 - 994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (HKSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (HKSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (HKSE)	LAG 1 (KLSE)
1984-1994	0.329*	0.109*	0.085*	0.409*	0.136*	0.186*	0.547*	0.026	0.087
1984	0.137**	0.143**	0.141**	0.227	0.048	0.356*	0.455	-0.141	-0.083
1985	0.017	0.079	0.074	0.182	-0.029	-0.250	0.065	-0.369	0.094
1986	0.155**	0.034	-0.096	0.003	0.150	-0.038	-0.293	0.750*	0.360
1987	0.341*	0.168*	0.215*	0.582*	0.300**	0.684*	0.871*	0.078	0.086
1988	0.497*	0.136**	0.032	0.435*	0.279**	0.027	0.638**	-0.021	0.024
1989	0.444*	0.058	-0.104	0.625*	0.002	-0.181	0.597**	-0.251	-0.462
1990	0.590*	0.267*	0.168*	0.772*	-0.007	-0.082	0.856*	0.162	-0.082
1991	0.493*	-0.129**	-0.086	-0.018	0.119	0.188	0.466	0.105	0.045
1992	0.275*	0.159*	0.037	0.330**	0.102	0.198	0.489	-0.211	-0.304
1993	0.155**	0.123**	0.021	0.452*	0.031	0.038	0.491	-0.387	-0.071
1994	0.567*	0.039	0.096	0.425*	0.254	-0.144	0.304	0.290	0.542

NB:

*Significantly different from zero at 1% level(i.e., two-twiled test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

the Malaysian stock market is less correlated[39] with other emerging markets compared with its correlation with developed markets [Table 7.13]. In fact, the Malaysian market is found to be negatively correlated with a number of emerging markets - Venezuela, for example.

(vi) When the results shown in Tables 7.14 (correlations in local currencies) and 7.15 (correlations in U.S. dollars) are compared, one can find a number of differences in the magnitude (including different signs) of correlations for some countries. Even so, these differences do not appear to be great: Stock markets which are shown to be relatively highly correlated in local currency terms with the KLSE in Table 7.14 - Thailand, the Philippines and Indonesia - are still found in Table 7.15, to be highly (positively) correlated (in dollar terms) with the KLSE. Likewise, both of these tables exhibit low correlation coefficients for countries such as Argentina, Colombia, Venezuela, India, Pakistan, Nigeria and Zimbabwe.

(vii) Another group of stock markets examined under correlation analysis - the results of which are shown in Table 7.16 - are those from the Asia-Pacific countries. As expected, the results indicate that the KLSE is highly (positively) correlated with all exchanges in this region. For all of these exchanges the null hypothesis of zero correlation has to be rejected (even at the 1% level, using the *t*-test). Among the exchanges which have the highest correlations with the KLSE are those from Singapore, Hong Kong, Thailand and Australia.

From table 7.16, it is interesting to note that the KLSE is leading a number of stock markets in the Asian countries. For the daily returns [column 5], the KLSE

[39]The exception here is the stock markets in the same region such as in Thailand, the Philippines and Indonesia.

Table 7.19

CORRELATIONS (log) OF THE KLSE EMAS (ALL-HARE) INDEX AND THE STOCK EXCHANGE OF SINGAPORE (SES) ALL-SHARE INDEX (Examined on a Yearly Basis): 1990 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (SES)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SES)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SES)	LAG 1 (KLSE)
1990-1994	0.668*	0.189*	0.179*	0.336*	0.121	0.603*	0.799*	0.050	0.011
1990	0.791*	0.406*	0.296*	0.252	0.109	0.717*	0.916*	0.251	-0.156
1991	0.689*	0.034	0.049	0.377*	0.127	0.500*	0.846*	0.567**	0.088
1992	0.494*	0.136**	0.125**	0.305**	-0.062	0.436*	0.217	0.123	0.157
1993	0.492*	0.198*	0.126**	0.182	0.342*	0.618*	0.736*	-0.216	-0.021
1994	0.698*	0.069	0.157**	0.474*	0.027	0.539*	0.787*	-0.342	-0.169

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

Table 7.20

CORRELATIONS (log) OF THE KLSE COMPOSITE INDEX AND THE SWISS BANK CORPORATION (SBC) GENERAL INDEX (Examined on a Yearly Basis): 1984 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (SBC)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SBC)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SBC)	LAG 1 (KLSE)
1984-1994	0.318*	0.166*	0.022	0.407*	0.157*	0.071	0.396*	0.035	0.139
1984	0.098	-0.042	0.195*	0.188	-0.118	0.052	0.023	0.070	-0.027
1985	0.104	0.044	0.007	-0.047	-0.185	-0.179	-0.619**	0.255	0.292
1986	-0.008	0.083	0.059	0.249	0.003	0.055	0.263	-0.512	-0.309
1987	0.431*	0.384*	0.056	0.707*	0.375*	0.407*	0.722*	0.072	0.304
1988	0.450*	-0.039	0.016	0.295**	-0.048	-0.287**	-0.089	-0.115	0.191
1989	0.596*	-0.184*	-0.236*	0.262	-0.028	-0.104	0.057	0.263	-0.466
1990	0.554*	0.371*	0.036	0.703*	0.188	-0.093	0.807*	0.324	-0.176
1991	0.436*	0.135**	0.052	0.437*	0.209	0.162	0.752*	0.233	0.130
1992	0.161*	0.204*	-0.013	0.462*	0.058	0.031	0.491	0.384	-0.350
1993	0.005	0.157**	-0.050	0.246	0.194	-0.129	-0.011	-0.146	0.196
1994	0.176*	0.011	0.005	0.146	0.353*	-0.383*	-0.314	0.274	0.362

NB:

* Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level(i.e., two-tailed t-test).

appears to lead the stock markets in Indonesia, The Philippines, Singapore, Taiwan and Thailand. For the weekly data [column 8], the KLSE is leading the stock markets in The Philippines, Singapore and Thailand.

In short, the Malaysian stock is positively correlated with overseas markets around the globe. By and large, these correlations are significantly different from zero. The question now is, is this phenomenon stable over time? To examine this issue, we choose seven stock markets which are highly correlated with the KLSE and break up the data according to years. The correlation coefficients are then examined on a yearly basis. Included in the sample are the 'Australian Joint Stock Exchange' (AJSE), the HKSE, LSE, NYSE, the Stock Exchange of Singapore (SES), the Swiss stock market and the Securities Exchange of Thailand (SET). The results of this analysis are given in Tables 7.17 through 7.23.

On examining Tables 7.17 through 7.23 the following findings, inter alia, can be gleaned:

(i) Even though the KLSE is highly correlated with the SES, HKSE, SET, AJSE, NYSE, LSE and the Swiss stock market, these correlations as expected, are not inter-temporally stable[40].

(ii) In most cases, the correlations between the KLSE and these overseas exchanges are relatively low in 1984, 1985, 1986, 1992 and 1993.

(iii) Correlations between the KLSE and foreign exchanges escalate with the outbreak of important international political-economic events. The evidence for this

[40]Several previous studies also found that the interrelatedness between national stock exchanges are not stable over time. See e.g., Makridakis & Wheelwright (1974), Panton *et.al* (1976), Maldonado & Saunders (1981), Othman Yong (1993) and Erb *et.al* (1994).

Table 7.21

CORRELATIONS (log) OF THE KLSE COMPOSITE INDEX AND THE SECURITIES EXCHANGE OF THAILAND (SET) INDEX (Examined on a Yearly Basis): 1986 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (SET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SET)	LAG 1 (KLSE)	SAME DATE	LAG 1 (SET)	LAG 1 (KLSE)
1986-1994	0.337*	0.054	0.219*	0.434*	0.089	0.231*	0.627*	0.058	0.147
1986	0.002	0.019	0.127**	0.128	-0.013	0.178	0.353	0.124	0.316
1987	0.276*	0.043	0.412*	0.579*	0.219	0.509*	0.756*	0.006	0.187
1988	0.496*	-0.028	0.128**	0.427*	0.016	-0.059	0.286	0.145	0.284
1989	0.489*	-0.150**	-0.147**	0.320**	0.004	-0.058	0.257	-0.115	0.136
1990	0.479*	0.173*	0.374*	0.586*	-0.031	-0.046	0.810*	0.131	0.082
1991	0.342*	0.068	0.212*	0.393*	0.032	0.428*	0.427	0.572**	0.356
1992	0.160*	0.022	0.072	0.104	0.085	0.315**	0.576**	0.355	-0.292
1993	0.227*	0.153**	0.111	0.172	0.138	0.279**	0.373	0.035	0.062
1994	0.525*	0.033	0.173*	0.461*	0.182	0.112	0.696*	-0.062	0.349

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

Table 7.22

CORRELATIONS (log) OF THE KLSE COMPOSITE INDEX AND THE LONDON STOCK EXCHANGE (LSE) FTSE 100 INDEX (Examined on a Yearly Basis): 1984 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (LSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (LSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (LSE)	LAG 1 (KLSE)
1984-1994	0.216*	0.214*	0.042**	0.379*	0.197*	0.097**	0.576*	0.030	0.006
1984	0.117	-0.106	0.084	-0.028	0.076	0.286**	0.128	0.325	-0.108
1985	-0.014	-0.006	0.032	-0.066	-0.037	0.033	-0.205	-0.113	0.208
1986	-0.045	0.121**	-0.041	0.212	0.089	-0.047	0.325	-0.878*	-0.438
1987	0.413*	0.418*	0.088	0.744*	0.408*	0.293**	0.966*	0.211	0.241
1988	0.196*	0.393*	0.024	0.396*	-0.012	0.16	0.647*	-0.099	-0.045
1989	0.105	0.162*	0.003	0.147	0.150	0.157	0.452	-0.050	-0.532
1990	0.344*	0.309*	0.047	0.502*	0.190	-0.236	0.635*	0.112	-0.054
1991	0.309*	0.111	0.072	0.326**	0.094	0.113	0.395	0.034	-0.014
1992	0.115	0.136**	-0.073	0.224	0.129	-0.154	0.397	0.286	-0.325
1993	0.130**	0.080	0.160*	0.331**	0.387*	0.093	0.223	-0.186	0.136
1994	0.161*	0.169*	-0.028	0.243	0.230	-0.108	0.415	0.082	-0.132

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

Table 7.23

CORRELATIONS (log) OF THE KLSE COMPOSITE INDEX (KLSECOMP)
AND
THE NEW YORK STOCK EXCHANGE (NYSE)
DOW JONES COMPOSITE 65 INDEX (DJCMP65)
(Examined on a Yearly Basis):
1984 - 1994

YEAR	DAILY RETURNS			WEEKLY RETURNS			MONTHLY RETURNS		
	SAME DATE	LAG 1 (NYSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (NYSE)	LAG 1 (KLSE)	SAME DATE	LAG 1 (NYSE)	LAG 1 (KLSE)
1984-1994	0.157*	0.337*	-0.020	0.323*	0.217*	-0.021	0.510*	0.062	0.018
1984	0.275*	0.117	0.030	0.425*	-0.251	0.029	-0.130	0.133	-0.096
1985	-0.119**	0.026	0.003	-0.100	-0.157	-0.169	-0.067	-0.338	0.072
1986	-0.050	0.060	-0.015	0.074	0.189	-0.044	0.507	-0.742*	-0.629**
1987	0.279*	0.542*	-0.095	0.601*	0.580*	0.002	0.835*	0.325	0.351
1988	0.078	0.509*	0.001	0.266**	0.060	-0.135	0.352	0.051	-0.029
1989	-0.002	0.416*	0.008	0.062	0.271**	0.091	0.516	-0.194	-0.399
1990	0.341*	0.467*	0.024	0.467*	0.237	-0.028	0.534**	0.191	-0.166
1991	0.166*	0.310*	0.137**	0.229	0.182	-0.017	0.467	0.438	-0.468
1992	0.111	0.227*	-0.007	0.425*	0.167	-0.128	0.612**	-0.419	0.165
1993	0.012	0.053	0.016	0.119	0.024	-0.059	0.232	-0.163	-0.283
1994	0.147**	0.166*	-0.066	0.195	0.138	-0.004	0.255	0.062	0.135

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

can be found for example, in 1987 and 1990[41].

(iv) Claims by some authors that world stock markets are more integrated after 1987[42] - as far as the KLSE is concerned - to some extent, appear to be true. The correlation coefficients between the KLSE and these national exchanges are higher starting from the 1987 onward, compared with the previous period [see e.g., Tables 7.17, 7.18 and 7.19]

(v) Interestingly (as has been mentioned above), for most years (essentially for the daily returns), the correlation coefficients between the KLSE and the NYSE are highest not on the same date (i.e., contemporaneous correlation) but at lag 1.

c) Partial Correlation Analysis

Our final step in investigating the linkages between the KLSE and foreign exchanges involves the employment of the partial correlation procedure. The purpose of this approach is to measure and to compare the importance of 'common factors' from certain foreign exchanges in affecting the movements in the Malaysian market. In conducting this aspect of study, three foreign exchanges which are identified to be influential and instrumental (highly correlated) in determining the nature and magnitude of fluctuations in stock prices on the KLSE, are chosen. They are, the SES, the HKSE and the NYSE. The outcomes of these inspections are reported in Tables

[41]A study by Cheung and Mak (1992) suggests that bad news affects the world's markets more than good news or no news. Erb *et.al* (1994) conclude their paper by claiming that correlations are highest when any two countries are in a common recession, and they are lower during recoveries and when the business cycles in the two countries are out of phase.

[42]Koutmos and Booth (1995) in studying the transmission mechanism of price and volatility spillovers across the New York, Tokyo and London stock markets, found that the linkages and interactions among the three markets have increased substantially in the post-crash era. Based on this finding, they claimed that since the 1987, national markets have grown more interdependent.

Table 7.24
PARTIAL CORRELATION (log) OF THE $KLSEMAS_t$ AND THE $SNGALLS_t$ (Holding the $KLSEMAS_{t-1}$ and the $DJCMP65_{t-1}$ Constant): 1990 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1990-1994	0.639* (0.408)	0.300* (0.090)	0.792* (0.627)
1990	0.731* (0.534)	0.432* (0.187)	0.927* (0.859)
1991	0.673* (0.453)	0.311** (0.097)	0.885* (0.783)
1992	0.456* (0.208)	0.198 (0.039)	0.237 (0.056)
1993	0.482* (0.232)	0.050 (0.003)	0.861* (0.741)
1994	0.692* (0.479)	0.456* (0.208)	0.887* (0.787)

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

7.24 through 7.29.

Table 7.24 displays the partial correlation coefficients between the KLSE Emas (All-share) Index (KLSEMAS) at time t and the SES All-share Index (SNGALLS) at time t - holding the KLSEMAS at time t-1 (i.e., lag 1) and the Dow Jones Composite 65 (DJCMP65) Index at time t-1 constant. Table 7.25 exhibits the partial correlation coefficients between the KLSEMAS at time t and the SNGALLS at time t - holding the KLSEMAS at time t-1 and the DJCMP65 at time t, constant.

Comparing Table 7.24 and Table 7.25 with Table 7.19, reveals that the $DJCMP65_{t-1}$ as well as the $DJCMP65_t$ (and the $KLSEMAS_{t-1}$) have some influence on the correlation between the $KLSEMAS_t$ and the $SNGALLS_t$. Nevertheless, it is clear that the interrelatedness of the KLSE and the SES is still very sound and substantial even with the absence of the 'New York factor'. For the daily data, as indicated by the coefficients of (partial) determination[43] in both Tables 7.24 and 7.25 - on the whole - about 40% of the movements on the KLSE could be explained by factors or influences common to the movements on the SES (when the 'New York factor' is held constant).

The partial correlation between the KLSE and the SES is further examined in Table 7.26. This time, the partial correlation between the $KLSEMAS_t$ and the $SNGALLS_t$ is examined by holding the $KLSEMAS_{t-1}$ and the Hang Seng Bank Index at time t ($HANGSENG_t$), constant. By comparing Table 7.26 with Tables 7.24 and 7.25, a conclusion can be drawn that the 'Hong Kong factor' is more influential than

[43]As discussed in Chapter Five, the *coefficient of determination* or also often referred to as r^2, is simply the square of the correlation coefficient. It indicates the percentage of common variance between the two markets (say, markets A and B). So, an r^2 of 0.10 or 10% for instance, may be interpreted as follows: Ten percent of price movements on market A are the results of influences common to the market B. See e.g. Walsh (1990); Solnik (1996).

Table 7.25
PARTIAL CORRELATION (log) OF THE $KLSEMAS_t$ AND THE $SNGALLS_t$ (Holding the $KLSEMAS_{t-1}$ and the $DJCMP65_t$ Constant): 1990 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1990-1994	0.646* (0.417)	0.330* (0.109)	0.761* (0.579)
1990	0.741* (0.549)	0.505* (0.255)	0.840* (0.706)
1991	0.681* (0.463)	0.407* (0.166)	0.778* (0.605)
1992	0.476* (0.227)	0.179 (0.032)	-0.156 (0.024)
1993	0.483* (0.233)	0.054 (0.003)	0.828* (0.686)
1994	0.690* (0.476)	0.466* (0.217)	0.703** (0.494)

NB:
*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

Table 7.26

PARTIAL CORRELATION (log) OF THE $KLSEMAS_t$ AND THE $SNGALLS_t$ (Holding the $KLSEMAS_{t-1}$ and the $HANGSENG_t$ Constant): 1990 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1990-1994	0.577* (0.333)	0.296* (0.088)	0.671* (0.450)
1990	0.649* (0.421)	0.210 (0.044)	0.437 (0.191)
1991	0.560* (0.314)	0.350** (0.123)	0.845* (0.714)
1992	0.453* (0.205)	0.222 (0.049)	0.114 (0.013)
1993	0.473* (0.224)	0.107 (0.011)	0.796* (0.634)
1994	0.575* (0.331)	0.476* (0.227)	0.796* (0.634)

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

the 'New York factor' in affecting price/returns movements on the KLSE (i.e., for the period of 1990 - 1994): If, without the 'New York factor' about 40% of price/returns movements on the KLSE are common to the KLSE and SES [see columns 2 of Tables 7.24 and Tables 7.25], with the absence of the 'Hong Kong factor' only about 33% (i.e., coefficient of determination) of the daily price/returns movements on the KLSE are determined by factors common to both the KLSE and the SES [see Table 7.26, column 2].

How influential factors common to the KLSE and the HKSE are in affecting price/returns movements on the KLSE are quantified in Table 7.27. With the absence of factors common to both Malaysian and Singaporean markets, only about 4% of the daily price/returns movements on the KLSE are identified as being determined factors common to the KLSE and the HKSE (i.e., during the period of 1990 - 1994).

For a longer period (i.e., 1984 - 1994), the influence of factors common to the KLSE and the HKSE, and the influence of factors common to the KLSE and the NYSE - respectively - are demonstrated in Table 7.28 and Table 7.29. Evidence provided by Table 7.28 [columns 2] denotes that about 8% of the daily price/returns movements on the KLSE could be explained by factors common to both the KLSE and the HKSE. Likewise, as manifested by Table 7.29 [column 1], when the 'Hong Kong factor' is held constant, daily movements on the KLSE still could be explained by about 8% of the factors common to the KLSE and NYSE (at time t-1).

Lastly, to recapitulate, the results of our empirical inspections on the behaviour of price/returns interrelationships between the KLSE and the SES, the KLSE and the HKSE, and the KLSE and the NYSE, could be generalised in the following:

(a) The SES is not only geographically the nearest foreign exchange to the

Table 7.27

PARTIAL CORRELATION (log) OF THE $KLSECOMP_t$ AND THE $HANGSENG_t$ (Holding the $KLSECOMP_{t-1}$ and the $SNGALLS_t$ Constant): 1990 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1990-1994	0.207* (0.043)	0.458* (0.210)	0.244 (0.060)
1990	0.199* (0.040)	0.739* (0.546)	0.549 (0.301)
1991	0.024 (0.00058)	-0.084 (0.0071)	0.053 (0.0028)
1992	0.070 (0.00049)	0.318** (0.101)	0.445 (0.198)
1993	0.017 (0.00029)	0.453* (0.205)	0.123 (0.015)
1994	0.302* (0.0912)	0.457* (0.209)	-0.111 (0.012)

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

Table 7.28

PARTIAL CORRELATION (log) OF THE $KLSECOMP_t$ AND THE $HANGSENG_t$ (Holding the $KLSECOMP_{t-1}$ and the $DJCMP65_{t-1}$ Constant): 1984 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1984-1994	0.288* (0.083)	0.373* (0.139)	0.552* (0.305)
1984	0.115 (0.013)	0.311** (0.097)	0.009 (0.000081)
1985	0.024 (0.000576)	0.222 (0.049)	-0.265 (0.069)
1986	0.162* (0.262)	0.049 (0.0024)	-0.480 (0.2304)
1987	0.334* (0.112)	0.371* (0.138)	0.889* (0.790)
1988	0.325* (0.106)	0.321** (0.103)	0.688** (0.473)
1989	0.428* (0.183)	0.619* (0.383)	0.323 (0.104)
1990	0.511* (0.261)	0.756* (0.572)	0.900* (0.810)
1991	0.462* (0.213)	-0.070 (0.005)	0.481 (0.231)
1992	0.255* (0.065)	0.329** (0.108)	0.511 (0.261)
1993	0.141** (0.020)	0.453* (0.205)	0.526 (0.277)
1994	0.553* (0.306)	0.437* (0.191)	0.746* (0.557)

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e.,two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

Table 7.29

PARTIAL CORRELATION (log) OF THE $KLSECOMP_t$ AND THE $DJCMP65_{t-1}$ (Holding the $KLCOMP_{t-1}$ and the $HANGSENG_t$ Constant): 1984 - 1994

YEAR	DAILY DATA	WEEKLY DATA	MONTHLY DATA
1984-1994	0.289* (0.084)	0.120* (0.014)	0.019 (0.0004)
1984	0.080 (0.006)	-0.224 (0.050)	0.085 (0.007)
1985	0.012 (0.0001)	-0.154 (0.050)	-0.421 (0.007)
1986	0.058 (0.003)	0.180 (0.032)	-0.740* (0.548)
1987	0.528* (0.279)	0.390* (0.152)	0.288 (0.083)
1988	0.335* (0.112)	0.042 (0.002)	-0.326 (0.106)
1989	0.418* (0.175)	0.301** (0.091)	0.091 (0.008)
1990	0.234* (0.055)	0.149 0.022)	-0.189 (0.036)
1991	0.193* (0.037)	0.156 (0.024)	0.268 (0.072)
1992	0.162* (0.026)	0.167 (0.028)	-0.551 (0.304)
1993	0.028 (0.0008)	0.050 (0.003)	-0.048 (0.002)
1994	-0.087 (0.008)	0.089 (0.008)	0.347 (0.120)

NB:

*Significantly different from zero at 1% level (i.e., two-tailed t-test).

**Significantly different from zero at 5% level (i.e., two-tailed t-test).

In the parentheses are coefficients of (partial) determination.

KLSE, but also the closest exchange to the KLSE in terms of the common factors affecting price movements. Expressed differently, the role of factors common to both the KLSE and the SES in impelling price/returns movements on the KLSE is relatively large.

(b) Factors common to the NYSE and the KLSE are as important as factors common to the HKSE and the KLSE in impelling movements on the KLSE.

(c) While the KLSE is moving contemporaneously together with the SES and the HKSE[44], to some extent and more often than not (as evidenced by Tables 7.13, 7.23 and 7.29) its movements are being led by the NYSE[45] (particularly beginning from 1987 - for the daily data)[46]. As noted earlier, a study by Cheung and Mark (1992) has documented that the U.S. market led most of the Asia-Pacific market during the period of 1978 through 1988.

7.3.3-Stock Market "Forecastability"

Early researchers found little evidence that stock prices and returns statistically and economically are forecastable [see Chapter Three].

Our investigation of the "forecastability" of stock prices and returns on an emerging market is motivated by a number of developments in recent literature:

(i) As reviewed in Chapters Four and Five, it has become almost a consensus among recent researchers that stock returns are statistically predictable.

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[44]Divecha *et.al* (1992) have also documented the same result.

[45]Cf. Eun and Shim (1989).

[46]A study by Ko and Lee (1991) indicates that the U.S. market leads the Asian markets, with the exception of Korea. Jeon and Von Furstenberg (1990) find that, since October 1987, the degree of international co-movement between international stock indices has increased.

(ii) In his paper, Harvey (1995) claims to have provided evidence that the emerging market returns are generally more predictable than the developed market returns.

(iii) In the forecasting literature (as highlighted in Chapter Six), it is widely advocated that the accuracy of forecasts could be improved by combining models; that "combining" is "the more pragmatic way of producing better forecasts"[47]. If combining is a more efficient approach to forecasting, then, employing this approach, could we improve the "forecastability" of stock returns?

Our empirical objective here is twofold: To investigate and assess how 'efficient' the Malaysian stock market is; to examine the capability of some procedures offered by the discipline of forecasting in predicting stock prices and returns.

A relatively new development in combining forecasts (or composite forecasting) is the *multi-process models* (or the Bayesian approach to combining forecasts). In trying to justify and assess the "forecastability" of an emerging market, as featured in Chapter Six, we are comparing the performance of three models. They are, the Steady Model (SM), the Linear Growth Model (LGM) or simply the Growth Model and the 'Combined' Model (or the multi-process models) which 'combines' the element of SM and LGM.

As noted in Sun-section 7.2.2, our tests of the "forecastability" of stock returns on the KLSE (employing the three aforementioned models) involve a sample of fifty individual companies. For the purpose of illustration - just to show how the three forecasting approaches 'perform' - we detail some of our results in Tables 7.30, 7.31

[47]Clive W.J.Granger, *International Journal of Forecasting*, Vol. 11, No. 4, December 1995, p. 587.

and 7.32. They are based on the daily data from three companies - the *Kuala Lumpur Kepong Bhd.*, the *Malaysian Airline system Bhd.* and the *Tanjong Plc*[48].

As specified in Chapter Six, the quality or the accuracy of forecasts here is assessed using four standard statistical measures of errors. They are, the sum of squared errors (SSE), the mean squared error (MSE) and the root mean squared error (RMSE).

For each of the Tables 7.30, 7.31 and 7.32, the forecasting errors at various time periods ahead (column six) - measured in terms of the SSE, MSE and RMSE - are listed in columns two, three and four. Column two exhibits the results from the 'Combined' method; whereas the results from the SM or the Exponentially Weighted Moving Average (EWMA) method and the LGM or the Exponentially Weighted Regression (EWR) method respectively, are displayed in columns three and four. [The forecasting formula for each of these models are given in Chapter Six].

Comparing these three columns for each of the three tables, reveals that the method of EWR does not produce 'accurate' or 'satisfactory' results [i.e., in most cases, it produces higher errors] compared with the ones produced by the EWMA and the 'Combined' method. Thus, we will concentrate on the performance of the EWMA and the 'Combined' method only[49] - to assess their potential capability of forecasting

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[48]We do not use any specific criterion in choosing these companies. Among the characteristics of these companies are as follows:

(i) The *Kuala Lumpur Kepong Bhd.* and the *Malaysian Airline System Bhd.* are the Malaysian incorporated companies, whereas the *Tanjong Plc.* is a U.K. incorporated company.

(ii) In terms of their industry classifications, the *Malaysian Airline System Bhd.* and the *Tanjong Plc.* are from the trading/services sector, whereas the *Kuala Lumpur Kepong Bhd.* is from the *plantation* sector.

[49]While factors related to implementation, such as ease of interpretation and ease of use are among the popular criteria used by researchers, practitioners, educators and decision-makers in selecting forecasting methods, a study by Yokum and Armstrong (1995) documented that research in forecasting has commonly assumed that accuracy is the primary criterion in selecting among forecasting techniques. "In fact, it has been used as the *sole* criterion in many studies. In the sixteen 1992 *International Journal of Forecasting* papers that compared the results of different techniques and series, only one used criteria other than accuracy"

Table 7.30

THE *KUALA LUMPUR KEPONG BHD* SHARE:
RESULTS OF FORECASTS FOR THE DAILY RETURNS
(Using the EWMA, EWR and the 'Combined' Methods)

MEASURE OF ERROR	COMBINED METHOD (CM)	EWMA	EWR (GROWTH)	CM/EWMA (i.e. for the MSE)	NUMBER OF PERIODS AHEAD
SSE	0.786131	0.780525	1.053113		
MSE	0.000590	0.000586	0.000790	1.00718	1
RMSE	0.024285	0.024198	0.028108		
SSE	1.550368	1.530647	1.973898		
MSE	0.001164	0.001149	0.001482	1.012884	2
RMSE	0.034117	0.033899	0.038496		
SSE	2.271949	2.229149	3.014577		
MSE	0.001707	0.001675	0.002265	1.0192	3
RMSE	0.041315	0.040924	0.047591		
SSE	3.780421	3.654818	5.584467		
MSE	0.002845	0.002750	0.004202	1.034366	5
RMSE	0.053334	0.052441	0.064823		
SSE	7.690439	7.136348	14.64108		
MSE	0.005808	0.005390	0.011058	1.077644	10
RMSE	0.076213	0.073417	0.105158		
SSE	10.81245	9.697173	24.81569		
MSE	0.008197	0.007352	0.018814	1.115011	15
RMSE	0.090540	0.085743	0.137164		
SSE	21.56970	18.26273	77.05193		
MSE	0.016541	0.014005	0.059089	1.181078	30
RMSE	0.128613	0.118343	0.243082		
SSE	43.89321	33.16027	261.2066		
MSE	0.034453	0.026028	0.205029	1.323669	60
RMSE	0.185615	0.161333	0.452801		

stock price and returns.

As indicated in columns two and four for each of the Tables 7.30, 7.31 and 7.32, the results produced by the 'Combined' method and the EWMA method do not appear to be much different. Accordingly, to compare the performance of these two approaches, we divide the MSE for the 'Combined' method by the MSE for the EWMA method. The results of this division which could be termed as the *comparative mean square error (CMSE)* of forecasts, are displayed in column five for each of the three tables.

A CMSE equal to 1.00 would imply that the accuracy of forecasts for the two methods are the same. The MSE for the 'Combined' method is higher than the MSE for the EWMA method when the CMSE is greater than one. By the same token, a CMSE of less than one would mean that the 'Combined' method produces a more accurate forecast than the EWMA procedure.

On examining column five for each of the three tables, one can readily discover that, except for Table 7.32, the CMSE values are greater than one for all time periods ahead. The CMSE values of slightly less than one can be found in Table 7.32 (for the *Tanjong Plc.*) - for the forecasting periods of thirty and sixty days ahead.

The CMSE values (at selected forecasting periods ahead) for all the fifty stocks in the sample are illustrated in the form of histograms depicted in Figures 7.6 through 7.13. Upon reviewing these charts, one would infer that the 'Combined' method could contribute some improvements in the accuracy of forecasts (i.e., CMSE < 1).

Particularly for long horizons, the accuracy of forecasts is slightly improved when the 'Combined' (multi-process models) method is employed. As evidenced by

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(p.591).

Table 7.31

THE *MALAYSIAN AIRLINE SYSTEM BHD* SHARE: RESULTS OF FORECASTS FOR THE DAILY RETURNS (Using the EWMA, EWR and the 'Combined' Methods)

MEASURE OF ERROR	COMBINED METHOD (CM)	EWMA	EWR (GROWTH)	CM/EWMA (i.e. for the MSE)	NUMBER OF PERIODS AHEAD
SSE	0.682144	0.673910	0.924483		
MSE	0.000538	0.000531	0.000729	1.012218	1
RMSE	0.023194	0.023054	0.027002		
SSE	1.392810	1.372993	1.756060		
MSE	0.001099	0.001084	0.001386	1.014433	2
RMSE	0.033156	0.032919	0.037229		
SSE	2.095739	2.062759	2.680069		
MSE	0.001655	0.001629	0.002117	1.015988	3
RMSE	0.040687	0.040365	0.046010		
SSE	3.377424	3.297483	4.754320		
MSE	0.002672	0.002609	0.003761	1.024243	5
RMSE	0.051691	0.051076	0.061330		
SSE	6.966001	6.638387	12.74424		
MSE	0.003553	0.005273	0.010123	1.049352	10
RMSE	0.074384	0.072614	0.100611		
SSE	10.60068	9.961226	24.18567		
MSE	0.008453	0.007944	0.019287	1.064195	15
RMSE	0.091943	0.089127	0.138870		
SSE	20.22725	18.71844	63.63021		
MSE	0.016325	0.015108	0.051356	1.080605	30
RMSE	0.127771	0.122913	0.226619		
SSE	49.63084	43.13244	239.7707		
MSE	0.041051	0.035676	0.198322	1.150662	60
RMSE	0.202611	0.188881	0.445333		

Table 7.32

THE *TANJONG PLC* SHARE:
RESULTS OF FORECASTS FOR THE DAILY RETURNS
(Using the EWMA, EWR and the 'Combined' Methods)

MEASURE OF ERROR	COMBINED METHOD (CM)	EWMA	EWR (GROWTH)	CM/EWMA (i.e. for the MSE)	NUMBER OF PERIODS AHEAD
SSE	0.591933	0.589370	0.743999		
MSE	0.0007158	0.0007127	0.0008996	1.00435	1
RMSE	0.026754	0.026696	0.029994		
SSE	1.149314	1.144339	1.358470		
MSE	0.0013914	0.0013854	0.0016446	1.004347	2
RMSE	0.037302	0.037221	0.040554		
SSE	1.694859	1.688882	2.010694		
MSE	0.0020544	0.0020471	0.0024372	1.003539	3
RMSE	0.045325	0.045245	0.049368		
SSE	2.675384	2.652722	3.438324		
MSE	0.0032508	0.0032232	0.0041778	1.008543	5
RMSE	0.057016	0.026774	0.064636		
SSE	5.740855	5.704578	9.066570		
MSE	0.0070182	0.0069738	0.0110838	1.006359	10
RMSE	0.083774	0.083509	0.1052798		
SSE	9.341795	9.334217	17.54959		
MSE	0.0114905	0.0114812	0.0215862	1.000812	15
RMSE	0.107194	0.107150	0.146923		
SSE	20.30032	20.58217	51.95487		
MSE	0.025439	0.0257922	0.0651064	0.986306	30
RMSE	0.159496	0.160600	0.255160		
SSE	46.08205	47.38743	180.8190		
MSE	0.0600027	0.0617024	0.0235441	0.972453	60
RMSE	0.244954	0.248400	0.485223		

Figure 7.11 (for thirty days ahead) and figure 7.12 (for sixty days ahead), about 7% of the fifty stocks in our sample are "forecastable" (i.e., CMSE < 1).

Nonetheless, under the null hypothesis that the 'Combined' model does not improve the forecasts obtainable from the Steady (EWMA) Model, we would expect half the forecasts based on the 'Combined' model to be worse than the corresponding tests using the Steady Model and only half to be better. In fact, we find that no more than seven percent of the forecasts based on the 'Combined' model are an improvement (i.e., CMSE < 1) on the forecasts based on the Steady Model. As such, this result is consistent with the random walk hypothesis.

We proceed with our study on stock market "forecastability" by examining how "forecastable" the KLSE is, compared with other exchanges. To conduct this aspect of study, the daily and weekly share price indices from the KLSE, NYSE, LSE and the HKSE are employed. These data are transformed into logarithms of returns [see equation 7.1]. Using the same methodology as discussed above, the results are displayed in Table 7.33.

Quite similar to the results based on cumulative logarithms of returns (for fifty individual companies from the KLSE), the 'Combined' method also fails to show much improvements in stock market "forecastability" with market index data from the KLSE, NYSE, LSE and the HKSE [as can be seen Table 7.33]. The KLSE seems to be "forecastable" (i.e., the CMSE < 1) only for a horizon of five weeks ahead (i.e based on weekly data). The LSE appears to be "forecastable" only when the prices are forecasted three days, five days and sixty weeks ahead. Likewise, the HKSE appears to be "forecastable" when its prices are forecasted sixty weeks ahead. These five cases of apparent improvement in "forecastability" have to be weighed against the remaining

Figure 7.6

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS: One Day Ahead

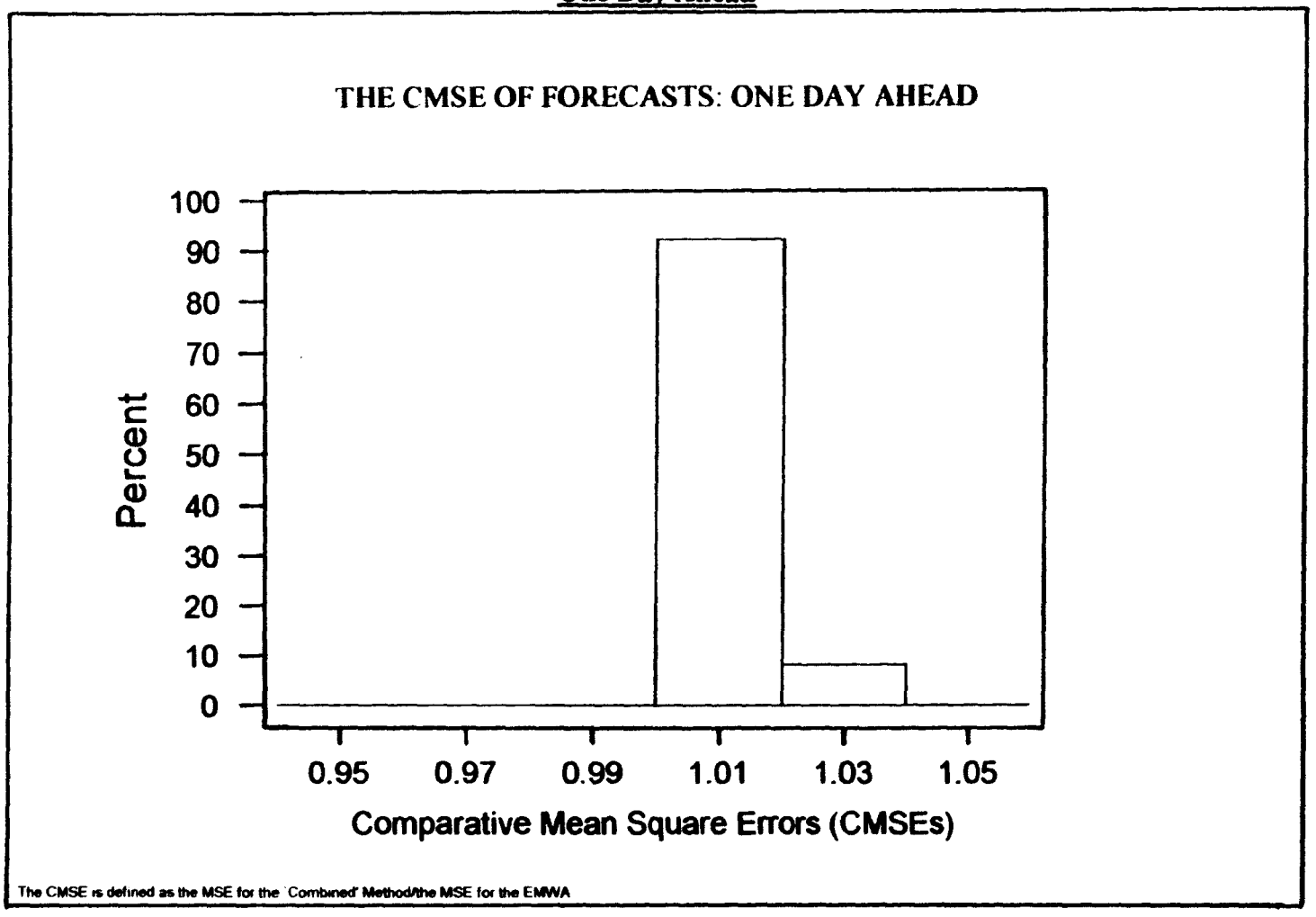


Figure 7.7

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS: Three Days Ahead

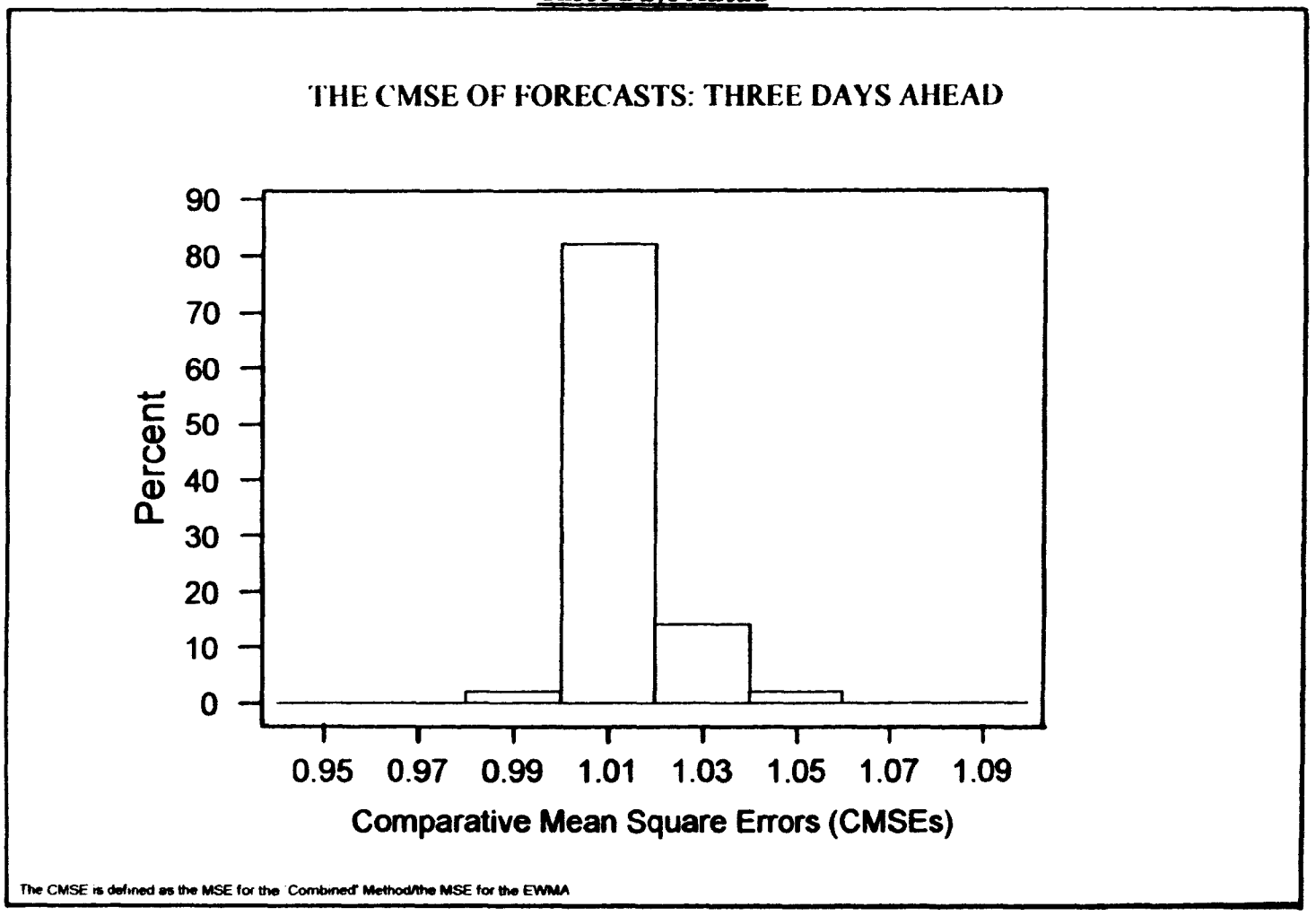


Figure 7.8

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS:
Five Days Ahead

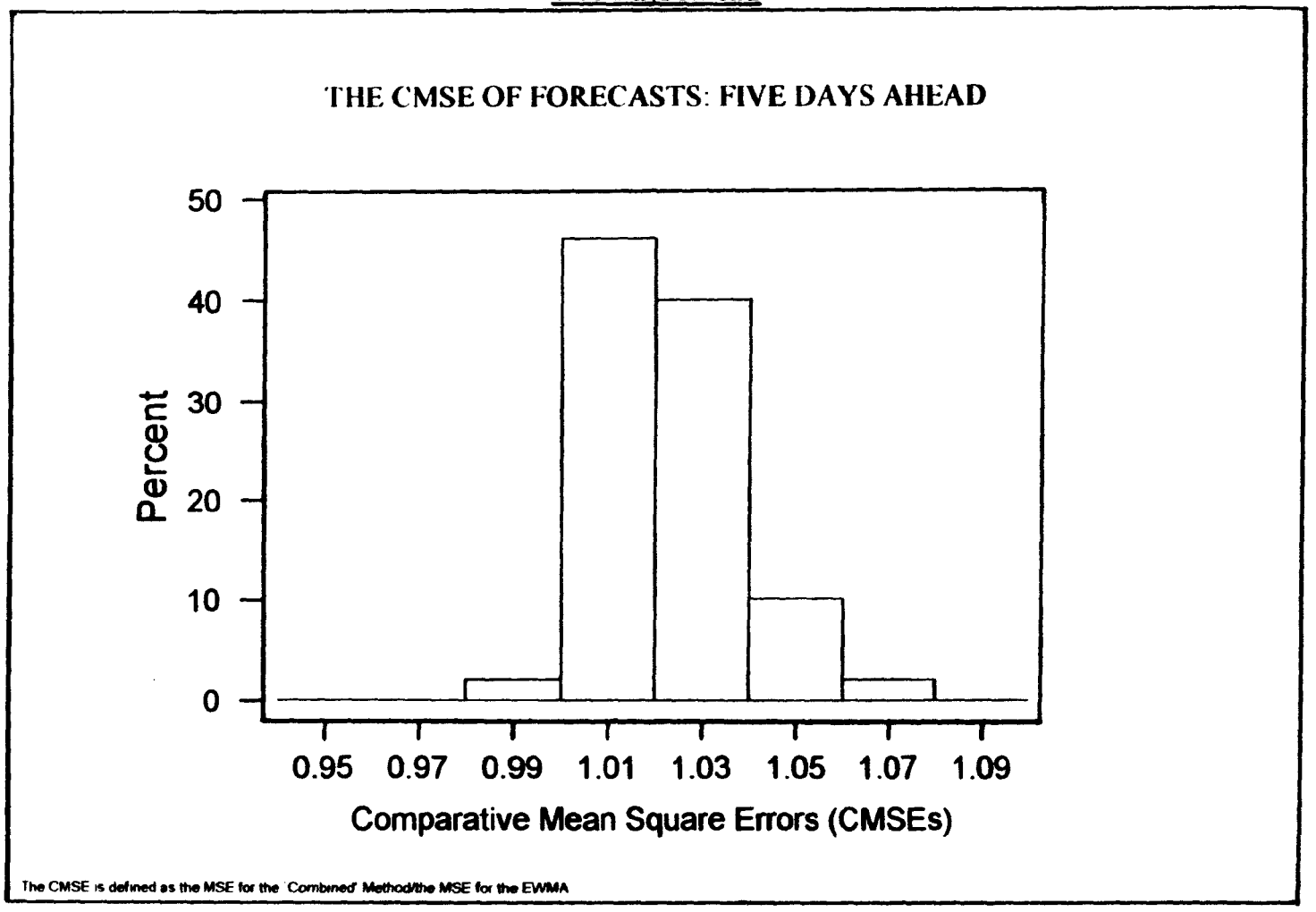


Figure 7.9

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS: Ten Days Ahead

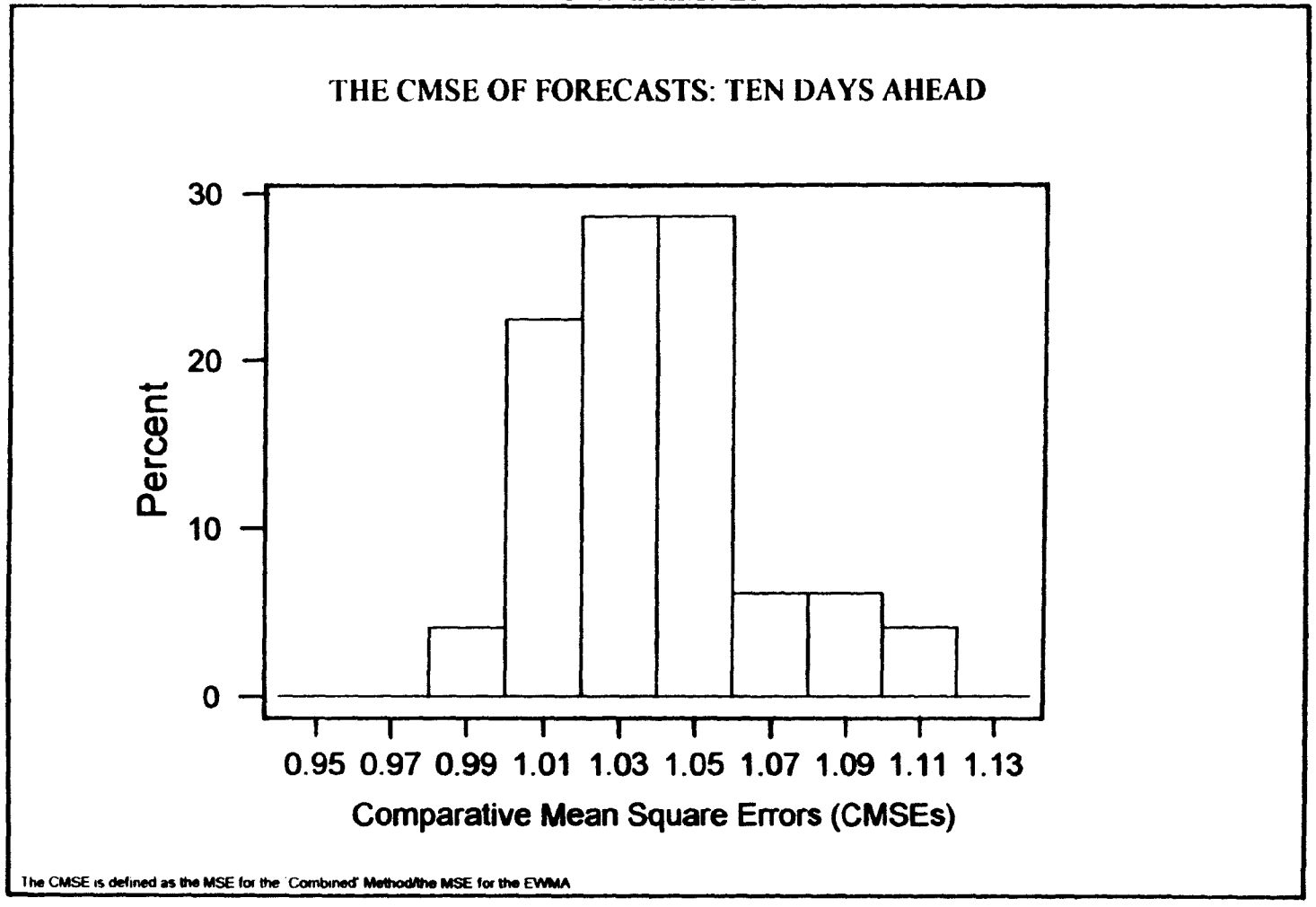


Figure 7.10

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS: Fifteen Days Ahead

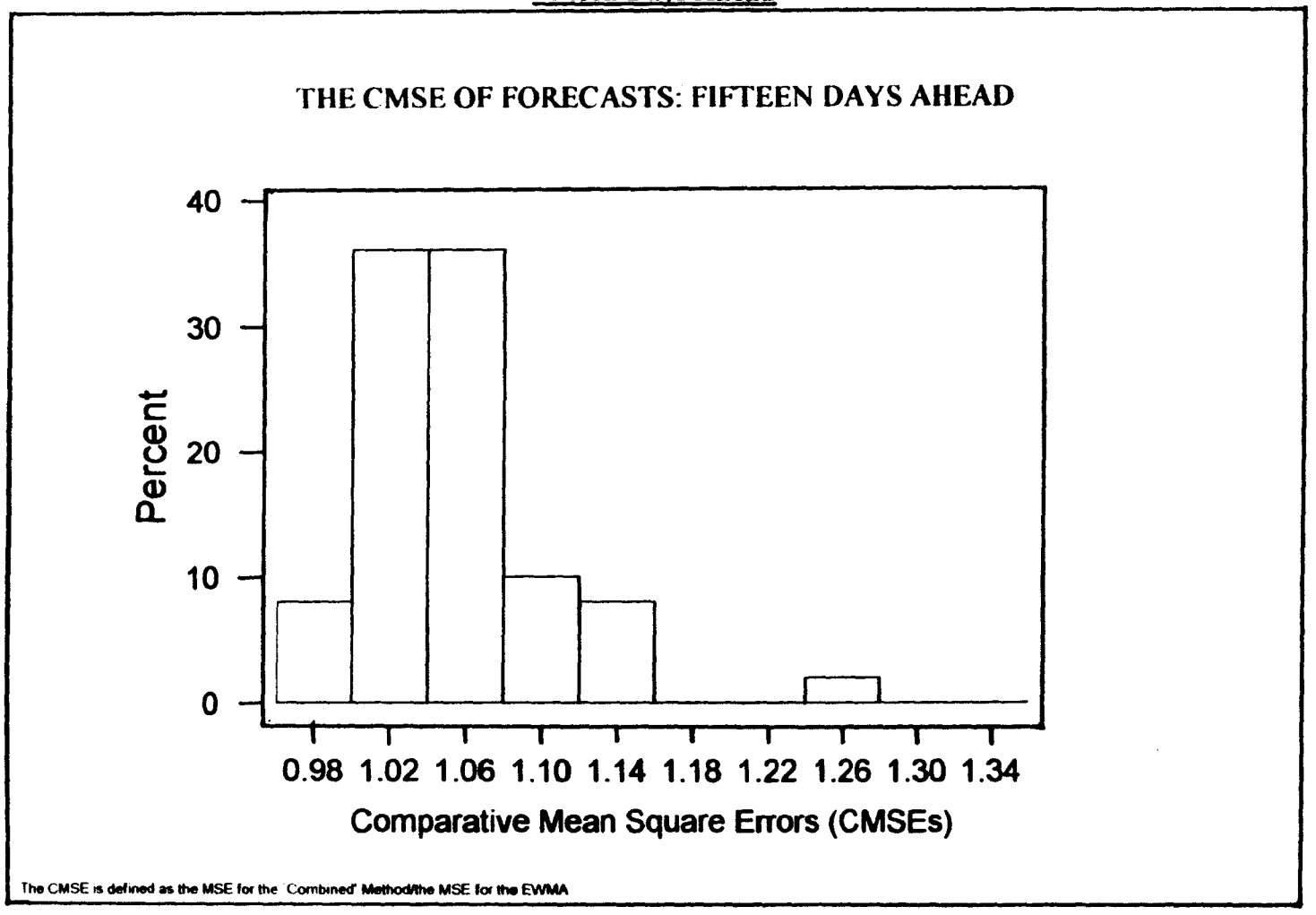


Figure 7.11

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS: Thirty Days Ahead

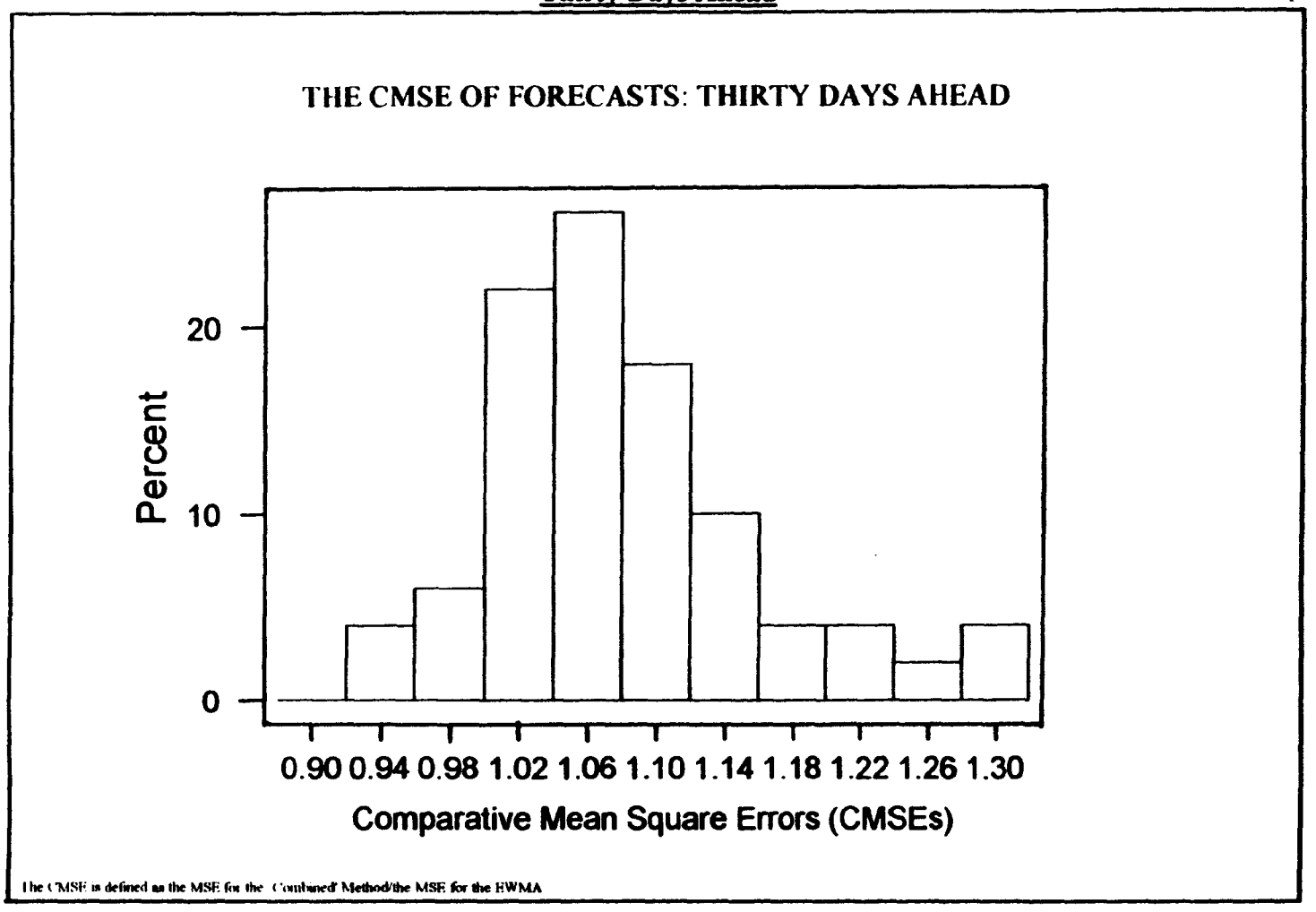
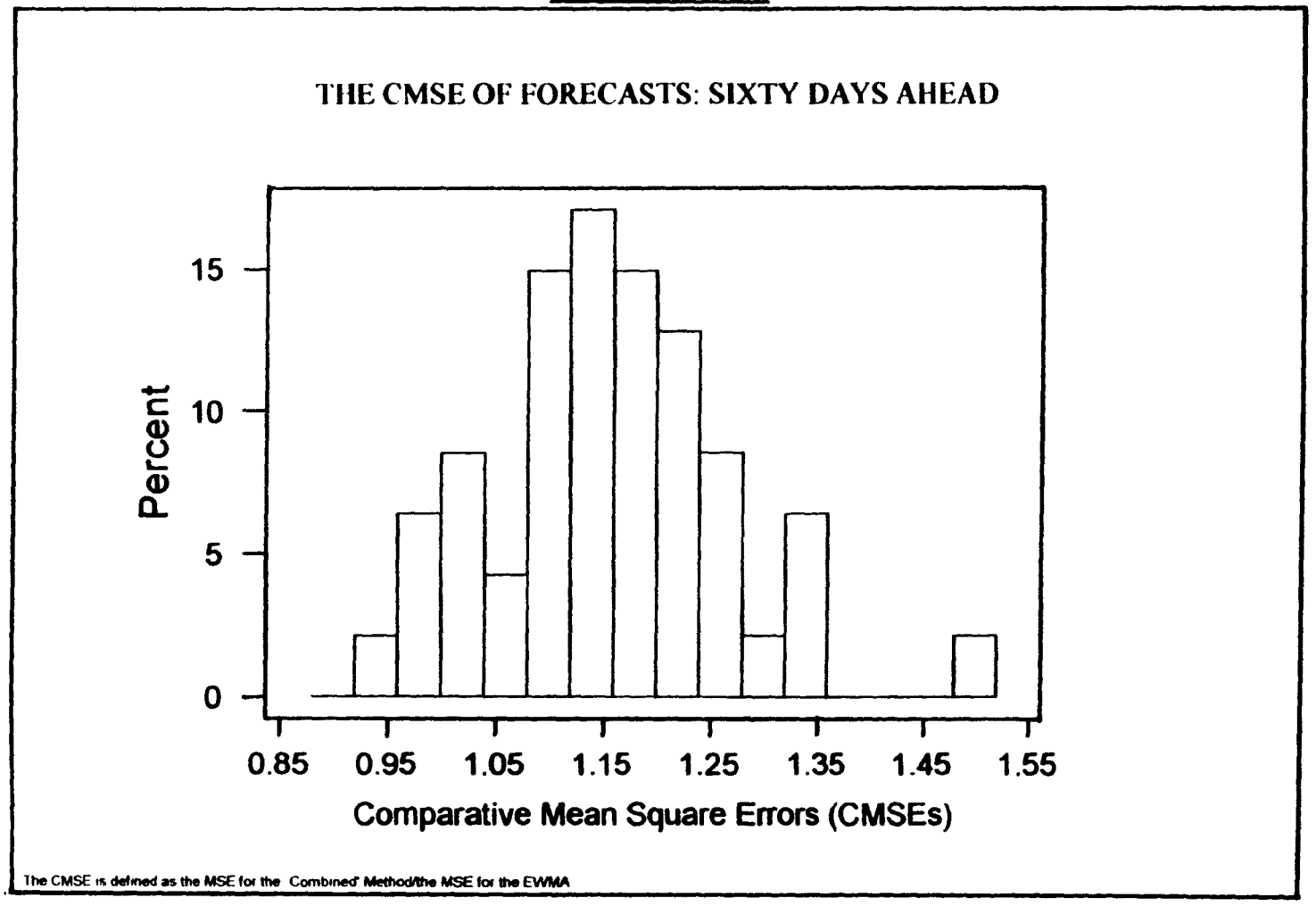


Figure 7.12

THE COMPARATIVE MEAN SQUARE ERROR OF FORECASTS:
Sixty Days Ahead



51 cases in the table in which the "forecastability" appears to be reduced when the 'Combined' (or the multi-process models) method is employed.

To conclude, the findings of our empirical investigations into the "forecastability" of stock prices/returns, could be interpreted as follows:

(i) Relatively few stocks listed on the KLSE appears to be "forecastable". Those few cases in which the forecastability of a stock appears to have improved may be the result of chance relationships rather than power of the 'Combined' method to make better forecasts.

(ii) In terms of "forecastability", we have no evidence that the KLSE is any less efficient than the LSE and the HKSE[50].

Results of our out-of-sample forecasts support the statements made by Makridakis (1986) and Granger(1992) as quoted in Chapter Five that forecasting stock market in a meaningful way is a very difficult manoeuvre. Clive W.J.Granger, "one of the most successful and influential time series analysts and econometricians of our time"[51] who, in 1970, co-authored (with Oskar Morgenstern) a book entitled *Predictability of Stock Market Prices*, was recently interviewed by the *International Journal of Forecasting* (Vol. 11, No. 4, December 1995). Responding to a question asking him whether he still held the same view on the predictability of the stock market prices and whether he has got any new insights from developments after 1970,

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[50]Probably we could relate this to the fact that the KLSE is a relatively big stock exchange in the developing world. As listed in Table 2.7, in 1993 the KLSE was the ninth largest stock market in the world (in terms of market capitalisation and value traded). According to Solnik (1966, p. 281), Malaysia and Mexico are classified as developed markets by some institutions.

A study by Kumar and Tsetsekos (1994) has found that some emerging markets - Greece, Korea, Malaysia and Mexico - have activity, size and pricing characteristics approaching those of developed markets.

[51]*International Journal of Forecasting*, Vol. 11, No. 4, December 1995, p. 285.

Table 7.33
THE KLSE, NYSE, LSE AND THE HKSE: THE COMPARATIVE MSE (CMSE) OF FORECASTS FOR THE LOGARITHMS OF THE DAILY/WEEKLY RELATIVE PRICE INDICES*

KLSE		NYSE		LSE		HKSE	NUMBER OF PERIODS AHEAD [Days (Weeks)]
KLSEMAS	KLSECOMP	NYSEALL	DJCMP65	FTALLSH	FTSE100	HANGSENG	
1.02859 (1.01816)	1.02511 (1.03299)	1.01556 (1.00587)	1.01544 (1.00914)	1.01671 (1.01920)	1.01551 (1.01510)	1.01958 (1.01879)	1
1.02623 (1.00845)	1.02516 (1.02071)	1.01136 (1.02392)	1.01028 (1.01757)	1.00215 (1.01682)	1.00614 (1.0142)	1.01386 (1.01317)	2
1.02763 (1.00124)	1.02544 (1.00461)	1.01052 (1.02883)	1.00988 (1.02284)	0.99871 (1.01766)	1.00510 (1.016221)	1.02842 (1.01166)	3
1.043127 (0.995193)	1.03633 (0.99787)	1.01939 (1.03957)	1.01651 (1.03037)	0.99960 (1.02615)	1.00866 (1.02746)	1.035912 (1.00742)	5
1.07594 (1.00347)	1.05702 (1.06480)	1.02866 (1.04155)	1.02243 (1.05982)	1.00036 (1.04443)	1.01324 (1.04486)	1.06654 (1.02220)	10
1.08358 (1.03870)	1.06044 (1.15693)	1.03198 (1.01903)	1.02487 (1.05127)	1.01677 (1.04340)	1.02604 (1.04376)	1.11469 (1.04535)	15
1.09828 (1.10577)	1.06131 (1.40863)	1.07674 (1.06451)	1.07399 (1.09368)	1.08437 (1.06637)	1.07759 (1.06502)	1.36967 (1.07434)	30
1.19892 (1.00151)	1.14260 (1.06086)	1.15520 (1.04696)	1.13161 (1.16374)	1.42922 (1.05615)	1.36401 (0.167763)	1.79753 (0.97818)	60

*Here, the comparative mean square error (CMSE) of forecasts is defined as the mean square error (MSE) for the 'Combined' method divided by the MSE for the EWMA method.

The natural logarithm (ln) of relative price indices (LRPI) is defined as:

LRPI = ln (I_t/I_0), where I_t is the current price index and I_0 is the first price index of the series.

In the parentheses are the results for the weekly data.

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Granger was reported to have made the following remarks:

> "I basically hold the same view as then. I don't think there is much forecastability in means. What forecastability there is can be found in volatility, as we now know. I think many of the lessons in the book have been rediscovered" (p. 586).

The EWMA method - the underlying assumption of which is the random walk in stock price/returns (when the smoothing coefficient is equal to 1.00)[52] - could be viewed as representing the conventional forecasting technique. The 'Combined' (or the multi-process models) method, as discussed in Chapter Six, is a relatively new methodology in the discipline of forecasting. Our forecasting results employing the 'Combined' method do not provide support for the claim based on recent findings that stock markets are somewhat "forecastable" [see Chapter Four]. Perhaps, this might be explained by the fact that most evidence for the claim that stock markets are "forecastable" are the results of in-sample forecasts, whereas our tests are based on out-of-sample approach.

As noted in Chapter Six, forecasting stock returns from an out-of-sample perspective in still not widely practised in the literature. As such, it difficult to compare our results with the results of such previous studies. Our review of the literature indicates that so far, there are only two published works [by Fuller and Kling (1990, 1994)] which deal with stock market forecasting from an out-of-sample approach. Fuller and Kling (1990, p. 35) for example reexamined the forecasting power of Fama and French's (1988a) "dividend yield model", and concluded that:

> "Given the model's erratic results, it is not clear that investors would have

[52]See Chapters Five and Six.

been able to identify its predictive ability and then capitalize on it to earn abnormal returns. Most investors do not have a fifty-one-year time horizons"

7.3.4-Mean Reversion and/or Mean Aversion in Stock returns?

Similar to the evidence provided by Fuller and Kling's (1990, 1994) out-of-sample tests, results of our out-of-sample tests do not suggest that stock markets are forecastable: The "forecastability" of stock returns cannot be improved even when a relatively newly developed forecasting technique known as the Bayesian approach to the combination of forecast (the multi-process models method) is employed.

Given the evidence that the multi-process models (or the 'Combined') method is not powerful enough to improve the "forecastability" of stock returns, we proceed with our empirical study by examining the possibility of mean reversive/mean aversive behaviour of stock returns on the KLSE, from a forecasting perspective (i.e., using the EWMA). The finding of this study might be useful for investors in selecting stocks to construct long term portfolios: Stocks which are mean reversive in their returns would be less risky in terms of the variability of their returns. Stocks which exhibit mean aversion in their returns could be viewed as more risky, because their returns are relatively more volatile.

Using the same data as the ones employed in the previous sub-section, we calculate variance ratios of the returns (at various horizons) for each of the fifty individual stocks in the sample. A variance ratio of less than one would imply a tendency for mean reversion, whereas a variance ratio of greater than one would indicate that the stock tends to be mean aversive [see Chapters Four and Five].

Tables 7.34, 7.35 and 7.36 respectively, exhibits (for the purpose of

illustration) the results for three individual companies; namely, the *Kuala Lumpur Kepong Bhd.* (KLK), the *Malaysian Airline System Bhd.* (MAS) and the *Tanjong Plc.* (TP). Referring to Table 7.34 for example, column one shows the horizon (k) or number of forecasting period (days) ahead. Column two lists the mean square errors (MSEs) from the forecasts - or variance - at various time periods ahead.

Forecasting errors are obtained from our forecasting process using equation 6.22. These errors are then squared and divided by the number of data points, n - to get the MSEs. [See equation 6.34].

Column three of Table 7.34 - ratio - is obtained by dividing the MSE at a particular time period ahead by the MSE for one period ahead. For example, the ratio for k = 3 (which is 2.870) is obtained by dividing 0.0017 by 0.0006. Column four (ratio/k) lists the variance ratios.

As can be seen from Tables 7.34, 7.35 and 7.36, KLK appears to exhibit mean reversion, while the returns for the MAS and the TP appear to be mean aversive.

The findings of our variance ratio tests for all of the fifty stocks in the sample are condensed into a number of histograms. These histograms, each of which represents the results for different horizons, are displayed in Figures 7.13 through 7.20. Observing these diagrams reveals that, over long horizons, some stocks are mean reversive, some are clearly mean aversive, while the rest appear to follow a random walk.

It is worth noting that some stocks exhibit a tendency to be mean reversive (i.e., variance ratio < 1), while others exhibit a tendency to be mean aversive (i.e., variance ratio > 1) - even for short horizons [see Figure 7.13]. However, clear evidence of mean reversion/mean aversion in stock returns can be found for periods

Table 7.34

THE *KUALA LUMPUR KEPONG BHD* SHARE:
VARIANCE RATIOS FOR THE DAILY RETURNS

HORIZON (Number of Days):K	MEAN SQUARE ERROR	RATIO	RATIO/K
1	0.0006	1.000	1.000
2	0.0011	1.973	0.986
3	0.0017	2.870	0.957
4	0.0022	3.771	0.943
5	0.0027	4.686	0.937
7	0.0038	6.504	0.929
10	0.0054	9.205	0.921
15	0.0073	12.612	0.841*
20	0.0097	16.630	0.831*
30	0.0139	23.959	0.799*
60	0.0187	45.472	0.758*
90	0.0277	67.280	0.748*
120	0.0338	82.318	0.686*
150	0.0363	88.258	0.588*
180	0.0412	100.158	0.556*
210	0.0571	138.944	0.662*
240	0.0769	186.995	0.779*
270	0.0943	229.403	0.850*
300	0.1022	248.682	0.829*

NB:
*Statistically significant at 5% level (using the F-test)

Table 7.35

THE *MALAYSIAN AIRLINE SYSTEM BHD* SHARE: VARIANCE RATIOS FOR THE DAILY RETURNS

HORIZON (Number of Days):K	MEAN SQUARE ERROR	RATIO	RATIO/K
1	0.0005	1.000	1.000
2	0.0011	2.047	1.023
3	0.0016	3.086	1.029
4	0.0021	4.016	1.004
5	0.0026	4.926	0.985
7	0.0036	6.780	0.969
10	0.0052	9.901	0.990
15	0.0079	14.906	0.994
20	0.0100	19.043	0.952
30	0.0150	28.487	0.950
60	0.0347	85.490	1.425*
90	0.0553	136.106	1.512*
120	0.0689	169.541	1.413*
150	0.0840	206.857	1.379*
180	0.0999	245.987	1.367*
210	0.1148	282.539	1.345*
240	0.1234	303.697	1.265*
270	0.1218	299.761	1.110*
300	0.1139	280.252	0.934

NB:
*Statistically significant at 5% level (using the Ftest).

Table 7.36
THE *TANJONG PLC* SHARE: VARIANCE RATIOS FOR THE DAILY RETURNS

HORIZON (Number of Days) :K	MEAN SQUARE ERROR	RATIO	RATIO/K
1	0.0007	1.000	1.000
2	0.0014	1.958	0.979
3	0.0021	2.898	0.966
4	0.0027	3.659	0.915
5	0.0033	4.495	0.899
7	0.0046	6.391	0.913
10	0.0070	9.610	0.961
15	0.0114	15.738	1.049
20	0.0162	22.218	1.111
30	0.0265	36.504	1.217*
60	0.0642	90.841	1.514*
90	0.1187	168.048	1.867*
120	0.1756	248.605	2.072*
150	0.2416	342.040	2.280*
180	0.3016	427.014	2.372*
210	0.3710	525.364	2.502*
240	0.4441	628.828	2.620*
270	0.5039	713.574	2.643*
300	0.5151	729.430	2.431*

NB:
*Statistically significant at 5% level (using the F-test).

of thirty days and above [see Figures 7.15 through 7.20]. As such, our results align with the results of previous researches [see Chapter Four] that mean reversion/mean aversion in stock returns are long-term phenomena.

Evidence of negative serial correlation (mean reversion) for monthly and annual returns have been found in studies, inter alios by Poterba and Summers (1987) and Fama and French (1988a). French and Roll (1986) and Lo and MacKinlay (1988) found evidence of negative serial correlation for daily and weekly data of individual companies. Lo (1991) and Mills (1993) to name a few, provide evidence of the tendency for stock returns to be positively serially correlated (mean aversive).

One serious issue raised in the literature concerning the variance ratio test is overlapping observations [see e.g., Richardson and Stock (1989); Jog and Schaller (1991)]. To examine the seriousness of this problem, we split up our data - each into twenty data points - and implement a forecasting procedure which 'jumps' every twenty data points. The results based on the samples of 'twenty data points' (i.e., "without overlapping") and the larger sample size (i.e., the ones "with overlapping") are found to be not much different: Even though the distribution of the values of the ratio appears to be different, stocks which are mean reversive/mean aversive in the sample with overlapping observations are also mean reversive/mean aversive in the sample without overlapping observation.

For the purpose of illustration (and comparison), the results for a horizon of twenty days ahead for the data "with overlapping observations" and the data "without overlapping observation" are summarised in Figures 7.19 and 7.20, respectively. Table 7.37 lists all the stocks which are found to exhibit mean reversion and/or mean aversion over long horizons.

Figure 7.13

STOCK RETURNS AND VARIANCE RATIOS

Horizon: Five Days

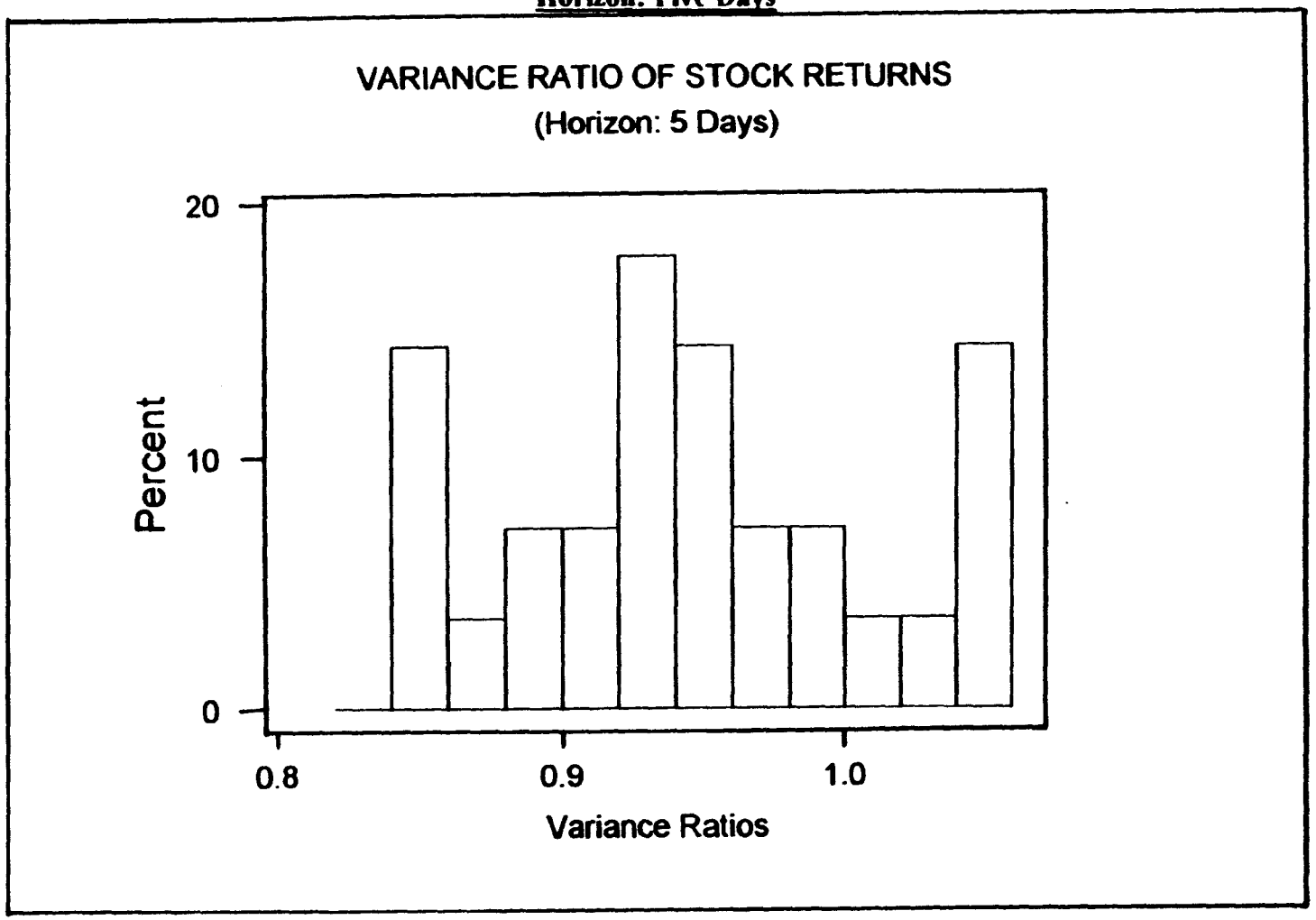

Figure 7.14

STOCK RETURNS AND VARIANCE RATIOS

Horizon: Fifteen Days

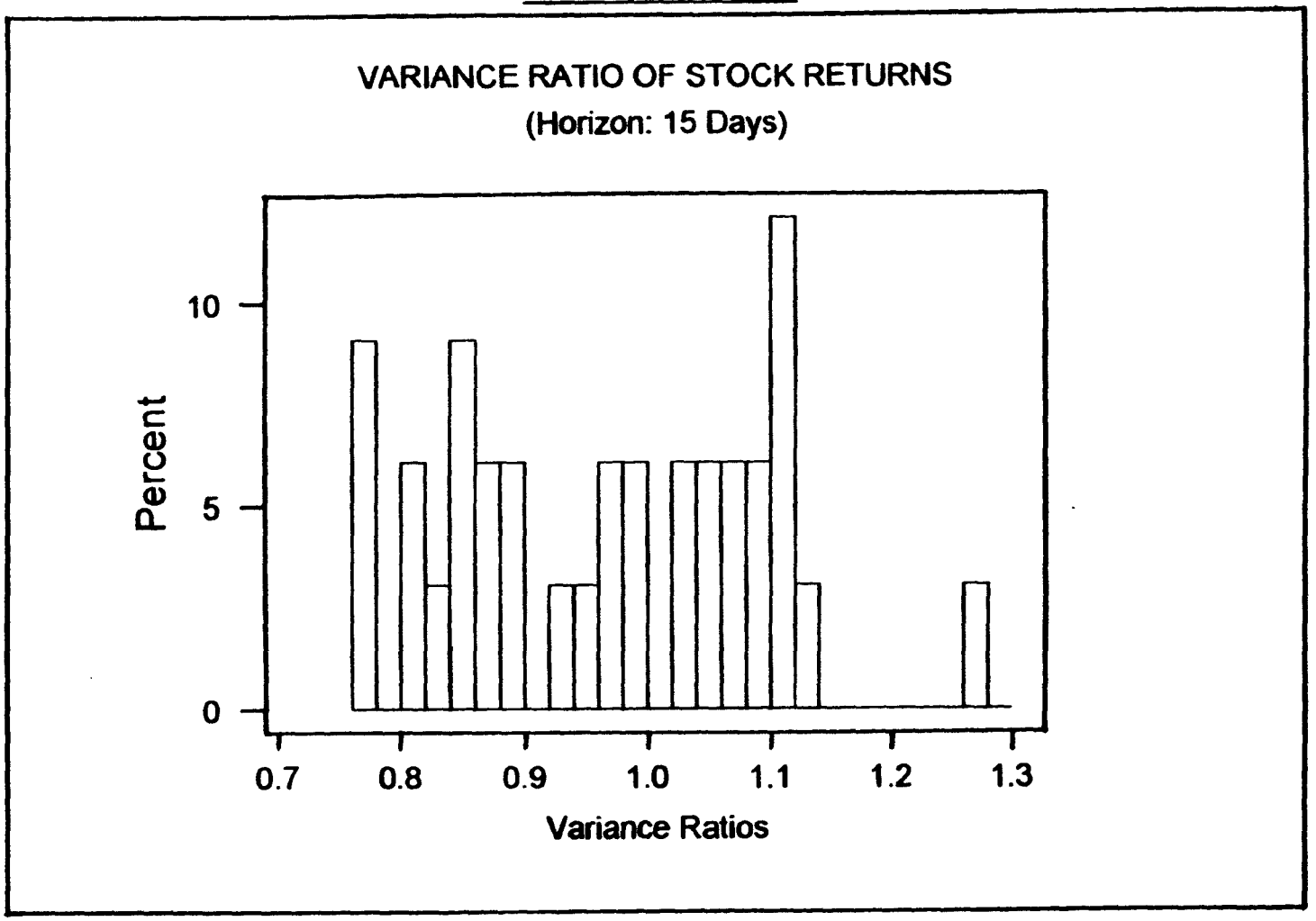

Figure 7.15

STOCK RETURNS AND VARIANCE RATIOS

Horizon; Thirty Days

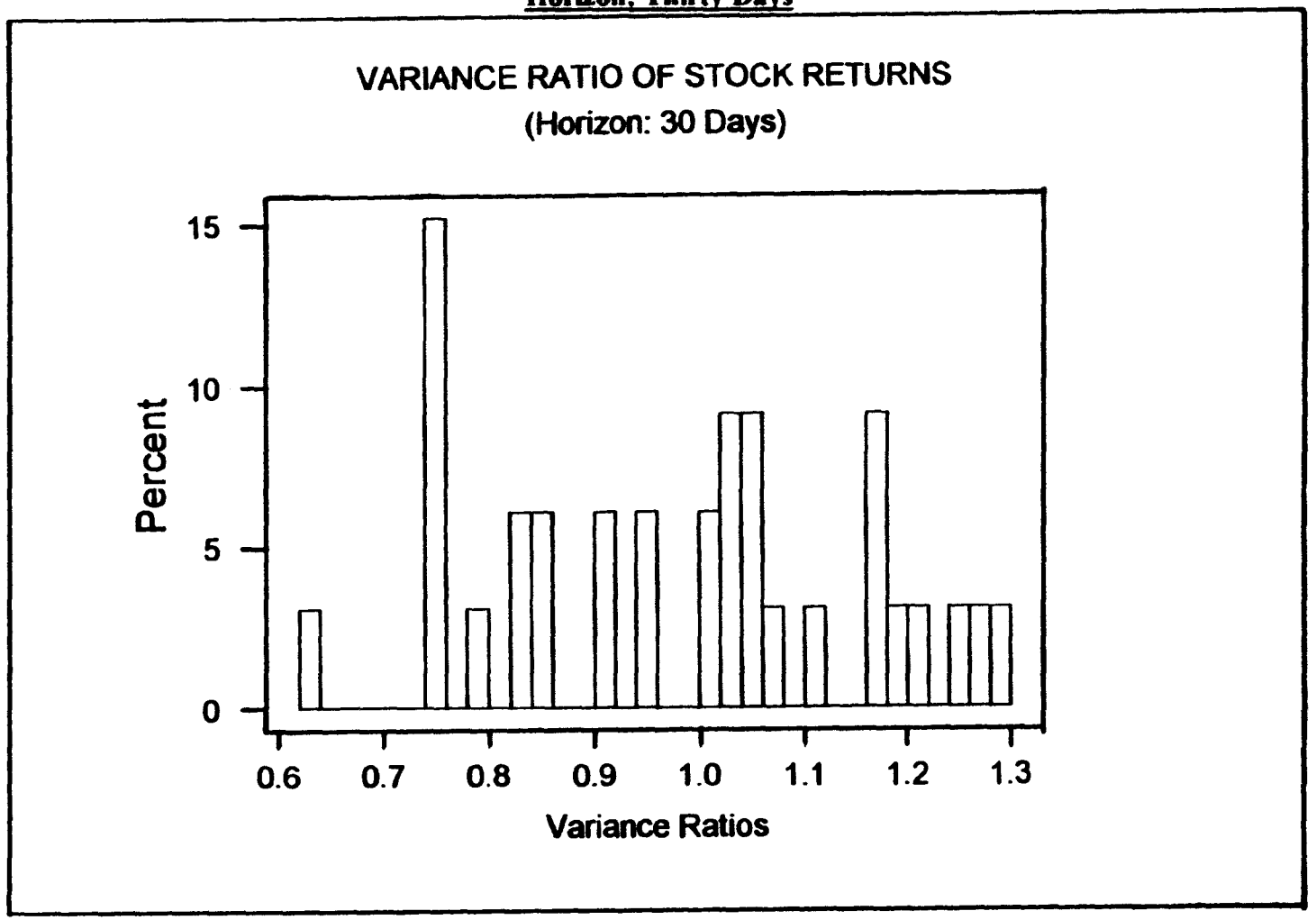

Figure 7.16

STOCK RETURNS AND VARIANCE RATIOS

Horizon: Sixty Days

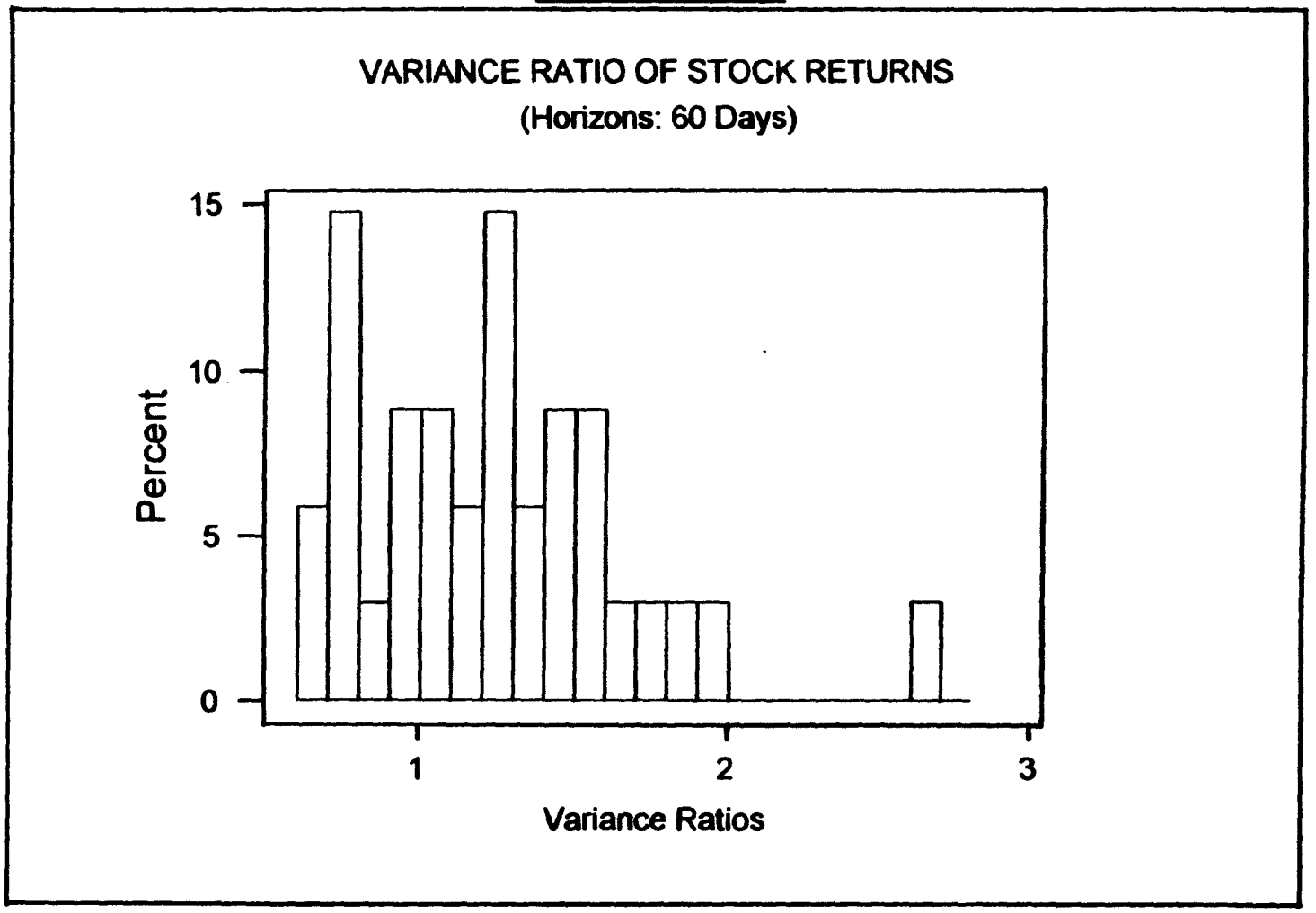

Figure 7.17

STOCK RETURNS AND VARIANCE RATIOS

Horizon: One Hundred and Eighty Days

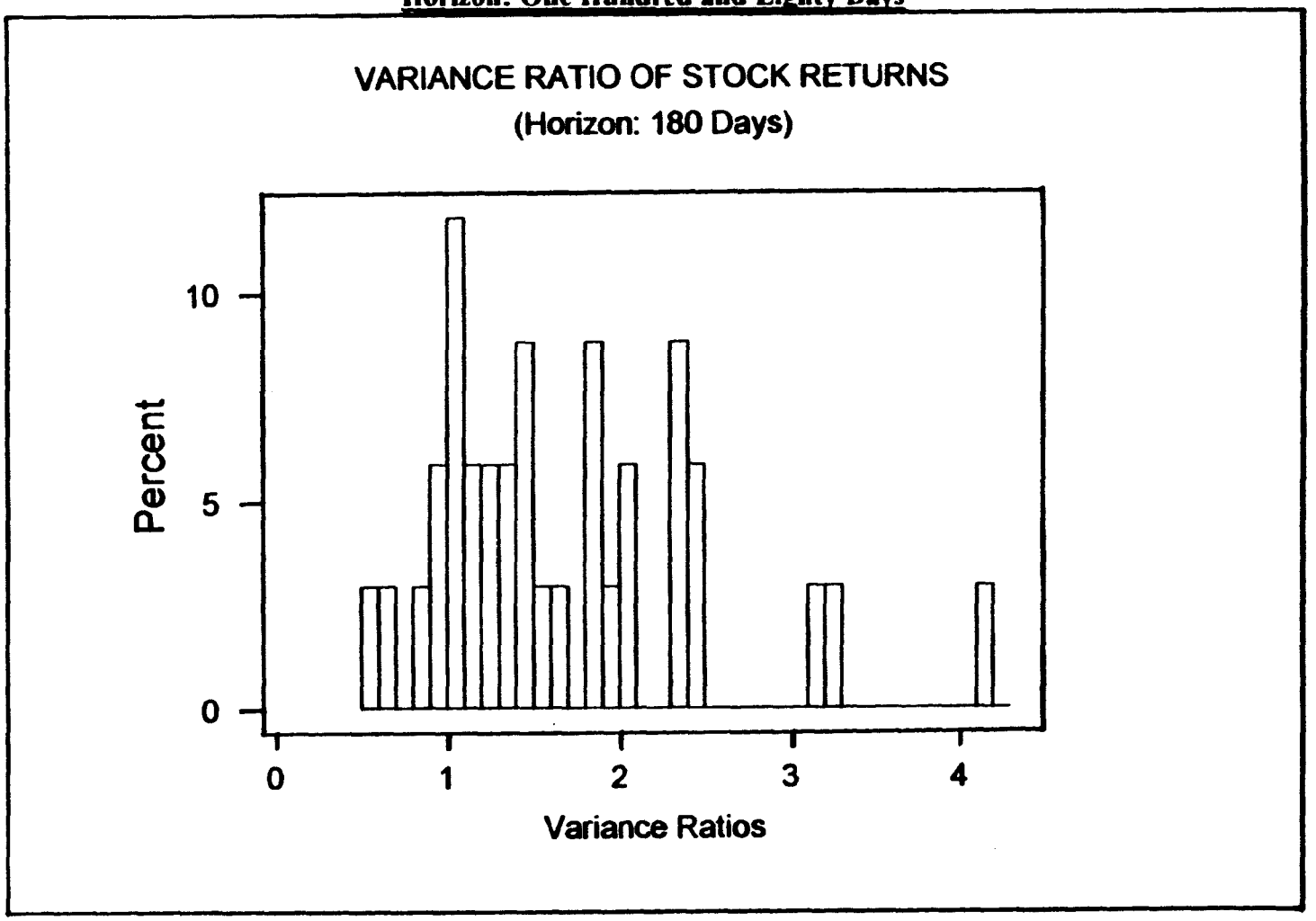

Figure 7.18

STOCK RETURNS AND VARIANCE RATIOS

Horizon: Three Hundred and Fifty Days

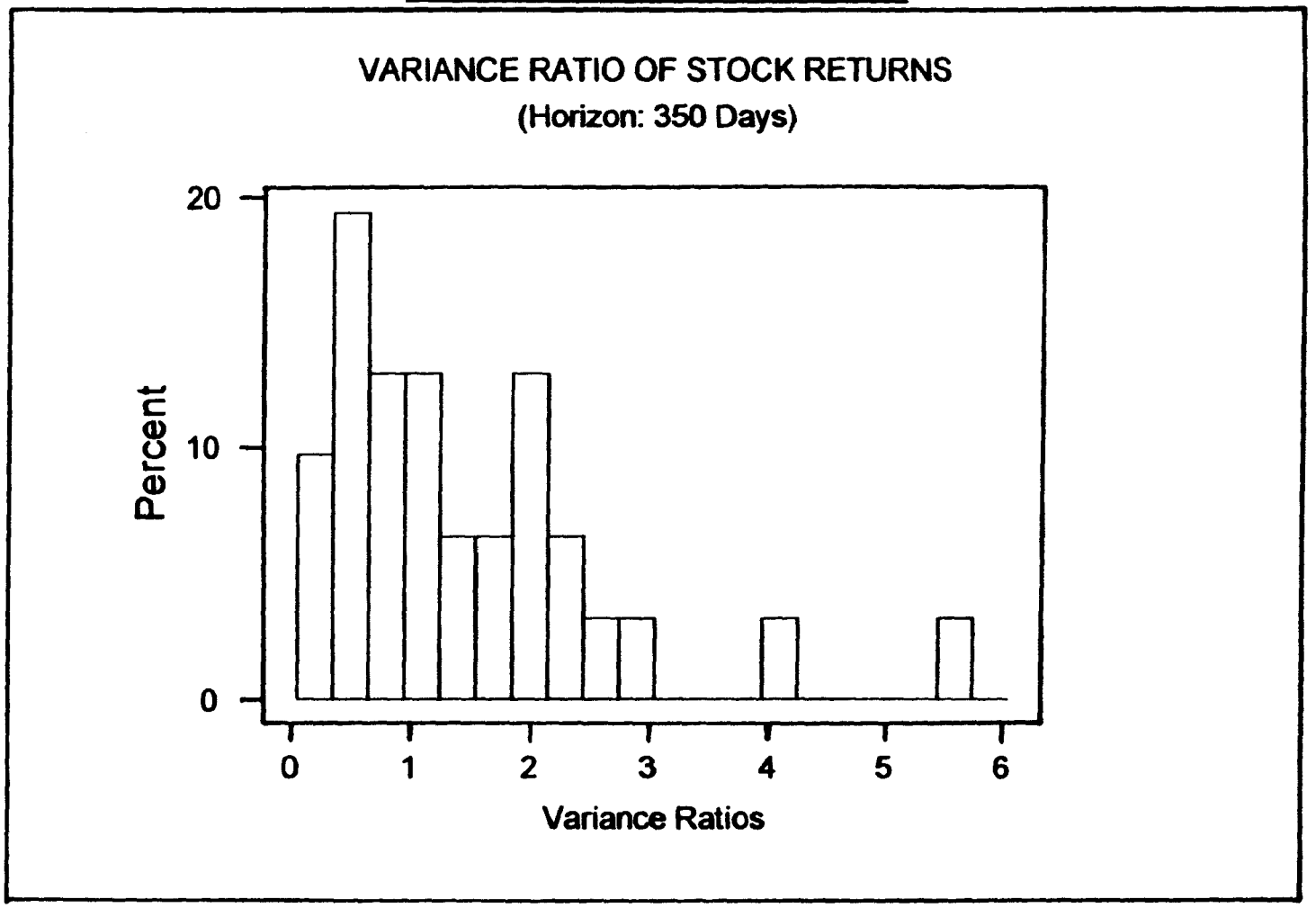

Figure 7.19

STOCK RETURNS AND VARIANCE RATIOS (WITH OVERLAPPING OBSERVATIONS)

Horizon: Twenty Days

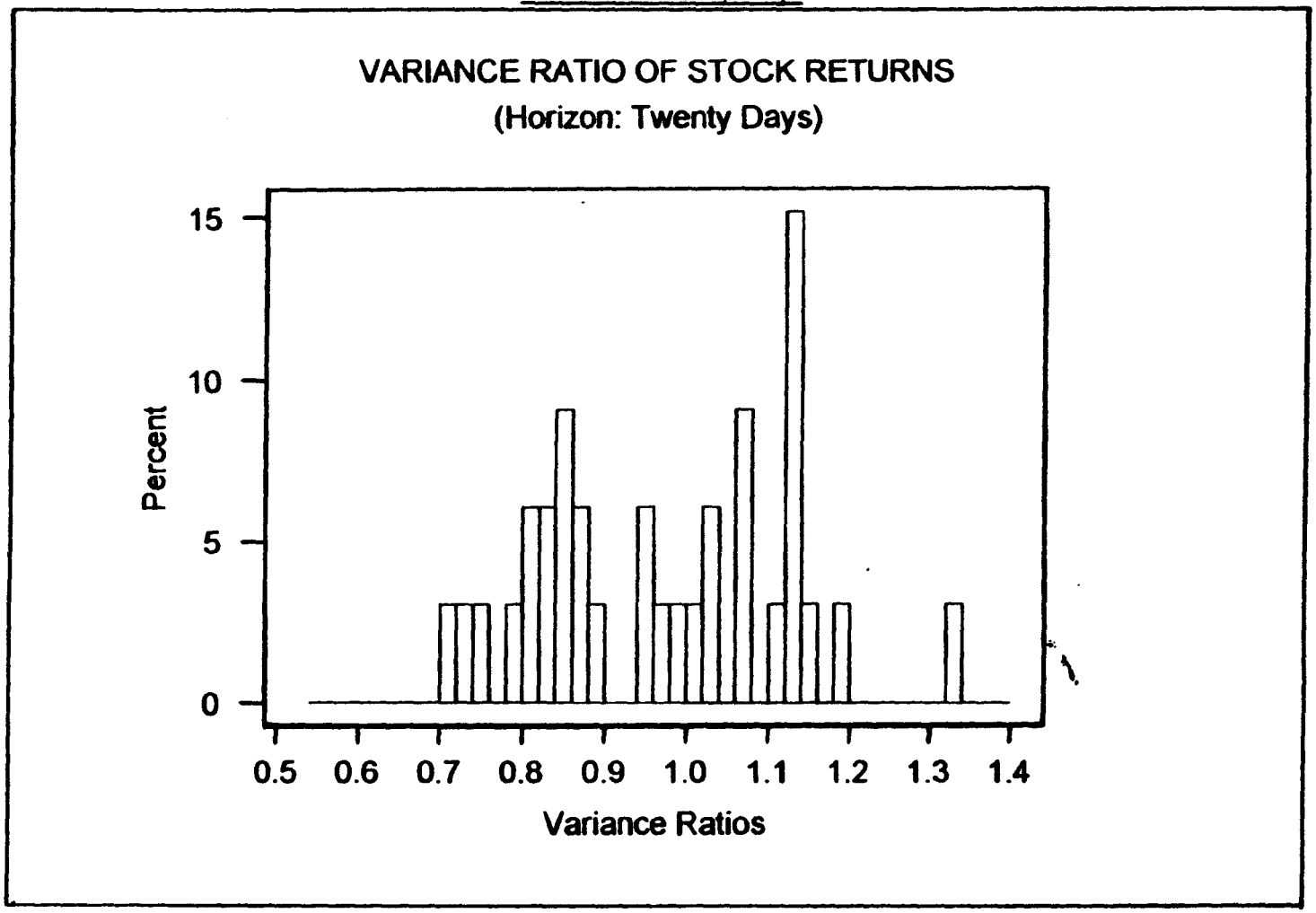

Figure 7.20

STOCK RETURNS AND VARIANCE RATIOS (WITHOUT OVERLAPPING OBSERVATION)

Horizon: Twenty Days

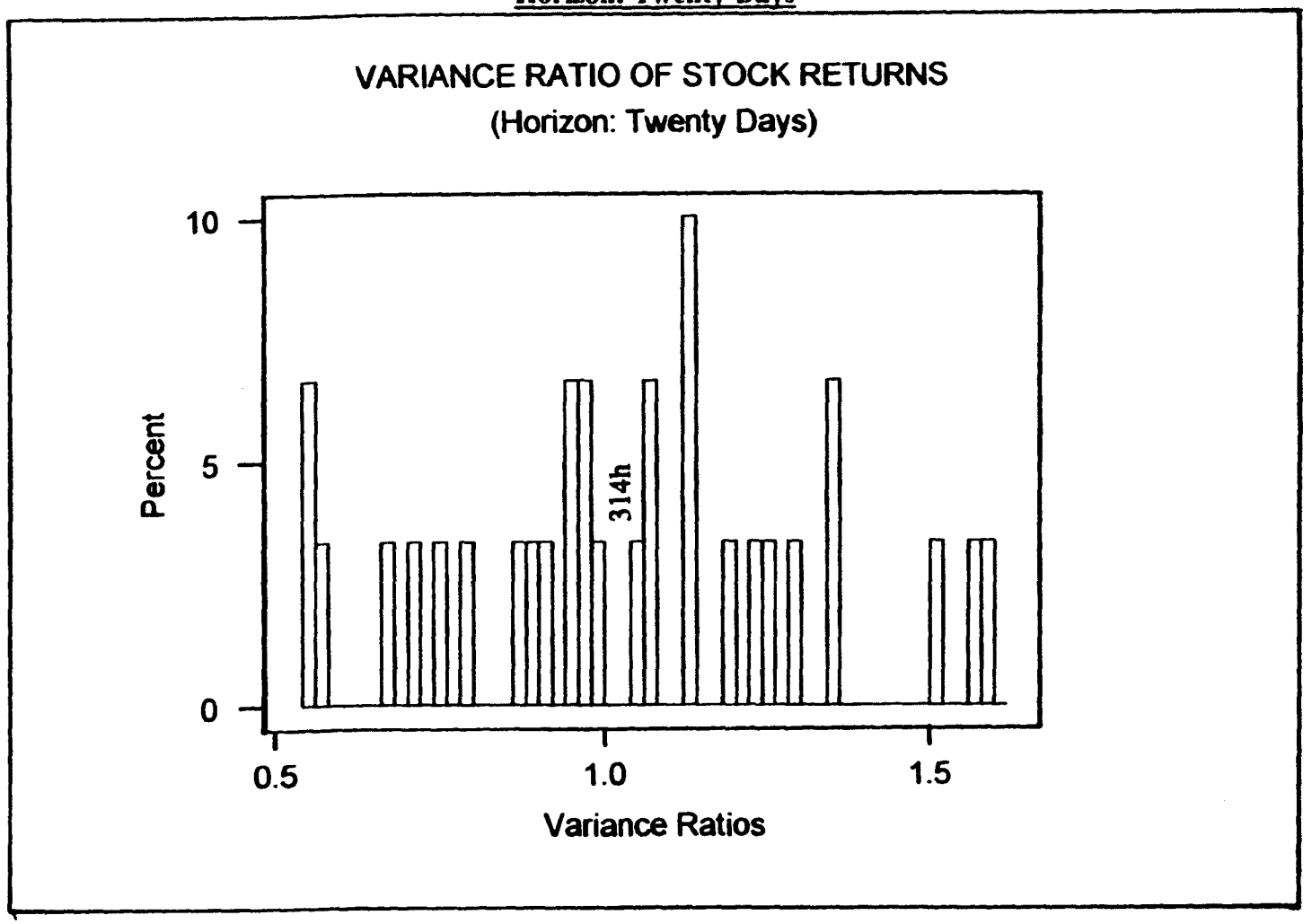

Table 7.37
STOCKS EXHIBITING MEAN REVERSION/MEAN AVERSION IN LONG HORIZON OF RETURNS

COMPANY NAME	HORIZON (Number of Days) & VARIANCE RATIO						
	150	300	400	500	600	700	750
Arab-Malaysian Development	1.087	1.213	0.392	0.270	0.391	0.472	0.522
Asia Pacific Land	1.075	0.904	0.414	0.313	0.306	0.212	0.211
Bandar Raya Developments	1.428	1.886	0.723	0.555	0.599	0.624	0.618
Chemical Company of Malaysia	0.787	2.024	2.849	3.410	4.339	7.131	8.795
Diversified Resources	1.997	1.933	1.277	0.832	0.356	0.123	0.128
Golden Hope Plantations	1.254	1.461	0.203	0.187	0.552	0.843	0.924
Guinness Anchor	0.860	0.845	0.768	0.667	0.564	0.436	0.347
Hume Industries (M)	1.314	1.774	2.081	1.933	1.859	1.912	2.052
Kuala Lumpur Kepong	0.588	0.829	0.228	0.178	0.265	0.292	0.375
Landmarks	1.540	1.499	0.521	0.382	0.518	0.501	0.464
Malayan Cement	1.889	2.413	2.408	1.919	1.945	2.121	2.236
Lion Corporation	0.674	0.579	0.478	0.343	0.343	0.191	0.182
Malakoff	4.036	4.334	0.633	3.432	7.558	11.532	12.748
Malaysian Airline System	1.379	0.934	0.616	0.455	0.496	0.355	0.250
Malayan Banking	2.275	3.082	1.280	1.129	1.901	2.513	2.914
MISC	1.079	0.949	0.353	0.213	0.432	0.538	0.589
Malaysian Mining Corporation	1.028	1.085	0.329	0.312	0.411	0.604	0.558
Malaysian Oxygen	2.093	2.624	11.540	11.186	10.098	9.711	9.745
The New Straits Times Press	1.670	2.259	2.835	2.931	2.971	2.829	3.002
Perlis Plantations	1.219	1.144	1.224	0.971	0.703	0.629	0.761
Public Bank	1.261	1.839	0.242	0.298	0.945	1.337	1.524
Shell Refining	2.277	3.020	5.503	5.719	4.833	4.423	4.310
Yeo Hiap Seng	2.412	3.710	0.971	1.330	2.604	4.336	5.884

Whilst our investigation into this aspect of the behaviour of stock returns (using forecasting approach) could be viewed as preliminary in nature, studying, identifying and understanding the detailed characteristics and idiosyncrasies (including price as well as earning behaviour and performance) of these companies might be interesting and useful for investment decisions and portfolio management. Such an area might deserve further research.

7.4-Concluding Comments

There are a number of conclusions that could be drawn from the findings of the present study. There are a number of implications for investment management and decisions that could be deduced from the results of the present empirical work. Our research also seems to provide some insights into the areas and issues which might be interesting and useful to be the focus of future research. However, to avoid repetition, we reserve our comment on these issues in this chapter. These subjects are to be covered in Chapter Eight.

CHAPTER EIGHT

SUMMARY AND CONCLUSIONS

8.1-Introduction

Portfolio theory suggests that expected returns commensurate with the level of risks investors have to bear could be the common stimuli behind their willingness to participate in the movements of a stock market. Expected returns in the form of price appreciations (capital gains) and/or dividends, considered to be the common goals being pursued by investors when they buy and sell in an exchange.

Market microstructure considerations[1] also suggest that the behaviour and activities of participants in a stock market are influenced and determined in part, by the behaviour of equity prices and returns. In turn, the behaviour of equity prices and returns in an exchange is of course, determined by the behaviour and activities of market participants.

This thesis examines some aspects of the behaviour of equity prices and returns in an exchange. The behaviour of stock prices/returns in an emerging stock market is studied from *comparative, descriptive* and *inferential* perspectives.

The methodology employed in the present study is featured in Chapter Six. Results of our empirical work presented in the forms of tables and charts are discussed

[1]See e.g., Blume and Siegel (1992), Malkamäki (1989), Schwartz (1991a); Amihud and Mendelson (1991), Cohen et.al (1986) and Garman (1976).

in Chapter Seven.

The present chapter concludes the thesis. An outline of the rest of the chapter is as follows: Section 8.2 summarises some of the major developments and issues that can be found discussed in the stock market literature. Salient empirical findings (of this study) are given in the ensuing section.

In Section 8.4 we provide some likely implications for investment management that could be conjectured from the findings of the present study. Like any empirical work, our empirical research has limitations, some of which are highlighted in Section 8.5. Some areas and issues which are considered worthy of further study are spotlighted in Section 8.6 . Section 8.7 offers some remarks that conclude the chapter.

8.2-Some Issues From the Literature

The foundation for stock market theory and research was perhaps, first laid down by Louis Bachelier in 1900. Notwithstanding that the tradition of stock market research had been pioneered as early as the turn of the twentieth century, subsequent empirical studies in this field only started some fifty years later with, inter alia, the work of Kendall (1953), Roberts (1959) and Osborne (1959).

With the advent of computer technology, more-serious empirical study examining the issue of random walks in stock price and returns - as well as other studies of stock market efficiency - took place around the 1960s and the 1970s. Indeed, by 1970, there had been a consensus among researchers that stock markets in general are informationally efficient - that historical prices/returns cannot be used to predict future prices/returns; that public information cannot be exploited to earn

abnormal returns in the stock markets.

By the 1980s, using newly developed procedures, researchers and analysts started to question the validity of the efficient market hypothesis (EMH). Literature on excess volatility, the overreaction hypothesis, noise trading and mean reversion in stock returns appears to suggest that stock markets are not perfectly efficient; that investors are not completely rational and that many traders trade on noise rather than on information.

While there had been common agreement among early researchers that stock prices/returns are not predictable, recent researchers contend that stock returns are, to some extent, predictable. While there appears to have been a consensus among some recent researchers and scholars that stock markets are statistically predictable, it is still not very clear whether they are also economically predictable. Puzzles in this area, remain.

The decade of 1980s also witnessed a number of cataclysmic changes which took place on many parts of the globe. Concurrent with, and as a result of, these global economic and political reforms, global investing has become an increasing phenomenon in stock market practice, research and literature. Moreover, it is often stated that these new global developments - the progressive removal of impediments to international investment as well as growing political, economic and financial integration - affect international stock market linkages [see e.g., Longin and Solnik (1995)].

Since about the beginning of the 1980s, as part of this rapid growth in global investing, emerging stock markets have become a focus of interest for global investors. Characteristics of emerging markets have captured the attention of both

investors and researchers. It is widely proposed in the literature that emerging equity markets are viable tools for diversification; and that these developing exchanges have an important role to play in effective investment diversification [see e.g., Speidell and Sappenfield (1992)].

Given the fact that global markets have become more integrated, and that the developed markets have displayed greater synchronization; given recent liberalization of emerging markets and their increasing integration into the world markets - an interesting concern is whether the benefits of diversification into emerging exchanges have been reduced. It is being suggested that as the emerging markets become increasingly integrated into the global market and economy, they will begin behaving increasingly like other markets and lose their diversification potential [see e.g., Barry and Lockwood (1995)].

8.3-Researched Areas and Empirical Findings

The focus of the present thesis is the Kuala Lumpur Stock Exchange (KLSE), an emerging market located in a South-east Asian country: Malaysia. Since emerging exchanges in general are not well researched and comparatively little is known by scholars about them, Chapter Two of the thesis introduces the KLSE. Historical developments, institutional and organisational structure as well as the trading system of the Exchange - among others - are detailed in this introductory chapter.

Since the literature on stock market theory and evidence is voluminous, we devote two chapters to reviewing literature. Whereas Chapter Three concentrates on

the EMH, Chapter Four essentially examines the various theories and evidence that appear to contradict or refute the EMH.

Our literature review as encapsulated in Section 7.2, reveals a number of intriguing issues and matters of contention. The subjects which are empirically addressed in the present thesis, are compressed into the following points:

Emerging stock markets - stock markets which are relatively young, emerging, developing and being modernised in the economies which are categorised as developing - are considered as having several idiosyncrasies which make them different from their matured counterparts in the developed economies. Whilst relatively not much is known about these young exchanges, they are often noted for their impressive realised returns and high volatility. Does the KLSE, which can be described as an emerging market, have such characteristics? We study these arguments by comparing some statistical properties of stock returns on the KLSE with those on the New York Stock Exchange (NYSE), the London Stock Exchange (LSE), the Hong Kong Stock Exchange (HKSE), and the 'Australian Joint Stock Exchange' (AJSE).

Emerging equity markets are also noted as having low correlations with developed markets as well as among themselves. For this reason, it has become a widespread belief among analysts (and investment practitioners) that these exchanges could provide excellent diversification benefits in combination with investments in the developed markets. As underlined in the foregoing section, however, given the current tendency for the financial markets to be increasingly integrated, is such a contention still true for an exchange like the KLSE? We study this question by examining the linkages and interactions between the KLSE and overseas exchanges - both developed and developing exchanges - employing *cluster analysis*, *correlation analysis* and

partial correlation analysis.

Our research on some statistical properties of stock returns on the KLSE as well as correlations between the KLSE and foreign exchanges, is extended by examining whether these variables are constant/stable over time. We do so by breaking up the data according to years and then examine them on a yearly basis.

Another topical subject which still appears to be unsettled in the literature is whether stock returns are economically forecastable or not. In this thesis, we investigate this issue of stock market "forecastability" from an 'out-of-sample' forecasting perspective, employing the relatively newly developed techniques known as *multi-process models* or the Bayesian approach to combining forecasts. In the meantime, how powerful and efficient this approach is - as a forecasting procedure - is assessed by comparing its performance with that of a 'conventional' forecasting method known as the *Exponentially Weighted Moving Average (EWMA)* method.

As noted in the previous section, early researchers have contended that stock prices/returns follow a random walk. Recent findings on the contrary, suggest that stock returns, particularly over long horizons, tend to exhibit mean reversion/mean aversion. A lack of published literature in this area concerning the KLSE provided an incentive for us to explore mean reversion/mean aversion in stock returns from the forecasting perspective.

Our empirical investigations into such questions have produced several results: a number of these findings (as far as the KLSE is concerned) appear as intriguing. Among the major ones are abridged as follows:

(1) The distributions of logarithms of stock returns on the KLSE are similar to those on the NYSE, LSE, HKSE and the AJSE: They are asymmetric; they are

leptokurtic and negatively (leftward) skewed.

(2) By and large, the means of stock returns on the KLSE have not been significantly different from those on the NYSE, the LSE, the HKSE and the AJSE. Nonetheless, the standard deviation of stock returns on the KLSE was relatively high, about as high as for the HKSE[2] and higher than for the NYSE, LSE and the AJSE.

(3) With very few exceptions, stock returns on the KLSE have been positively correlated with all other exchanges. In general, the KLSE is more highly correlated with developed exchanges than with other emerging markets.

(4) Similar to many other national exchanges, the KLSE has tended to exhibit strong regional links. The Exchange is found to have been quite highly correlated with the markets in Singapore, Hong Kong, Thailand, the Philippines and Australia.

(5) The KLSE is found to have had significant lagged correlations with a number of developed exchanges including those in the U.S., Canada, Switzerland, the U.K. and France[3].

(6) Three exchanges are identified as having been the most influential markets to the KLSE in terms of their comovements (and/or lagged correlations). These exchanges are, the Stock Exchange of Singapore (SES), the HKSE and the NYSE.

About 40% of the contemporaneous movements on the KLSE could be explained by factors common to the KLSE and the SES. About 8% of the movements on the KLSE could be attributed to the factors which are common to the KLSE and

[2]A study by Meric and Meric (1989) has revealed that, out of the 17 country indices tested, stock markets in Hong Kong and Singapore are among the most volatile.

[3]Solnik (1996) argues that the lagged correlation of Tokyo and London with New York can be explained by the difference in time zones, and not by some international market inefficiency that could be exploited to make a profit.

the HKSE. About 8% of the movements on the KLSE at time t could be explained by factors common to the NYSE at time t-1.

(7) Within the eleven-year period of our study, considerable year-to-year variations were found in the levels of returns and volatility and also in correlation coefficients[4] (and hence coefficients of determination) between the KLSE and overseas exchanges:

(a) Considerable changes in the year-to-year performance (in terms of mean and standard deviation of returns) of the Malaysian stock market might partly be explained by the fact that Malaysia is a very open economy. The market appears to be very sensitive to various major international political and economic events.

(b) Correlations between the KLSE and other national exchanges have increased in periods of high turbulence or during recessions/down markets (e.g., in 1987 and 1990): International correlation as suggested in Longin and Solnik (1995) increases when global factors dominate domestic ones and affect all financial markets. Expressed differently, correlations between and among national stock exchanges tend to increase with the advent of news that increases global uncertainty.

(c) In general, the KLSE appears to have been integrated/correlated with foreign exchanges (essentially the developed exchanges) since 1987[5].

(8) Our tests of the "forecastability" of stock returns based on a sample of fifty stocks from the KLSE do not support that the performance of 'out-of-sample'

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[4]Hsu (1984), based on his study, noted that stock market return variability is frequently on the move, reacting to shifts of the general economic conditions or the occurrences of some special political-economic events. Similarly - like a barometer - the Malaysian stock market has evolved in a way that reflects the general investment climate and the influences of special/major socio-political and economic events.

[5]For evidence, see columns two and five (and even column eight - for monthly returns) for each of Tables 7.17, 7.18, 7.20 and 7.22. See also Table 7.24 (columns three and six).

forecasts on stock returns can be improved significantly when a relatively newly developed technique known as the multi-process models technique (or the Bayesian approach to combining forecasts) is employed. Relatively few companies on the KLSE appear to be "forecastable".

(9) Using price indices as the data base, we compare the "forecastability" of the KLSE with the NYSE, the LSE and the HKSE. We find only isolated instances of apparent "forecastability" at particular horizons.

Our evidence does not suggest that the multi-process models approach is capable of improving the "forecastability" of the KLSE, the NYSE, the HKSE and the LSE.

(10) Lastly, our research has provided evidence that stocks listed on the KLSE could be classified, based on the behaviour of their long term returns, into three genera: stocks which are mean reverting in their returns; stocks which are exhibiting mean aversion in their returns and stocks which appear to be following a random walk.

Based on our review of literature, we found that some aspects of our investigations have not been addressed in previous studies. Some of the procedures used in the present research also have not been employed in previous studies. As such, some of the discoveries highlighted above, could be considered as providing some contributions to knowledge in the following ways:

(1) Testing the "forecastability" of stock markets using 'out-of-sample' data is still not widely implemented in the literature. To the best of our knowledge, the method of 'out-of-sample' forecasting based on the multi-process models employed in the present study, has never been employed in previous stock market studies.

2) Even though there are several previous studies which examine the correlations between the KLSE and overseas exchanges, our study in this aspect of the KLSE is different or new compared with the previous studies, on the following grounds:

(a) The method of partial correlation analysis (used in our study) appears never to have been employed in previous stock market studies.

(b) These correlation coefficients, partial correlation coefficients (and partial coefficients of determination) - are not only investigated on a yearly basis, but also from lead-lag perspectives. We find no previous research which has examined the interrelatedness of the KLSE and other exchanges in such detail (by including most other stock markets).

(3) In the present research, we compare some aspects of the behaviour of the KLSE with a number of selected foreign exchanges. To the best of our knowledge, there is no previous research as comprehensive as this - in examining the behaviour of the KLSE from a comparative perspective[6].

8.4-Some Possible Implications for Investors

Some of the findings of this study as discussed in the foregoing subsection have some implications for investment management. Some of these possible implications for investors could be conjectured as follows:

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[6]Othman Yong (1989), in his brief "Performance Comparison" study, used only weekly data of the KLSE Industrial Index to compare its "performance" with the Hang Seng Index, Neikei Index and the Dow Jones Industrial Index. The sample period for the study was only 1983:01 through 1987:12.

In our study, we have used the daily, weekly and monthly share price indices covering the period of 1984:10 and 1994:12. These data are examined on a yearly basis.

(1) Positive correlations between the KLSE and most foreign exchanges suggest that global factors affect their covariations. Attempting to identify such factors/variables and estimating their expected future behaviour might be beneficial for investors in projecting expected portfolio performance and accordingly, planning their investment decisions.

(2) Even though these correlations are positive, as displayed in several tables in Appendix II, they are far from unity: by and large, they are less than 0.5, and in a few cases they are estimated to be negative. This implies that, there is ample room for successful risk diversification [see e.g., Watson (1980); Solnik (1996)].

(3) Given the fact that the correlations between the returns from the KLSE and from developed exchanges are relatively high compared with their correlations with those of most emerging markets, better diversification benefits could be enjoyed if the Malaysian stocks are combined with those from emerging markets (rather than combining the Malaysian stocks with stocks from the developed exchanges).

(5) Given the fact that the KLSE tends to exhibit strong regional links, expectations of future returns on the markets in the same region - Singapore, Hong Kong, Thailand, the Philippines and Australia - might be used to help form expectations of returns on the KLSE. On the other hand, portfolio theory would suggest that combining the Malaysian stocks with the stocks from these exchanges is less attractive than other combinations.

(6) Since the SES, the HKSE and the NYSE are identified as the most influential markets to the KLSE in terms of their comovements (and/or lagged correlations), in planning investment decisions and portfolio strategies,

(a) it should be worth keeping track of the behaviour of these markets -

their expected movements, volatilities and correlations; and

(b) major socio-political, economic and financial developments/events which are taking place or expected to take place in Singapore, Hong Kong and the U.S. would be useful to be taken into consideration.

(7) The tendency of the KLSE (and other exchanges) to exhibit changes in long-term behaviour and performance, underlines the need for an active/dynamic asset allocation strategy in portfolio management.

(8) The tendency of correlations between the KLSE and overseas exchanges to change through time suggests that portfolios need to be constructed on the basis of expected correlations rather than past averages. If a portfolio is formed based on average correlations, the performance of the investment could be worse than expected because, for example, as suggested in Erb *et.al* (1994), correlations tend to increase in down markets.

(9) There appears to be no advantage for investors to try to predict share price changes on the KLSE using share price history alone.

(10) Over long horizons, returns for some stocks listed on the KLSE appear to be mean reversive; some to be mean aversive, while the rest tend to follow a random walk. The presence of mean reversion in long period stock returns, as suggested by Frennberg and Hansson (1993), implies that the portfolio choice is not invariant to the investment horizon. Stocks which are mean reverting should be attractive to long term investors because they are relatively less risky for long investment horizons [see also Chapter Four].

8.5-Limitations of the Study

Like any empirical work, this study has limitations. They include the following:

(1) Similar to other studies, our investigations are based on *ex post* data. Since stock markets are evolutionary rather than stationary, *ex ante* behaviour of a stock market might be significantly different from its *ex post* behaviour.

(2) Our study is based on linear statistical methods. However, in a social institution such as the stock market, relationships between variables might be nonlinear.

(3) As we have discussed in Chapter Four, variance ratio tests which we have employed in our study have several statistical problems which are not resolved in this research.

(4) Whilst we have confined our study to data for indices and the most actively traded stocks, our results especially for the emerging markets will have been biased to a degree by thin trading effects.

8.6-Some Directions for Future Research

The objective of this section is to suggest some of the many possible directions that could be pursued by future researchers. While not claiming it to be exhaustive, this section provides some guidelines into the areas and issues which we think could be promising and interesting for the focus of future studies:

(1) In examining some statistical properties of stock returns on the KLSE, we found that the mean of returns on the Exchange have been similar to those on some developed exchanges, but its standard deviation of returns has been relatively higher. The related question is, will the Exchange provide adequate compensation for relatively higher risk? This subject could become an interesting area for comparative study.

(2) One of our findings suggests that there are strong linkages between the KLSE and its neighbours in the same region (vis-a-vis other foreign exchanges). As noted in the previous chapter, we have no clear evidence to suggest that time zone is the major factor in determining this tendency. Additionally, our research has also revealed that there are quite strong lagged correlations between the KLSE and a few of the developed exchanges. Could this phenomenon be attributed only to time zone; or, is it also an indication of market inefficiencies which could be exploited for a profit? As far as we are aware, the issue of time zone heretofore has been neglected in studying the interrelatedness of the KLSE and foreign exchanges. For this reason, and because of its potential importance, this may be an area deserving detailed investigation.

(3) As part of our empirical research, we have examined the "predictability" of stock prices/returns on the KLSE using 'out-of-sample' data. To the best of our knowledge, no previous research of this type has been implemented on the KLSE's stocks. Accordingly, to justify and/or to improve our results - to contribute towards what might be phrased as 'a more definitive conclusion' - it is advocated that our results be reexamined by employing different time series or other econometric models and techniques.

(4) In comparing the "forecastability" of stock returns on the KLSE with those on some selected developed exchanges, we have used share price index data. Future researchers could feasibly reexamine and/or amplify the results of this comparative study by employing individual company share price data from various national equity markets.

(5) We have found evidence that over long horizons, some stocks listed on the KLSE tend to exhibit mean reversion in their returns. Given the fact that such stocks could be attractive for long-term investors, it might be worthwhile for researchers to extend this study with a larger sample size. It could also be interesting to examine closely the various characteristics of these mean reverting companies. The findings of such studies of course, could be of interest to practitioners in making portfolio choices.

(6) One of the methods that we have used in examining the covariations between and among stock markets, is known as hierarchical cluster analysis. Even though this method is not very new, it does not seem to have been widely applied as a tool in stock market research. We have the view that this method could potentially be used to examine other aspects of stock market behaviour. For example, this method could be used to classify companies listed on an exchange. Perhaps, this procedure could also be employed to group various companies listed on different exchanges. Results obtained from such studies could be advantageous for portfolio choice and diversification.

(8) All research concerning share prices in emerging markets have been afflicted to a degree by the effects of thin trading. Efficient methods of adjusting correlations between stock market indices affected by thin trading of constituent stocks

need to be derived.

8.7-Concluding Remarks

The present research has resulted in a number of findings. We have found that the average return on the KLSE has been similar to those on some well-established exchanges, whereas its standard deviation of returns has been relatively higher. We have found that the returns on KLSE are positively correlated with returns on most exchanges and the Exchange appears to exhibit strong regional links. We have found that the KLSE is so integrated with a number of overseas exchanges that innovations on these exchanges could perhaps, be useful in explaining movements on the KLSE. We have found that returns for relatively few stocks on the KLSE appear to be more "forecastable". Some stocks listed on the KLSE are identified as having the tendency towards exhibiting mean reversion in their long-term returns and others exhibit mean aversion.

Some of these findings could conceivably be advantageous for practitioners. Some of our findings are novel for a relatively unresearched market like the KLSE. As implied earlier, we do not claim that our results are totally definitive. In empirical science, in the academic 'journey' of searching for reality, many things could and should possibly be done to justify, verify, or improve an empirical result[7].

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[7]According to De Groot (1969), "Empirical science seeks to gain knowledge of the world, that is, of the reality in which we live" (p. 1).

De Groot (1969) further stresses that,

"Scientific knowledge should be true knowledge. . . . we can in fact say that a *striving for truth* is characteristic of all scientific activity.

". . . , since the concept of 'truth' poses many problems of interpretation. Be that as it may, one of its implications is undoubtedly that a scientific investigator will not be easily satisfied with his

For instance, our results could be justified or verified by revisiting them from different perspectives - reexamining them based on different procedures. Future research could also focus on the same subjects/issues but using a different data set, a different sample size or a different sample period.

Indeed, being a member of the family of emerging exchanges, the KLSE represents an element of the rich variety of institutional structures, trading arrangements and regulatory paradigms which exist across different markets. Behaving much like developed markets in a number of important ways - and yet differing in other ways - the KLSE serves as a segment of the massive financial laboratory of emerging equity markets.

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findings or their formulation. In particular, he will strive for *a greater measure of certainty* than is usual in ordinary life" (p. 19).

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