ON THE FUNCTIONING AND THE EFFICIENCY OF THE EMERGING EQUITY MARKETS.

A thesis submitted for the degree of Doctor of Philoshophy

by

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February 1997

ACKNOWLEDGMENTS

I would like to thank my mother, Ifigenia, for her moral and financial support, without which the writing of this thesis would have never had taken place.

Also, I would like to thank Prof. A. Antoniou and Dr. I. Garrett for their excellent and consistent supervision and support throughout the entire project, and Prof. D.M. Power and Dr. A. Ozkan for their comments on the final draft of this thesis.

Furthermore, I would like to thank the participants of the following *Conferences* and two anonymous referees from the *Manchester School*, for their useful comments and suggestions on the presentation of the empirical results of the thesis (Chapters 4,5,6,7):

1. International Conference in Quantitative Analysis, University of Piraeus, November 1996, Piraeus, Greece.
2. Money Macro and Finance (MMF) 1996 Annual Conference, London Business School, September 1996, London, UK.
3. British Accounting Association (BAA) National Conference, Gardiff Business School, March 1996, Gardiff, UK.
4. British Accounting Association SWAG Conference, Cheltenham School of HE, September 1996, Cheltenham, UK.

ABSTRACT

In the present thesis a series of theoretical and empirical issues relating to the functioning and the efficiency of the emerging equity markets is investigated. The sample covers ten markets; four from the Latin America and six from the Asia, Asia-Pacific, for the period between 1976 to 1994. In particular, I investigate various aspects of the behavior of equity prices in emerging markets, focusing on whether financial markets in the emerging economies are efficient [as in Fama (1970b)] or exhibit seasonal patterns; whether they move together over time and any subsequent implications this long-run comovement may have for international portfolio diversification; how volatility in these markets behaves and whether there are volatility spill overs from one market to another; whether financial liberalization has increased or decreased equity market volatility; what factors are important in determining equity returns in emerging economies.

The main results that emerge from the analysis suggest that prices in the markets of the sample do not follow Random Walks and exhibit seasonal patterns, such as the well known Monday-effect. Furthermore, common long-run trends were detected within regions, however, more detailed analysis suggested that benefits to international portfolio diversification are not eradicated in the long-run. Also, a meteor shower effect, i.e. volatility spill-overs, was detected for most markets.

CONTENTS.

CHAPTER I

INTRODUCTION

"Over the next 25 years the world will see the biggest shift in economic strength for more than a century. Today the so-called industrial economies dominate the globe, as they have for the past 150 years or so. Yet within a generation several are likely to be dwarfed by newly emerging economic giants. History suggests, alas, that such shifts in economic power are rarely smooth." [1]

During the 1880s many wealthy Europeans decided to invest in farm land in what was perceived at the time to be a new but rich and undeveloped land: the American West. One hundred years later, in the middle 1980s, 11 institutional investors from the Western industrialised markets put up US$ 50 million to exercise the very same principle: investing in new and emerging markets. The rationale behind both actions is the same and quite straightforward: while the developed markets reach a stage of economic maturity and growth stability many less industrially developed markets are just beginning their cycle and therefore offer far better opportunities for economic growth and capital appreciation. For example, the south-east Asian region experienced and annual average GDP growth of 7.5% for the period 1974-1993. The World Bank predicts that the region will continue to grow at a rate of 7.6% a year, for the period 1994-2003. The respective figures for the industrialised countries of the West are 2.9% and 2.7%.[2] Furthermore, the World Bank predicts that six of the ten biggest economies in 2020 will be today's emerging giants: China, India, Indonesia, South Korea, Thailand and Taiwan.[3]

The importance of these markets for global economic stability is becoming paramount. One need not go further than recall the Mexican moratorium in the early 1980s, that initiated the International Debt Crisis (discussed in chapter 2) or the devaluation of the Mexican peso in the 1990s: in December 1994, the Mexican government of Ernesto Zedillo decided to devalue the Mexican peso; a move that resulted in the collapse of

[1] *The Economist*, October 1st, 1994, Survey: "The Global Economy", p1.
[2] Source: *World Bank Tables*, 1994.
[3] Source: *World Bank Economic Forecasts*, GDP at PPP, 1994.

Mexico's bond markets and in a world-wide financial market crisis. The Mexican government underestimated the role that foreign investors play in the country's bond markets. Nearly 70% of the outstanding peso-denominated bonds, and nearly 80% of the outstanding dollar denominated bonds were held by foreign investors. Mexico's crisis did not leave the financial markets of Latin America unaffected. During the next fourteen days from the "peso-crisis" the stock market in Argentina fell by 11%, in dollar terms, and the stock market in Brazil by 17%. Argentina's Brady Bonds fell by 17% and Brazil's Brady Bonds by 9%. In Asia, during the first weeks of January 1995 equity and bond markets in Hong-Kong, Thailand, Singapore and the rest of Asia, Asia-Pacific region fell sharply and many governments had to defend their currencies.

In addition, during the recent years the emerging markets have attracted an enormous amount of direct and indirect investment from the Western industrialized countries because they are perceived to offer high average returns, low correlation with developed markets, predictable returns, high volatility, and significant investment opportunities.

Given the emerging markets' growing economic significance in the global economy, and their increasingly important role in the international financial markets and the stability of the system, it is surprising that relatively little empirical research has taken place concerning these financial markets; many issues concerning the *Functioning and the Efficiency* of these markets have remained uninvestigated.

This thesis aims to investigate some of these issues, and shed some light on the way these markets operate. In particular, I investigate various aspects of the behavior of equity prices in emerging markets, focusing on whether financial markets in the emerging economies are efficient [as in Fama (1970b)], whether they move together over time, how volatility in these markets behaves, and what factors are important in determining equity returns in emerging economies.

For the purpose of the thesis, I define emerging and industrialized markets as follows: emerging markets are the low and middle-income countries, and industrialised markets are the high-income countries (World Bank classification). However, per capita GNP alone as a measure is not enough: in 1990 the United Arab Emirates had a per capita GNP of US$ 19,866 which was nearly US$ 3,000 more than that of Italy, Spain or Belgium. Therefore, the level of *industrialisation* is also very important. Finally, emerging economies without financial markets, or economies with financial markets that impose major restrictions to the international investor and the flow of funds in and out of the economy cannot be included in the sample. It is well beyond the scope of this thesis to investigate the functioning and the efficiency of the emerging markets as a whole.The focus of the thesis is on emerging *equity* markets.

Therefore, for the purposes of this thesis an emerging market is one that has low or middle per capita GNP; is at the beginning of the industrialisation process; has organised capital markets, with no major restrictions to the flow of funds in and out of the economy.[4]

I chose as a sample 10 countries from two different geographical regions: Latin America (Brazil, Argentina, Chile, Mexico) and Asia, Asia-Pacific (India, Thailand, Malaysia, South Korea, Philippines, Taiwan). I use for the most part of the study the International Finance Corporations' Emerging Market Indices; this is partly because many emerging stock market indices that are reported locally very often mislead as much as they inform and partly because it is these indices that the financial community are using when evaluating emerging equity market performance [source: Bloomberg Emerging Markets Magazine, 1995]. For example, the most frequent problem of the locally reported indices is the overwhelming dominance of just a few stocks in an index: in the Chilean Selective Index 47% is accounted for by the *three* largest electric utilities. In Mexico's *bolsa* (stock market index) the telecommunications giant Telefonos de Mexico accounts for 23.75% of the index, in Brazil's Bovespa the state-

[4]By 1994 there were 25 such markets: Hong-Kong, Mexico, Korea, Taiwan, Malaysia, India, Thailand, Singapore, Brazil, Chile, Argentina, Philippines, Indonesia, Turkey, Greece, Portugal, Pakistan, Venezuela, Colombia, Jordan, Peru, Sri-Lanka and Bangladesh. Source: "The investor's guide to the emerging markets", Mark Mobius, *Financial Times Publications*, 1994, p13.

controlled telephone and electric companies (Telebras and Electrobras) account for 52% of the index. Because of these inefficiencies in the construction of the equity market indices professional money managers do not feel they can rely on these indices and instead they often use indices compiled by Morgan Stanley Capital Group, Barings securities, and the International Finance Corp., which track the performance of a more representative sample of stocks that are large enough and can be easily purchased.

The thesis is organized as follows:
In Chapter II, the macroeconomic environment of the emerging markets that comprise the sample of the study, is discussed. I focus on the political reforms, the liberalization of the markets and the opening of the economies that took place during the last 10-15 years, in order to see why these measures have transformed the countries and how. I look at the long-run behavior of the most important macroeconomic indicators, government policies, long run trends in imports and exports, inflation, etc. Also, vital statistics are presented on how many funds are active in these markets, how much money they invest and what is the funds' behavior during the last 10 years. Finally, I review the Debt crisis and how it has affected the LDCs.

In Chapter III, the relevant Literature is reviewed. More specifically, I discuss the most important empirical studies on the Efficient Market Hypothesis and the literature on the stock market "anomalies". Also, the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) are reviewed.

In Chapter IV, the Efficiency of the emerging equity markets is examined. More specifically, I test whether the equity prices in the emerging markets follow a Random Walk process with a test that that is based on the variance of the series and avoids many of the methodological problems of the procedures used in the past. Further, I utilize both parametric and non-parametric procedures to test for weak-form efficiency of the markets, predictability of the returns, monthly effects (the January effect) and day of the week effects (the Monday effect).

In Chapter V, the long-run trends of the emerging stock markets prices and their dividend payments are examined. I test whether the trends in the equity markets are stochastic or deterministic, whether the markets are integrated and the implications for international portfolio diversification. The Johansen multivariate procedure for testing for cointegration is employed and this is one of the first attempts to investigate this issue in such a manner for the emerging equity markets (to the best of my knowledge). Earlier research presents evidence that the stock prices of the most developed equity markets share a common stochastic trend, a fact that suggests that they respond to a common world growth factor. I examine whether the emerging markets behave similarly to the developed markets, and in addition I indirectly test the predictions of the Dividend Discount Model of Asset Pricing, for the emerging markets.

In Chapter VI, I examine whether the long-run trends that where detected in the previous chapter are systematic, undiversifiable, sources of risk that are priced in an Asset Pricing Model. Further, the possibility that a set of domestic and international, expected and unexpected macroeconomic shocks represent sources of systematic risk is investigated. In so doing the Keynsian Model of National Income Determination is employed to help us arrive at the identification of the macroeconomic variables, and then a multivariate regression model (Seemingly Unrelated Regression (SUR)) is used to estimate and test an Arbitrage Pricing Model. This framework was developed recently (early 1990s) and avoids many of the methodological problems inherent in earlier Asset Pricing tests. Further, this framework is utilized for the first time to study return behavior in the emerging markets.

Finally, in Chapter VII, the AutoRegressive Conditional Heteroscedasticity (ARCH, GARCH) methodology is employed in order to examine whether the Financial Liberalization that took place in many emerging markets have reduced (Neoclassical approach) or increased (Keynsean approach) the volatility of the markets. Also, the possibility of spill over effects, or meteor showers is investigated. The evidence for meteor showers is scarce even for the developed equity markets and again it is the first time such a testing framework is utilized for the emerging markets, (to the best of my knowledge). Most previous studies examine the effect for the exchange rate markets.

Finally, Chapter VIII, summarizes and discusses the results and concludes the thesis. The Bibliography follows.

CHAPTER II

THE EMERGING ECONOMIES.

2.1. INTRODUCTION.

The capital market is only a part of the complex economic system that comprises the national economy of a country. It is influenced, and occasionally it influences, the workings of the other sectors of the economic system. Thus, in order to get a clear picture of an equity market one has to be aware of the macroeconomic environment in which this market operates.

Therefore, before I proceed in the examination of the functioning and the efficiency of the emerging financial markets, I shall discuss, briefly, the macroeconomic environments in which these equity markets operate. I do so by examining some important macroeconomic indicators such as GDP, Consumer Prices, the Current Account, the Trade Balance, Industrial Production, etc., the analysis of which will suggest the trends, and directions these economies follow. I concentrate on the economic analysis of the countries of the sample; the macroeconomic data were obtained from the International Monetary Fund Statistical Yearbook (1993, 1994) and the World Bank Tables (1994), while the financial data were obtained from Datastream (International Finance Corp. Emerging Market Indices).

This chapter is organised as follows: section 2 looks at the macroeconomic environment of the Latin America and the Asian Pacific countries of the sample, section 3 discusses the Debt Crisis, section 4 compares some key macroeconomic indicators for the two regions and discuss their differences, section 5 takes a snapshot at the emerging financial markets, while section 6 concludes the chapter.

2.2. THE MACROECONOMIC ENVIRONMENT.

2.2.1. The emerging economies and the global economy.

In 1990 the less developed markets covered 77% of the world's land area and had 85% of the world's population. Yet only 23% of the world's GDP comes from these countries (Mobius (1994)).[5]

As can be seen from Table 2.1, which presents the World Bank forecasts and historical figures of real GDP growth for several regions of the globe, the East Asian region is growing, and will continue to grow, at rates that reach 7.6% a year. The situation is similar for the South Asia (5.3%), while, Latin America is expected to grow at an average rate of 3.4% a year for the next decade, Sub-Saharan Africa at 3.9%, and Middle-East at 3.8%. These growth rates are far higher than the 2.7% average yearly growth that the industrialised countries of North America and West Europe are expected to achieve. Furthermore, note that for most of the developing areas the forecasted growth rates are often double or triple their historical rates. The exceptions are the Asia and Latin America regions which have been growing at rates roughly similar to the excepted rates.

A second point to note is that until recently the GDP trends and business cycles of the LDCs were following those of the industrialised countries. However the situation is changing and now the ex-LDCs are less influenced by the developed countries. For example, the developed countries experienced a heavy recession during the last part of the 1980s and the beginning of the 1990s. The emerging countries not only did not follow but also experienced rates of growth that reached 8-10%. Many analysts have argued that this was due to the fact that now an increasing proportion of emerging market import and export trading is done among these markets, thus, making them less dependant on the business cycles of the developed economies.

[5] However, this gap is narrowing very fast for a number of demographical and technological reasons, which makes many of the emerging markets the fastest growing areas of the world.

Table 2.1

Real GDP growth, annual average,%.

	1974-1993	1994-2003
RICH INDUSTRIAL COUNTRIES :	2.9	2.7
DEVELOPING COUNTRIES :	3.0	4.8
of which, East Asia	7.5	7.6
South Asia	4.8	5.3
Latin America	2.6	3.4
Eastern Europe, Former USSR	1.0	2.7
Sub-Saharan Africa	2.0	3.9
Middle-East & North Africa	1.2	3.8

Source : World Bank, 1994.

A third important point, that highlights the dynamic nature of the growth process of these markets, is that most of the 15 larger economies in 2020 are likely to be what we know call "emerging economies". This is clearly suggested from the following Table 2.2, which shows the 15 largest economies in 1992, and the 15 largest economies in 2020, according to the World Bank projections. Nine out of a total of fifteen largest economies in 2020 will be today's emerging economies: China, India, Indonesia, South Korea, Thailand, Taiwan, Brazil, and Mexico.

A final point to note, at this stage, concerns the equity markets of these countries. During the last decade they have grown at amazing rates: in 1980 stock markets in LDC countries listed 5,531 domestic companies and had a market capitalisation of US $86,125 million and an annual trade volume of US $23,672 million. By the end of 1992, the same LDCs had listed a combined total of 13,217 domestic companies with a combined market value of $774,093 US million and an annual trade volume of $594,685 US million.

Table 2.2

15 largest economies 1992	15 largest economies 2020
1. USA	1. China
2. Japan	2. USA
3. China	3. Japan
4. Germany	4. India
5. France	5. Indonesia
6. India	6. Germany
7. Italy	7. South Korea
8. UK	8. Thailand
9. Russia	9. France
10. Brazil	10. Taiwan
11. Mexico	11. Brazil
12. Indonesia	12. Italy
13. Canada	13. Russia
14. Spain	14. UK
15. South Korea	15. Mexico

Source : World Bank Economic Forecasts, GDP at PPP.

To summarise thus far, before we take a more specific look at the emerging economies, we have seen that the economic gap between the emerging markets and the industrialised economies is narrowing at a such fast rate, that the World Bank predicts that within the next two decades most of the world's largest economies are going to be what economists know call 'emerging markets". Furthermore, this growth boom was combined with an extraordinary growth of the emerging equity markets.

2.2.2. The Latin America (LA) region.

At the beginning of the 1980s it was difficult to find a country in Latin America that was not ruled by an authoritarian government, often a military one. For decades the main political characteristics were that of militarism and Marxism, while the dominant economic characteristic was that of a closed economy, even though the GDP of the region as a whole between 1950 and 1980 was growing at an annual rate of 5.3%; Brazil, for example, had one of the world's highest growth rates.

The first signs of the problems, that were yet to come, arose with the first oil crisis in the beginning of the 1970s. The countries of the region were faced with higher oil prices, lower saving rates, bigger budget deficits, growing national debts, and rising inflation. The governments responded by higher borrowing, which bankers from all over the world were more than willing to provide, until 1982. On the 12th of August 1982, Mexico announced that it could no longer service its debts. Soon, all LA countries, except Colombia, had to reschedule their debts. This was the beginning of a new era for the region's economies with important implications for the rest of the world. The breathtaking debt brought hyperinflation: annual inflation in Brazil hit 2,750%, in Argentina 3,080%, in Peru 7,500%, in Bolivia 11,800%, between 1980-1990. Recession, unemployment, and falling real wages followed. More than US$ 223 billion were transferred abroad by these countries only for servicing the debt.

The governments of the region soon realised that this could not go on. New people assumed the economic decision making process and in co-operation with the World Bank reforms started to take place: budgets started to be balanced, workers were fired, markets were liberalised, a new less regulated environment was established, a long privatisation program was initiated for the vast state-owned enterprises, tariffs and quotas were abolished and free trade started to take place.

The results were soon apparent: in 1992 Chile grew at a rate of 10.4%, while the Argentina economy grew at a rate of 9%. Inflation in Mexico was around 10% and annual growth was between 2.5% - 4.5% for the period of 1989-1992. The situation in the rest of the LA countries was similar.

Brazil.

Brazil, is by far the most populous country in the LA region with a population of 156 million, and a $450 billion economy (which is twice the size of the Eastern European economies). In 1960 less than 60% of the population could read but by 1991 the figure had increased to 81%. In 1990, there were 91 telephone lines per 1000 people (an index often used to indicate, among other things, the level of industrial infrastructure in a country), up by 214% from 1960. Brazil is huge, rich in natural resources and has many relatively efficient export industries.

Although, a big privatisation program has started, tariffs have been dismantled and a great deal of foreign investment has been attracted in the country, during the last decade alone five price and wage freezes, eleven stabilisation programs, three debt moratoriums, and seven letters of intent by the IMF, took place. Brazil's main problem is inflation: in 1993 it was still around 30% a month, and during the first months of 1995 it grew again to around 700%.

This high inflation rate leads to higher interest rates, and diverts investment to government bonds rather to investment in physical assets, a typical example of the "crowding out" effect. Furthermore, it denies working capital to smaller firms. Oddly, Brazilians have long been able to live with this problem. The GDP from 1,233 million in 1989 rose to 31,802 million in 1990 and 1,804,533 million in 1992 (in local currency units). The economy grew by 3.5% in 1993 and it approached 6% in the first quarter of 1995.

The current account (which records all exports and imports of goods and services) was at a US$ 12,806 million deficit in 1980, but by 1992 it was at a US$ 6,275 million surplus, and in 1994 the surplus had grown to US$ 10,400 million. In 1980, exports were at US$ 20,132 million, but by 1990 they had grown to US$ 30,870 million, and by 1993 to US$

38,701 million. Industrial production grew at a rate of 12.5% between November 1994 and November 1995.

Chile.

For many economists the best managed economy of the region is that of Chile (population 13.81 million). Switzerland's World Economic Forum (1993), for example, ranked Chile as the fifth most competitive economy among the newly industrialised countries after Singapore, Hong-Kong, Taiwan, Malaysia. The Chilean economy had long been a state dominated one: during the 1970s and some of the 1980s, banks, copper companies, and many factories, were state owned; the prices of some 3,200 items were controlled.

The reforms that were initiated in the 1980s transformed the country to a relatively free market economy, with a prosperous private sector, rising exports, a steady inflow of foreign investment, and many abolished tariffs. For example, exports have risen from 12% of the GDP in 1973 to 35% of the GDP in 1993. Annual inflation had fallen from 505% in 1974 to around 12% in 1993. Investment, much of which comes from abroad, was at the rate of 19% of GDP in 1993. In addition the unemployment rate was around 4%. By 1990, 67 people in every 1000 have a telephone line, an increase of 60% since 1960.

The current account moved from a deficit of US$ 1,971 million in 1980, to a surplus of US$ 700 million, in 1994. The trade balance (merchandise exports minus merchandise imports) was at a 764 million US$ deficit in 1980, but since 1982 it is in a surplus.
The GDP grew at an average rate of 3.9% a year in the 1990s, while industrial production grew at a rate of 2.2%. Inflation in February 1995 was running at the rate of 8.5% and short term interest rates were at 12.8% p.a.

Argentina.

In Argentina (population 33.5 million people) one of the most important reforms was the Convertibility Law that passed in the beginning of the 1990s which lays down that the monetary base of the peso must not exceed the value of the country's foreign reserves. Every peso can be converted, one for one, to US dollars. The result was amazing: in 1989 consumer prices were rising by almost 5,000%, while in 1993 the rate was only 12%.

GDP growth for 1994 was 4.5%, while the current account is constantly in deficit since 1980, with the exception of 1990. The trade balance, though, was in constant surplus between 1981-1992, while the surplus grew from US$ 712 million in 1981 to US$ 9,100 million, in 1994. Industrial production rose at a rate of 4.1% in 1994, and inflation ran at 5% in 1995. Short term interest rates were at 10.70% p.a.

Mexico.

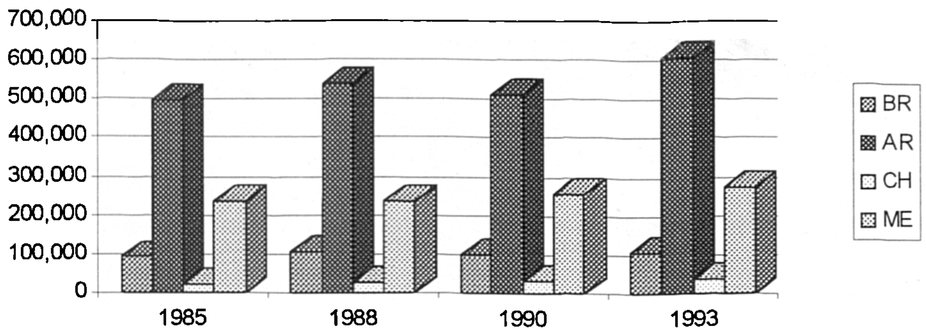
Mexico (population 86 million people) has also undergone a great deal of reforms. The Mexican economy is much more open than before; Mexico has joined GATT and the NAFTA (North American Free Trade Agreement) is under way. However, there is still a long way to go: huge public utilities such as electricity, railways, oil companies, are still state owned, deregulation is needed in the financial services sector. Adult literacy in Mexico at 1960 was 65% while in 1990 it had increased to 87%. In 1990 there were 132 telephone lines for every 1000 people, an increase of 175% from 1960. Most of Mexico's business is done with the USA: 70% of Mexico's total imports in 1992 came from the USA, and 76% of its exports went to the USA. Mexican tariffs on American goods have fallen from 100% in 1981 to 10% in 1993, and American tariffs on Mexican goods average 4%.

Mexico's current account had a deficit of US$ 10,750 million in 1980, a deficit which grew to US$ 18,600 million in 1994, while the trade balance was in deficit by US$ 27,200 million in 1994. Industrial production grew at a rate of 7.3% in 1992, 6.9% in 1993 and 6.7% in

1994. The GDP grew at a rate of 4.5% in 1994 and in 1995 inflation was running at the rate of 7.1%. Short term interest rates were at 30% p.a.

Diagramatically, Figure 1, presents the GDP growth of the four Latin America countries of the sample, in 1990 prices (US $, millions), for four different years during the last decade. It becomes apparent that the biggest economy in the region is that of Argentina, with Brazil coming second, and Mexico third. We can easily observe the upward trend in GDP growth for all countries.

Figure 1. GDP of Latin America countries, 1990 prices, in millions of US $.



Notes to Figure 1:
BR stands for Brazil, AR for Argentina, CH for Chile, ME for Mexico.

To recapitulate on the Latin America markets, we have seen that the economic problems increased in severity with the first oil crisis in the beginning of the 1970s (see below for more) when the countries of the region were faced with higher oil prices. Governments resorted to higher borrowing until 1982 (second oil crisis) when they had to reschedule their debts. This was the beginning of a new era for the region's economies, where, with the co-operation of the World Bank, reforms started to take place, budgets were balanced, markets were liberalised, a new regulatory environment was established, a long privatisation programs was initiated and tariffs and quotas were abolished. The results included high growth rates, lower inflation and higher industrial production.

2.2.3. The Asian-Pacific region.

The situation appears to be quite different with the Asia-Pacific countries. Many of these economies responded differently to the two oil shocks and the result became apparent in the late 1980s and the beginning of the 1990s. As we shall soon see, these countries were less indebted than their Latin America counterparts, so they did not suffer as much from the increase in interest rates in the 1980s. Also, they followed relatively cautious macroeconomic policies in the 1970s, thereby avoiding high inflation, and simultaneously they made productive use of borrowed external funds, invested in human resources, expanded productive bases and did not allow public sector enterprises to run massive deficits.

India.

In India (population 870 millions) during the 1980s the economy was growing at a very fast rate. In 1988, for example, it reached 10%. This growth, however, was financed mainly by borrowing which led to an increase of the foreign debt and record budget deficits. Economic reforms started to take place in the beginning of the 1990s; the government used mainly devaluation and deflation to avoid defaulting on their foreign debt, which combined with the reforms to open up the economy put the country's economy back on course: the list of industries reserved for the public sector fell from 17 to 6, quotas were abolished on all imports except consumer goods, the maximum import duty was slashed from over 200% to 85%, foreign institutional investors were allowed to invest in the stock market, subsides to the public sector were slashed, a privatisation program was initiated.

The budget deficit shrunk from 8.3% of the GDP in 1991, to 4.7% in 1993, while inflation fell from around 17% in 1991 to 9% in 1994. Growth in GDP rose from 1.2% in 1991 to 4.7% in 1994. Industrial production rose from 2.9% in 1992 to 10.3% in 1994. The country's foreign reserves rose from US$ 8 billion in 1992 to US$ 19.7 billion in 1994. The collapse of the Soviet Union has harmed the exports of India: in 1993 exports grew by only

3.6%. When, the rupee was made convertible for settling trade accounts exports soared by 28.9%, in April 1993.

Thailand.

Thailand (population of 55.58 millions) in the 1980s was growing at a rate of more than 10% a year. In the beginning of the 1990s growth slowed down but remained at high levels by international standards, i.e. 7-8%. However, despite this economic growth poverty is proving stubbornly hard to eradicate. According to a World Bank study in six East Asian countries Thailand was the only country that had failed to make significant inroads into poverty during the 1980s. In 1980, 17% of the population were living in 'absolute poverty', while in 1990 the figure was still around 16%. World Bank officials noted that in 1990 Thailand's incidence of poverty was as high as Indonesia's, even though its average GNP per capita was 2.5 times higher. Chalongphob Sussangran of Thailand's Development Research Institute points out that even if all primary-school pupils go to higher education from 1993 and onwards, there will still be 70% of Thailand's workforce in the year 2000 that will have only primary school education (source: *The Economist*, October 1994, Survey: The Global Economy).

Despite rapid industrialisation, 55% of the population still live in the countryside and in 1990 there were only 21 telephone lines per 1000 people. Rice remains the second biggest export by value, after textiles and clothes. The country was the world's largest exporter of rice in 1993. The country's current account is at a constantly in deficit, while the trade balance follows a similar pattern. Inflation was running at the modest rates of around 6-7% in the beginning of the 1990s (in 1994 it was 4.6%). Short term interest rates were 12% p.a. For 1994, the GDP grew at a rate of 8.4%, and industrial production at a rate of 8.9%.

Malaysia.

Malaysia, with a population of 18.61 million people, is experiencing a steady growth during the last years: GDP grew at a rate of 8.9% in 1994, industrial production at a rate of 11.8%, and inflation was at 3.2%. The current account has been in a deficit since 1980, while the trade balance on the other hand had been for nearly all the 1980s in a surplus. Inflation has always been low during the 1980s, within the range of 2-7%, so interest rates also remained low within the range of 3-9%. In 1994 short term interest rates were 5.71% p.a. Telephone lines per 1000 people rose to 91 in 1990 from 24 in 1960 (+278%).

South Korea.

South Korea, with a population of nearly 44 million is also experiencing, during recent years, strong economic growth: in 1994 GDP was up 7.7%, industrial production was growing at the rate of 12.1%, inflation was 4.9%, and short term interest rates were at 16.5% p.a. The current account was constantly in surplus during the second half of the 1980s, as was the trade balance, however, they both returned to deficits in the 1990s. The foreign reserves were at US$ 20.2 billion in 1993 and US$ 25.6 billion in 1994.

Furthermore, in contrast to Thailand, for example, the country has significantly improved the standard of living of the population: in 1970 23% of the population were living in conditions of absolute poverty, nearly as many as in Thailand. In 1990 only 5% of the population were living in absolute poverty compared with 16% in Thailand (World Bank, see above). For every 1000 people there are 303 telephone lines, an increase of 658% from 1960.

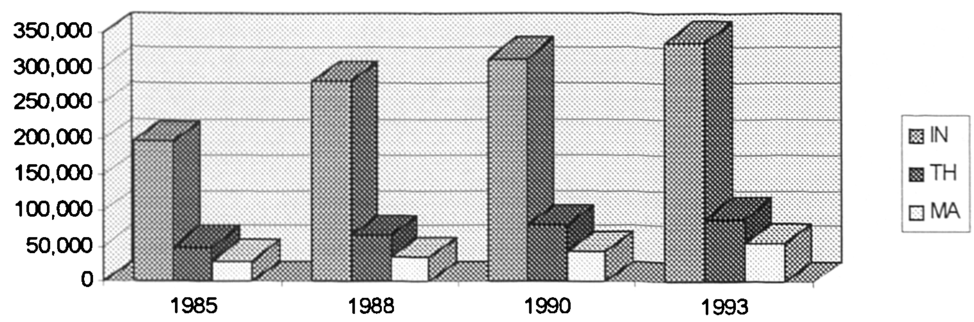
Philippines.

Philippines (population 66 million) in 1994 experienced a GDP growth of nearly 5.1% while industrial production grew by only 0.8%. Inflation was around 6% and short term interest rates were 8.44% p.a. in 1994. The government has started a liberalisation program that has opened up many sectors of the economy: Telecommunications (which was owned by one family) and shipping have already been freed. The banking sector is soon to be opened to foreign competition.

Philippines, like Thailand, have failed to tackle the problem of poverty despite the industrialisation that has recently taken place in these countries. The World Bank estimates that in 1988 about 21% of the population lived below the poverty line compared with about 35% in 1971. Furthermore, nearly 60% of the population is living in the countryside.

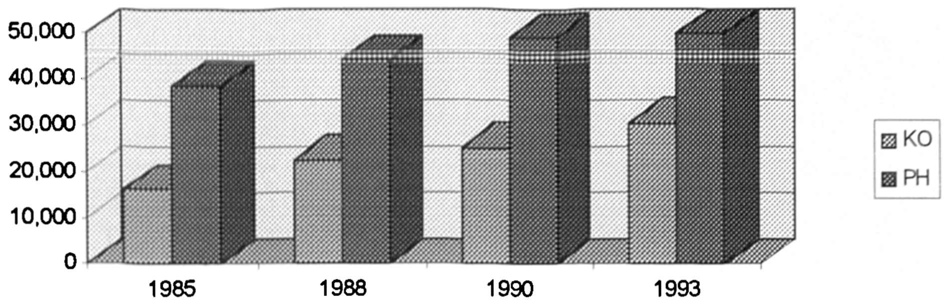
Figures 2 and 3 exhibit the evolution of the GDP of India, Thailand, Malaysia (figure 2) and Philippines and Korea (figure 3), for 4 different points in time during the last decade.

Figure 2. GDP of India, Thailand, Malaysia, 1990 prices, in millions of US$.



Notes to Figure 2:
IN stands for India, TH for Thailand, MA for Malaysia.

Figure 3. GDP of Korea, Philippines, 1990 prices, in millions of US$.



Notes to Figure 3:
KO stands for Korea, PH for Philippines.

We can easily observe the upward trends in the evolution of the GDP in the Asian countries, and from comparing the GDP of the Asian and the Latin America countries it becomes apparent that the former have experienced much higher levels of growth than the later, a fact confirmed by the tables in the beginning of the Chapter.

Now that we have, briefly, described the macroeconomic environment in the markets of our sample, perhaps it is time to turn our attention to an important topic that has played a crucial role in the way governments and financial institutions in these countries behave function and operate.

2.3. THE INTERNATIONAL DEBT CRISIS.

During the 1960s the economies of many developing countries grew relatively rapidly. Export markets in the industrialised countries expanded and their productive capacity also grew quickly. Direct investment by foreign companies and official funds accounted for most of the external development finance. International banks were finding developing countries to be increasingly attractive customers, in the late 1960s and early 1970s. Long-term borrowing from financial institutions by the 25 major borrowers grew annually at an average rate of over 30% between 1967 and 1973.

The 1973 oil price rises increased the import bills of those developing countries that did not produce oil themselves. Growth slowed down, and the terms of trade worsened, so current account deficits widened. At the same time the resulting recession in the industrialised countries severely curtailed their export earnings. The governments of many of these countries tried to maintain the growth levels by heavy borrowing. For these countries the relatively low incomes and poorly developed capital markets meant that there were insufficient domestic savings to finance the needs of the governments. So, they had to look to international banks for borrowing.

International bankers at the time were more than willing to lend money to developing countries for many reasons: These countries still appeared to have a steady growth, while the banks had excess of savings looking for appropriate investment opportunities (funds deposited to them by the oil producing countries-for example the current account surpluses of the OPEC countries rose from $6.2 billion in 1973 to $66.7 billion in 1974) and at the same time the recession that hit industrialised countries offered limited opportunities for profitable investment.

What the international bankers failed to take under consideration, however, was that the current account deficits of the Less Developed Countries (LDCs) that borrowed from them grew from $8.7 billion in 1973 to $42.9 billion in 1974 and $51.3 billion in 1975. The LDCs until 1979, had no particular problems in servicing their debts, since they were experiencing healthy rates of economic growth. So, the governments of many of these developing countries after the first oil shock failed to adjust their policies to the changing economic climate. They relied on bank lending.

The second oil shock in 1979-1980, worsened this situation, since these countries stepped up their bank borrowing to finance their widening current account deficits. The share of bank borrowing in total finance rose to over 70% and became increasingly short term as banks now became less willing to lend for long periods. At the same time industrialised countries, in contrast to their reaction to the first oil shock, tightened economic policies in order to accommodate the inflationary impact of higher oil prices. Real interest rates rose substantially. The exchange rate with the dollar, in which some four fifths of the debt was dominated, rose sharply, increasing the share of export revenues needed to finance their debts.

The result was that the total external debt of non oil producing countries had risen from $200 billion in 1973 to $330 billion in 1978 and $670 billion in 1983. Over $600 billion was concentrated in the 25 major debtors. The five largest (Mexico, Brazil, Argentina, South Korea, Venezuela) accounted for almost half the total.

Most LDCs, particularly in Latin America, found themselves with record levels of indebtedness and debt service repayments, while at the same time their ability to raise revenues to finance their payments had greatly diminished.

The debt crisis began with the Mexican moratorium (12th of August 1982). Mexico requested further new loans from foreign governments and a rescheduling of its principal repayments which were falling due. This made international banks realise that many other countries were facing similar difficulties in servicing their debt and if Mexico went into default it could be quickly followed by other major debtors. Many US banks had more loans outstanding in Latin America than the value of their equity. A default by any of the big four debtors could easily have set off a chain reaction of banking failures and provoke a collapse of the banking systems in the developed countries.

The debt crisis was managed on a case by case basis. The creditor banks dealt with each debtor nation on an individual basis rather than collectively as a group. The sets of proposals for solving the debt crisis, can be broadly categorised into three strategies, although most proposals combine elements of the three: a) alter the structure and nature of the debt, b) economic reform in the debtor countries and c) some degree of forgiveness on the debt owed. The banks and international institutions such as the International Monetary Fund have been keen to promote economic reforms such as exchange rate devaluation (to make economies more competitive), a tight fiscal policy based primarily on reducing government expenditure and a tight monetary policy (to stabilise inflation).

Also, deregulation was needed in many cases. Overall the measures have been summed up as 'devaluation, deflation, deregulation". However, it has to be mentioned that 61 out of 111 developing countries did not have to reschedule their debts. Most of these countries were located in Asia. The reasons why they did not face such difficulties in servicing their debts, like the Latin America and sub-Saharan African countries, were mainly three: firstly, they were typically less heavily indebted so they did not suffer as much from the increase in the interest rates, also being less dependent on commodity prices they were better able to withstand the decline in commodity prices. Secondly, they treated exogenous shocks as permanent and promptly undertook adjustment, thereby avoiding recourse to excessive borrowing. Thirdly, they followed relatively cautious macroeconomic policies in the 1970s, thereby avoiding high inflation and simultaneously made productive use of borrowed external funds, eased infrastructure bottlenecks, invested in human resources, expanded productive base, and did not allow public sector enterprises to run up massive deficits.

This was the economic environment in which most of the developing markets were operating until the beginning of the 1990s, and it would be fair to say that the economic reforms which took place appeared to be working for many of these markets, which are now called, by the economic community, the emerging markets.

2.4. SOME KEY MACROECONOMIC INDICATORS.

Figures 4 to 9, present some key macroeconomic indicators. Published data from the International Monetary Fund's Statistical Yearbook was examined and five key indicators were constructed for the countries in the sample: the Trade Balance, the Current Account Balance, Imports, Exports, and Inflation. The aim of this exercise is to compare the trends between the regions, and see how the main sectors of the economies have evolved during the last decade.

Figure 4 exhibits the Trade Balances of the two regions for 1980, 1985, 1990 and 1993. We can see that the Asian (ASIA) countries had, for most years, a negative balance in contrast to their Latin America (LA) counterparts. It becomes apparent that during the 1980s there had been a major improvement in both regions' Trade Balances but the situation deteriorated again in the 1990s.

As for the Current Account Balances, the trends are similar: all countries have a negative Current account Balance and they seem to follow a similar trend. The situation improved in the 1980s and started to deteriorate in the 1990s.

Figures 6 and 7 present the total imports and exports of the countries of the sample and a feature that becomes apparent is that both exports and imports follow a similar upward trend for all countries and for most of the time period under study. Note that while in the beginning of the 1980s the imports of the 4 Latin America countries of the sample were nearly three times as large as the imports of the Asian countries, by the middle of the 1980s they were the same and since then the Asian imports exceed these of the Latin America countries. As for the exports, it is clear that there is an upward trend for both regions with the Asian region having a much higher rate of growth of the exports.

Figure 4. Trade balances in millions of US$.

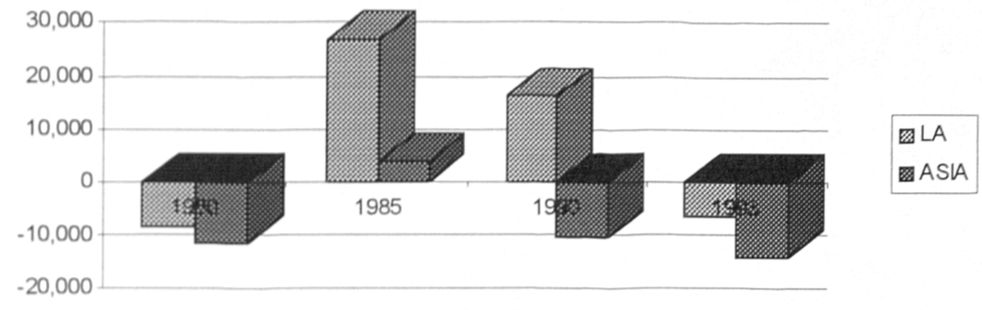


Figure 5. Current Account Balances in millions of US$.

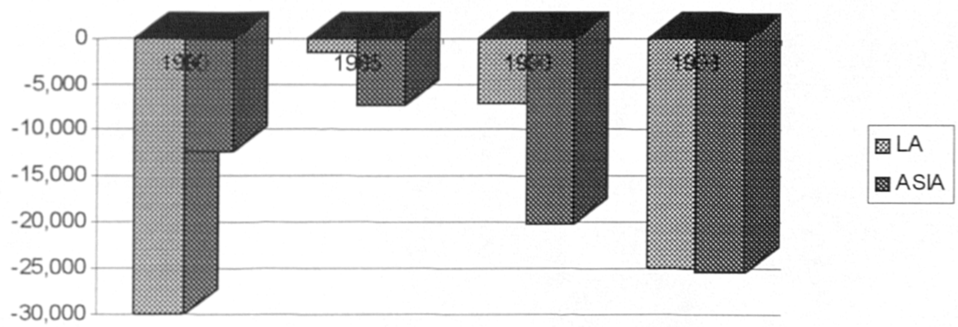


Figure 6. Total Imports in millions of US$.

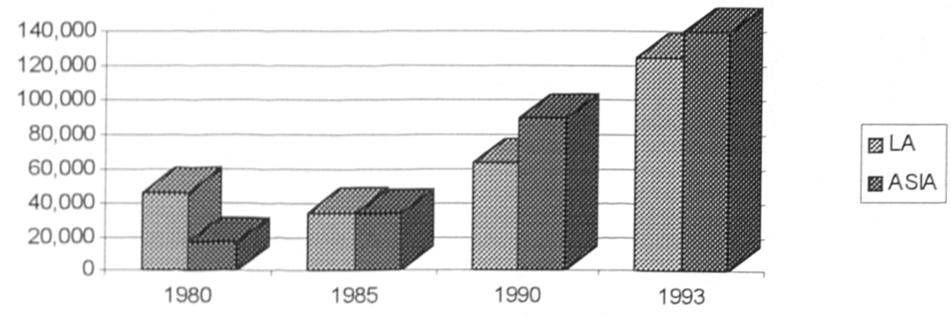
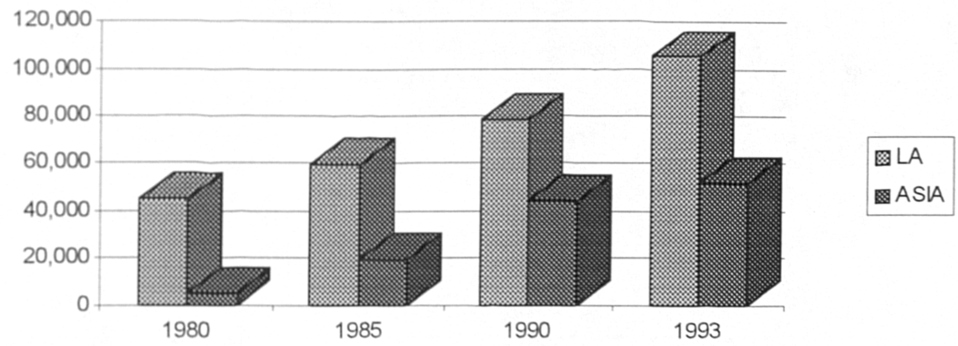


Figure 7. Total Exports in millions of US$.



The following figures 8 and 9 plot the average rates of inflation (%) of the countries of the sample for the period 1977Q1-1994Q4 with the IFC data. Figure 8 plots the average rate of inflation for the 4 Latin America countries and figure 9 plots the rate of inflation for the Asian, Asian-Pacific countries

The differences in the evolution of the prices for the two regions becomes apparent: for the Latin America region inflation rates of 200-300% are the norm for most of the period and at the beginning of the 1990s prices change at the rate of 2000%, while in the Asian region prices change with modest rates, the highest level being 18%, and a clear downward trend is evident for the last decade

Figure 8. Average inflation rate (%) for the 4 Latin America countries of the sample, quarterly data, 1977Q1-1994Q4.

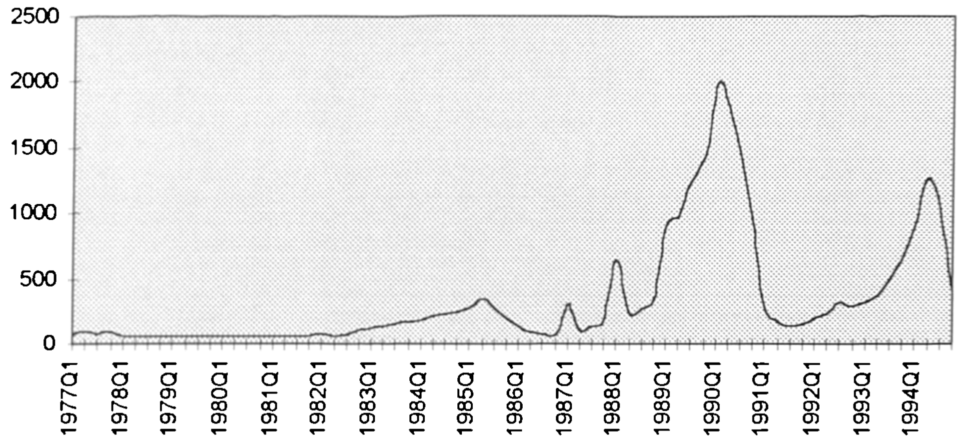
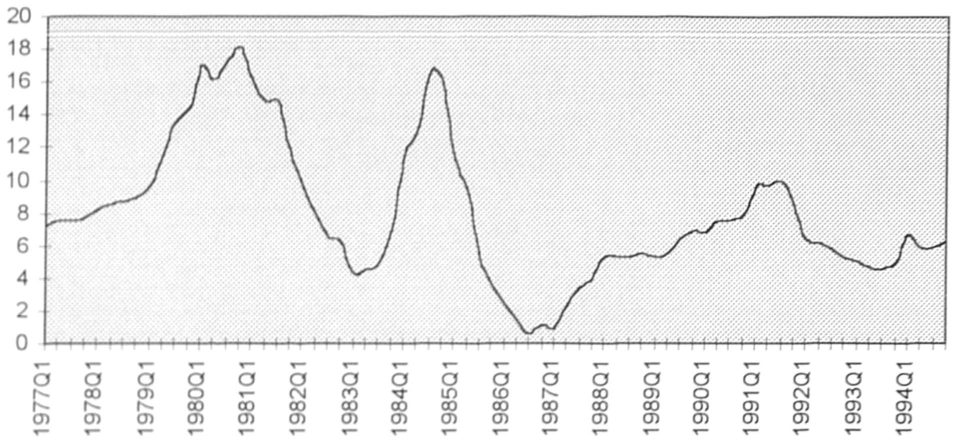


Figure 9. Average inflation rate (%) of the six Asian, Asian-Pacific countries of the sample, quarterly data, 1977Q1-1994Q4.



2.5. THE EMERGING STOCK MARKETS.

The significant political changes that took place in most of the LDCs during the last 10-15 years could not (and did not) leave their financial markets unaffected. The opening of the economies to the outside world and the high growth rates soon attracted American and European Funds whose managers were looking for new global opportunities. The money that poured into these economies, either in the form of direct investment or in the form of indirect investment, further boosted the economic transformation of these countries.

In Table 2.3 we can see exactly how many International Emerging Market Equity Funds were active in these markets and more importantly, how much money was directed toward these markets, during the period 1988-1993. The first thing to note is that Africa has failed to draw the attention of Western fund managers (only 45 million US$ and 2 funds invested there by 1993) In the Asia region (including China) 63% of the total funds and 52% of total assets are invested. By contrast in the Latin America region one can find only 14% of the total number of funds and 12.4% of the total assets invested.

The single country with the most money invested is Korea with 3,420 million US$ and 56 funds, or equivalently 4.6% of total assets and 10% of the funds. Also, note that the fund managers have invested more than US$ 300 million in Korea, India, Thailand, Taiwan, Brazil and Mexico, from as early as 1988; the rest of the markets started to attract funds mainly in the 1990s.

Finally, one can easily observe the growth rates in the exposure of the funds in the emerging markets: since 1988 total assets invested in the emerging markets by Western Funds have risen by 1114% and the number of funds investing there increased by 492%.

Table 2.3

The Historical Growth of International Emerging Market Equity Funds.

Equity Funds	Total Net Assets in US$ millions (numbers of Funds in Brackets)				
	1993	1992	1991	1990	1988
Global	24,750 (108)	7,750 (78)	3,750 (39)	2,300 (29)	900 (15)
Asian Regional	21,500 (130)	8,000 (115)	5,350 (92)	4,000 (75)	1,750 (35)
China	3,220 (48)	1,300 (34)	110 (4)	60 (3)	47 (2)
India	2,055 (13)	1,090 (7)	970 (6)	830 (6)	270 (3)
Indonesia	860 (22)	440 (21)	400 (18)	525 (18)	35 (1)
Korea	3,420 (56)	1,710 (38)	1,310 (24)	1,205 (13)	990 (10)
Malaysia	995 (17)	620 (19)	600 (17)	505 (17)	75 (3)
Pakistan	310 (6)	65 (3)	65 (2)	0	0
Philippines	670 (10)	350 (9)	290 (8)	240 (8)	45 (3)
Sri-Lanka	30 (1)	0	0	0	0
Taiwan	1,860 (16)	925 (15)	890 (13)	475 (5)	380 (4)
Thailand	2,860 (26)	1,920 (26)	1,580 (26)	1,400 (25)	845 (11)
Vietnam	50 (3)	30 (2)	10 (1)	0	0
Latin America Regional	5,200 (53)	2,000 (40)	1,510 (18)	380 (5)	0
Argentina	170 (3)	105 (2)	115 (2)	0	0
Brazil	625 (8)	485 (8)	380 (4)	165 (3)	220 (3)
Chile	1,115 (4)	850 (4)	740 (4)	380 (4)	0
Colombia	63 (1)	17 (1)	0	0	0
Mexico	1,865 (8)	1,040 (8)	780 (5)	530 (4)	300 (1)
Peru	30 (1)	20 (1)	0	0	0
East Europe	570 (11)	350 (8)	240 (5)	210 (4)	0
Greece	95 (2)	100 (2)	120 (2)	130 (2)	70 (1)
Turkey	145 (2)	80 (2)	90 (2)	115 (2)	0
Portugal	275 (6)	225 (5)	225 (5)	230 (5)	50 (2)
Africa	45 (2)	15 (1)	0	0	0
TOTAL	**72,778 (557)**	**29,487 (449)**	**19,525 (297)**	**13,680 (232)**	**5,977 (94)**

Source: 1994-1995 Micropal Directory of the Emerging Markets, as of December 31, 1993.

The fund managers are not interested only in emerging market Equity but also in emerging market Debt. A similar trend with that of the above table is observed with LDC Debt. The following Table 2.4 gives a clear picture of the distribution of the funds between Equity and Debt, as of September 13, 1994. It can easily be seen that the Latin American Debt attracts more funds than the Asian Debt, in other words fund managers appear more interested in Asian Equities and Latin American Debt. Nearly 12% of all emerging market funds in 1994 were investing in emerging market Debt, which can be a very profitable investment indeed, under certain conditions. For example, the price of Sudan's external Debt traded in the secondary market rose 700% in the second half of 1992, an amazing fact considering that there was a civil war going on in the country (obviously, for some investors things could just not get worse, so they rushed in and bought the debt).

Table 2.4

Distribution of Funds in Emerging Markets.

SECTOR	Number of Funds
Global Emerging Equity	130
Global Emerging Debt	35
Latin American Regional Equity	76
Latin American Regional Debt	26
Latin American Single Country Equity	40
Latin American Single Country Debt	24
Asian Regional Equity	172
Asian Regional Debt	5
Asian Subcontinent Equity	32
Emerging Europe Regional Equity	3
East European Funds	22
Mediterranean Funds	12
Africa and Middle East Equity	19
Africa and Middle East Debt	4
Total equity	738
Total Debt	94

Source: 1994-1995 Micropal Directory of emerging Market Funds.

In general, emerging market debt investors have discovered that if priced low enough the debt of even the most troubled countries can produce big gains. The belief is that the trend toward market economies and the expansion of foreign investment will eventually spread in all LDCs. The "exotic" assets (as debts like that of Sudan are called in the bond dealer jargon) represent a very small portion of the market: Mexico for example has more than US$ 20 billion of fixed rate Brady par Bonds outstanding compared with US$ 750 million of debt issued by the Dominican Republic. However, it is the "exotic" instruments that yield the high returns: according to J.P.Morgan in the first 10 months of 1993 the "exotic" Peruvian Loans gained 134% and the Moroccan Series A loans gained 69%.[6]

As mentioned earlier, this flow of funds has altered the very nature of the emerging stock markets: the total market capitalisation of the 25 emerging markets that had a stock market in 1980 was US$ 144,849 million and by 1992 it had risen to US$ 981,295 million, an increase of 577% in 12 years. Table 2.5 presents the difference in market capitalisation between 1980 and 1992 for the 10 markets of the sample, US and Japan.

Table 2.5

Market Capitalization of emerging markets in US$ millions.

Market	1980	1992	(%) change
Brazil	9,160	45,261	+394
Chile	3,864	18,633	+382
Mexico	12,994	139,061	+970
Argentina	3,864	18,633	+382
India	7,585	65,119	+759
Thailand	1,206	58,259	+4,731
Malaysia	12,395	94,004	+658
Taiwan	6,082	101,124	+1,563
Korea	3,829	107,448	+2,706
Philippines	3,478	13,794	+297
USA	1,448,120	4,023,000	+178
Japan	379,679	2,332,000	+514

Source: International Finance Corporation.

Not surprisingly, the biggest change is observed in Thailand (+4,731%) and Korea (+2,706%) the two countries that have attracted the highest numbers of funds and assets (see Table 2.3).

A very similar trend is observed with the average daily trading volumes in these stock markets. Table 2.6 exhibits the average daily trading volumes for years 1980 and 1992 along with the percentage change. Once more we can see that the biggest change in trading volume is observed in Korea (+6,927%) and Thailand (+13,014%).

[6] While for the same period, the J.P.Morgan Global Bond Index returned 12% and the Brady Bonds gained 36% (Source: Bloomberg Newsletter Summer 1995).

From both Tables 2.5 and 2.6 we can see that the Asian region stock markets have benefited the most from the wave of Western investment in the emerging markets in both market capitalisation and average trading volume. The Latin American stock markets have attracted less funds; their percentage changes are not negligible but (with the exception of Mexico) are significantly lower than the Asian markets.

Table 2.6.

Average daily trading volumes in emerging stock markets in US$ million

Market	1982	1990	(%) change
Brazil	24.15	71.52	+196
Chile	2.49	6.91	+177
Mexico	14.83	162.60	+997
Argentina	4.95	65.30	+1,219
India	12.55	28.51	+127
Thailand	1.40	183.59	+13,014
Malaysia	11.69	119.55	+923
Taiwan	20.47	352.78	+1,624
Korea	8.50	597.26	+6,927
Philippines	2.81	12.49	+344
USA	1,862.80	6,899.01	+270
Japan	731.50	1,882.32	+157

Source: International Finance Corporation.

Finally, Table 2.7 presents some discriptive statistics on the sample markets that we employ in this study. The features that become imediately aparent are, first, the substantial gains for an investor who bought a portfolio the biggest and most liquid companies in these markets (more specifically the IFC 'portfolio') in the 1970s and held them until the middle 1990s.

However, one has to bear in mind the high inflation rates (especially for the Latin America countries) and the fluctuations in the exchange rates. Even though, Philippines, for example, has returned nearly 3,200% within the last decade with an inflation rate below 10%. From the table we can also see the big differences between the Latin America countries and the Asian countries regarding consumer prices, and interest rates. Inflation rates above 30-40% (or up to many thousand %, for a period) are the norm for Latin America in contrast for the Asian countries which exhibit modest rates.

Table 2.7
Main differences and similarities of sample markets.

A. DESCRIPTION OF STOCK MARKET DATA.

COUNTRY	Number of stocks (market)[1]	Number of stocks (IFC index)[2]	Market capitalization (IFC Index)[3]	Net % return of IFC Index[4]	% of market cap. held by 10 largest stocks[5]
Brazil (1977)[6]	565	69	23.20	71.7	29.3
Argentina (1977)	175	29	14.29	5321	68.8
Chile (1977)	80	35	21.93	8366	78.5
Mexico (1977)	195	62	66.11	1092	31.7
India (1977)	2,781	62	25.36	1101	22.6
Korea (1977)	688	91	66.46	329.9	30.5
Thailand (1977)	305	51	28.37	704.6	28.5
Taiwan (1985)	256	70	60.45	992.2	30.2
Philippines(1985)	170	30	8.17	3162.8	52.2
Malaysia (1985)	366	62	47.94	191.22	30.9

B. MACROECONOMIC INDICATORS.

	Average imports (in millions of US$)[7]	Average expotrs (in millions of US$)[8]	Average interest rate (1980-1994)[9]	Average inflation rate (1980-1994)[10]	Recipients of FDI (billions of US$)[11]
Brazil	6,621	9,307	4,041	706.2	7.6
Argentina	6,544	8,191	595,6	572.5	10.6
Chile	6,585	7,098	28.3	24.6	na
Mexico	24,038	23,754	37.3	46.8	18.4
India	16, 424	11,801	na	11.0	na
Korea	35,897	42,935	10.05	8.68	na
Thailand	14,709	12,550	11.4	5.49	9.5
Taiwan	na	na	na	na	6.0
Philippines	11,484	8,253	15.2	13.1	na
Malaysia	19,125	26,382	5.39	3.91	13.2

Notes to Table:
na: not available
1,2,3,5 *Source:* Claessens, S., Dasgupta, S., Glen, J., 'Returns Behavior in Emerging Stock Markets", *The World Bank Economic Review*, 9, 1995, page 136. Figures correct as of December 1992. Market capitalization in billions of US dollars.
4 The return from a buy and hold strategy from the begining of the sample period until December 1994. The simple % net return between two periods t and t-1 is defined as $R_t = [(P_t / P_{t-1}) -1] \times 100$.
6 The year in parenthesis is the start year of available data for the respective IFC indices.
7,8 Average yearly imports and exports figures for period 1980-1995..
7,8,9,10 *Source*: International Monetary Fund Statistical Yearbooks, 1980-1995.
11 FDI=Foreign direct Investment, 1988-1993. *Source*: *Ecomonist*, October 1994.

2.6. CONCLUSION.

To sum up the discussion in this chapter, we have seen that the financial problems of the emerging markets increased in severity (especially in the Latin America markets) with the first oil crisis in the beginning of the 1970s, when most of the then LDCs were faced with higher oil prices. What actually happened was that the 1973 oil price rise increased the import bills of those developing countries that did not produce oil themselves. As a result, growth slowed down, and the terms of trade worsened, so current account deficits widened. The governments of many of these countries tried to maintain the growth levels by heavy borrowing. The second oil shock in 1979-1980, worsened this situation, since these countries stepped up their bank borrowing to finance their widening current account deficits At the same time, since the industrialised countries tightened economic policies in order to accommodate the inflationary impact of higher oil prices, the exchange rate with the dollar (in which some four fifths of the debt was dominated) rose sharply.

Most LDCs, particularly in Latin America, found themselves with record levels of indebtedness and debt service repayments, while at the same time their ability to raise revenues to finance their payments had greatly diminished. So, after the Mexican moratorium, many countries asked to reschedule their debts. This made international bankers very wary because a default by any of the big four debtors could easily have set off a chain reaction of banking failures and provoked a collapse of the banking systems in the developed countries, since many US banks had more loans outstanding in Latin America than the value of their equity.

One of the strategies for the solution of the debt crisis was the promotion of economic reform in the debtor countries; the banks and international institutions such as the IMF have been keen to promote economic reforms such as exchange rate devaluation, a tight fiscal policy, a tight monetary policy, and deregulation. So, in co-operation with the World Bank reforms started to take place: budgets started to be balanced, markets were liberalised, a new regulation environment was established, a long privatisation program was initiated for the vast state-owned enterprises, tariffs and quotas were abolished and free trade started to take place. The results were soon apparent: in 1992 Chile grew at a rate of 10.4%, Argentina at a rate of 9%. Inflation in Mexico was around 10% and annual growth was between 2.5% - 4 5% for the period of 1989-1992. The situation in the rest of the LA countries was similar (note however that 61 out of 111 developing countries did not have to reschedule their debts; most of these countries were located in Asia).

That economic environment of high growth, low inflation, rapid industrialisation, and good future prospects (recall for example the World Bank's forecasts, Tables 1 and 2) soon attracted the attention of international fund managers who spotted in the emerging equity markets a good opportunity for capital appreciation. Thus, the total amount of funds investing in the emerging markets increased from 94 in 1988, to 557 in 1993, while the total assets invested increased from US$ 5,997 million to US$ 72,778 million, for the same period The effect of that foreign indirect investment was that equity markets like Thailand with a market capitalisation of US$ 1,206 million in 1982 have grown to US$ 58,259 million, by 1992, a change of 4,731%.

This rapid growth has made the emerging equity markets an important part of the international financial environment. However, there is very little research on the functioning and the efficiency of these equity markets. It is my intention to investigate many of the issues that relate to the efficiency of the markets, their long run trends, their sources of risk, and their volatility, in the rest of this thesis.

CHAPTER III.

LITERATURE REVIEW OF THE EFFICIENT MARKET HYPOTHESIS AND THE ASSET PRICING MODELS.

3.1. THE EFFICIENT MARKET HYPOTHESIS.

Market participants determine stock prices after evaluating the risk involved and calculating the expected cash flows to be received from a particular stock. In doing so they use all information that is available to them and also their beliefs about the future. In both cases information is the key issue in the determination of stock prices and therefore the central notion in the Efficient Markets (EM) concept.

One of the first definitions of the EM was given by E.Fama (1970b). He defined an EM as one where all prices fully reflect all relevant available information, quickly and accurately. Fama also operationalized the notion of capital market efficiency by defining 3 levels of efficiency as follows

a. Weak-form for efficiency: Historical price data should already be reflected in current prices and should be of no value in predicting future price changes. No investor should be able to earn excess returns by developing trading rules based on historical price or return information

b. Semi-strong form efficiency: If markets are semi-strong form efficient, then all publicly available information, such as earnings announcements, dividend announcements, stock splits, accounting changes, etc., should be quickly incorporated in the share price. No investor should be able to earn excess returns from trading rules based on any publicly available information. Note that the semi-strong form encompasses the weak-form because market data are part of the larger set of all publicly available information.

c. Strong-form efficiency: This form states that stock prices fully reflect all information, public or non-public. No investor should be able to earn excess returns using any information, whether publicly available or not.

In general, we can say that an Efficient Market can be determined by the following characteristics: a large number of traders, information availability, low transaction costs, homogenous expectations, free flow of funds and securities, competitive analysis, information is generated in a random fashion.

Most empirical studies on the EM agree that the markets are efficient in the weak and semi-strong form but not in the strong form. The fact that the EMH cannot be tested directly has driven researchers to test the implications of the EM i.e. to test whether returns are uncorrelated, whether expected excess returns are zero, on average, to test for the existence or not of superior trading rules that can lead to excess returns, to test whether information is incorporated in security prices instantaneously and in an unbiased way, etc.

We can categorise the empirical tests of the EM as weak form tests, semi-strong form tests, strong form tests.

a. Weak form tests: The Weak form EMH is related to the Random Walk (RW) hypothesis If prices follow a RW price changes over time are random (independent). The price change of today is unrelated to the price change of yesterday, or any other day. If new information arrives randomly in the market and investors react immediately to it, changes in prices will also be random. So, one way to test for weak market efficiency is to test statistically the independence of stock price changes. Stock price changes in an efficient market should be independent. A second way is to test specific trading rules that attempt to use past price data. Tests in the 1950s and 1960s, by Kendall, Working, Robert, Alexander, among others, suggested that prices respond only to new information and since new information may be random, prices will move in an unpredictable way. Tests of trading rules by Alexander (1961), Fama and Blume (1966), etc., revealed that a technical trading rule based on past price data, after all proper adjustments have been made (e.g. incorporation of transaction costs) cannot outperform a simple buy and hold strategy.

b. Semi-strong form tests: The empirical tests on the semi-strong form of efficiency are mainly tests on the speed of price adjustment to public information (such as stock splits, earnings announcements, etc.)

One of the first event studies (examination of a stocks' returns to determine the impact of a particular event) was conducted by Fama, Fisher, Jensen and Roll (1969). They used monthly data and 940 stock splits for the period 1927-1959. The question that drove their research was what effect stock splits have on shareholders wealth. A stock split adds nothing of value to a company and therefore should have no effect on the company's total market value. The FFJR used a Cumulative Abnormal Return (CAR) methodology based on the market model stock returns. Company returns are the residual error terms representing the difference between the securities actual return and that given by the market model i.e. any remaining portion of the actual return (after adjusting for what the company's return should have been, with the market model) is an abnormal return representing the impact of a particular event. The authors found that positive abnormal returns occur before the split, not after. They concluded the split itself did not affect stock prices This result supports the semi-strong form of efficiency.

Ball and Brown (1968) examined the speed of adjustment the US market to new information. They used monthly data for 261 firms for the period 1946-1965. They separated the sample into companies that had earnings that where either higher or lower than those predicted by a naive time-series model[12]. They found that when earnings were higher than predicted, returns were abnormally high. In addition returns appeared to adjust gradually until, by the time of the annual report almost all of the adjustment had occurred: most of the information contained in the annual reports was anticipated by the market before the report was released. Prices continuously adjust in an unbiased manner to new information.

[12] They also used a regression model to predict next year's change in earnings. Then estimated earnings changes were compared with actual earnings changes. If the actual change was greater than estimated the company was put in a portfolio where returns were expected to be positive and visa-versa.

Other researchers studied the effect on stock prices of announcements of accounting changes such as depreciation, investment tax credit and inventory reporting (LIFO versus FIFO). For example, Hong, Kaplan and Mandelker (1978) tested the effect of pooling and purchase techniques on stock prices of acquiring firms. With the pooling method the income statements and balance sheets of the merging firms are simply added together, while with the purchase technique the assets of the acquired company are added to the acquiring company's balance sheet along with an item called goodwill. According to US regulations goodwill should be written off as a charge against earnings after taxes, in a period not to exceed 40 years and while there is no effect on cash flows, earnings per share (EPS) decline In an Efficient Market, since there is no difference in cash flows between the two techniques (and it should be the cash flows not EPS the relevant information that investors are using to value the firm), there should be no difference between different accounting treatments of a merger. In other words, if markets are efficient, the stock price of the companies that used the pooling method should not exhibit an abnormal performance around the merger. They used monthly data for the period 1954-1964 and 122 firms that used the pooling and 37 that used the purchase method. Their results indicated that there was no evidence of positive abnormal performance around the month of the actual merger for the companies that used the pooling method, and no evidence of negative abnormal performance for the companies that used the purchase method, i.e. investors value companies on expected cash flows as the should in an efficient market.

c. Strong form tests: Studies of this form of efficiency have concentrated on whether inside information can lead an investor to earn abnormal returns. Jaffe (1974) and Finnerty (1976) both found that insiders can beat the market, but regulations prohibit the use of inside information. Furthermore, it has been argued that Mutual Fund managers and in general managers of big institutional funds can earn abnormal returns because of superior information, not available to the rest of the investors, although early research such as Jensen (1968), Mains (1977) and others found that fund managers could not outperform the market, after adjusting for transactions costs, etc.

3.2. MARKET ANOMALIES.

The theory of the EMH has often been challenged by empirical research that suggests that under some circumstances stocks or portfolios of stocks can earn "abnormal returns". In other words researchers have come up with results that are inconsistent with the economic theory. The most well known inconsistencies with the theory are the "size-effect", the existence of seasonality in stock returns and the excess volatility of stock prices relative to their fundamentals.

3.2.1. The Size Effect.

Many studies have examined the relationship between returns and total market value of common stocks. Very often it was found that smaller firms earned higher risk adjusted returns, on average, than larger firms. The size effect was documented for the first time in 1981 by Banz. He examined the empirical relationship between return and the total market value of common stocks. The results revealed that shares of firms with large market values had smaller returns, on average, than similar small firms. Keim (1983) also tested the relationship between the anomalous return and size and his results supported the findings of Banz Furthermore, he went on and examined the month-to-month stability of the size anomaly and reported that the size effect was more pronounced in January than any other month. Examination of the month-to-month magnitude of the size effect, measured by the difference in risk adjusted returns between the smallest market value portfolio and the largest market value portfolio, further supported this conclusion. The excess returns on January were persistent, of high magnitude and statistically significant. No persistent pattern was apparent across the remaining 11 months.

Ritter and Chopra (1989) documented a small firm positive return, even in Januaries for which the market return is negative. Furthermore, they found that the higher the beta the more positive the returns on small firms. The authors argued that patterns in small firms' returns have led other researchers to conclude that there is a January seasonal in stock returns, a conclusion that is not correct because this pattern exists only for small firms.

Fama and French (1992) evaluated the joint roles of market beta, size, E/P, leverage and book to market equity in the cross section of average returns on NYSE, AMEX and NASDAQ stocks for the period 1963-1990. Their results suggested that beta does not help to explain the cross section of average returns. Furthermore, the univariate relations between average return, size, leverage, E/P and BE/ME were strong. But the combination of size and BE/ME seemed to absorb the roles of leverage and E/P.

3.2.2. The January Effect.

Many empirical studies have documented statistically significant and positive returns during the month of January. This pattern consists a violation of the weak form of the EMH since mean monthly returns should be the same among all the months of a year. Many hypotheses have tried to explain the January effect. The most prominent ones are the Tax Loss Selling Hypothesis (TLSH) and the Information Hypothesis, (IH).

The TLSH was initially suggested by Branch (1977) and Dyl (1977) and the idea was based on a year end tax loss selling of shares that had declined in value over the previous year. Investors wish to realise their losses before the new tax year and this creates a downward pressure on these stocks near the end of the year and a price rebound at the beginning of the new tax year as the selling pressure dissipates.

The information hypothesis was based on the fact that January marks the beginning and the end of several potentially important financial informational events (Rozeff & Kinney, 1976). January is the beginning of the tax and accounting year for many firms, the start of the tax year for many investors, the time when announcements of previous years' accounting earnings are made, etc.

The portfolio rebalancing hypothesis was proposed by Hougen and Lakonishok (1987). Money managers engage in "window dressing" i.e. they rebalance their portfolios prior to the year end to remove securities which might be embarrassing if they appear in the year-end balance sheets. As soon as December 31 passes they rebalance their portfolios investing in more speculative securities including high risk small securities.

The studies that document the January effect are numerous. In one of the first studies on seasonalities Officer (1975) used Australian stock returns for the 1958-1970 period and developed a mixed autoregresive and moving average linear stochastic model which included seasonal elements. He then showed that forecast errors, using the seasonal model were lower than forecast errors using a simple random walk model. Furthermore, he found a 9-month, 6-month, and a lesser 12-month seasonal in the Autocorelation Function (ACF).

Rozeff and Kinney (1976) examined aggregate rates of return on the NYSE, for the period 1904-1974. All the tests in this study were on a market index because of earlier evidence (Officer 1975) that seasonality is more likely to be detected in an index of shares rather than in individual shares. A visual inspection of the monthly rates of return for the period 1904-1974 suggested that returns seemed to have been generated by a stochastic process that was mean stationary. Only for Oct. 1929 and May 1940 the observations lied more than 3 standard deviations from the mean. The authors calculated summary sample statistics of the stock return distributions by month and over 5 different time-periods. Upon examination of the arithmetic mean and the median a very consistent feature became apparent; a very high January mean rate of return, for all the time periods and for all statistics. Assuming that stock price behaviour is well described by a Random Walk and due to the controversy over the exact nature of the distribution of the model's variables the authors employed both non-parametric tests (which assume only that the distributions are continuous) and parametric tests (which assume normal distributions with finite moments). The nonparametric tests revealed that seasonality in the US market is a statistically significant phenomenon and that January is probably the reason for this. For the parametric tests, they started by testing the hypothesis of equal means. The null of homogeneity of variances was rejected. Furthermore, the null that monthly rates of return are equal over all months was also rejected. In summary, the parametric analysis' results were consistent with the nonparametric results indicating that monthly distributional differences exist and that

January is the month responsible. This study was one of the first studies that detected a January seasonality

Keim (1983) examined the month-to-month stability of the size anomaly and reported that the size effect was more pronounced in January than any other month. In the same year, Gultekin and Gultekin (1983) examined stock market seasonality in major industrialised countries. They used both parametric and nonparametric tests and both methods yielded similar results. In 12 out of 17 countries, for example, a Kruskall-Wallis nonparametric test rejected the null hypothesis that stock returns are time invariant, at the 10% level of significance. The authors investigated the relationship between the January seasonality and the existence of a December tax year end, to test the Tax Loss Selling Hypothesis, (TLSH). The evidence they found supported the TLSH.

The relationship between the turn of the year effect (i.e. the January effect) and the size effect was examined by Roll (1983). He calculated the mean difference in returns between an equally weighted index and a value weighted index, for the first and the last 20 trading days of each month, for the period 1962-1980. With this he tried to investigate whether there is a period, other than January, where the returns of small firms display a high premium, and the test showed that there is not. Then he identified 4 possible causes for the January seasonal: data base errors, new listings, delistings, "phoney" transactions. He discovered that new listings occur uniformly during the year, but delistings occurred more frequently near January the 1st. However, by excluding the 5 returns prior to the delisting and the 5 returns after the listing he observed that the January pattern still existed. The other two possible causes were similarly rejected. Then he examined the TLSH. He observed that a negative pattern exists between the turn of the year returns and the returns over the rest of the year and that small firms are more volatile than large firms. That meant that small firms had a higher probability of achieving a negative return over a given period. i.e. "they were more likely candidates for tax loss selling".

3.2.3. The Monday effect.

Many studies have examined the behaviour of stock returns around the weekend. The pattern that has been documented is statistically significant positive returns on Fridays and negative returns on Mondays. This violates the weak form of the EMH since mean daily returns should be the same among all the days of the week; any differences should not be predictable.

The first study on the weekend effect appeared in the literature in the beginning of the 1930s and was conducted by a graduate student at Harvard, M.J. Fields[8]. He reported that prices in the USA stock exchanges tended to rise on Saturdays. The next study appeared in 1973: Gross studied the returns on the S&P500 and found that the mean Friday returns were positive while the mean Monday returns were negative. French (1980) also studied the S&P500 index and obtained the same results. Gibbons and Hess (1981) studied the daily returns of the S&P 500, the Dow Jones 30 and the value-weighted and equal-weighted CRSP portfolios. As in earlier studies the sample means on Mondays were generally negative. A more formal test (a dummy variable regression) also rejected the null of equality of the distribution of the daily returns. The authors also examined the Treasury-Bill market for a weekend effect. They discovered a pattern similar to that of stock returns. Then they examined whether this phenomenon was due to market inefficiency. They extended the market model to include a variation in mean returns according to the day of the week: stock returns still exhibited day of the week effects.

Lakonishok and Levi (1982) suggested a possible explanation for the weekend effect. This explanation relied heavily on the delay between trading and settlements in stocks and in clearing cheques. In the US settlement takes 5 business days after trade. So, in an ordinary week (no holidays) payment is due on the same day as the trade but in the following week. In addition cheques take one day to clear. So, stocks purchased on days other than a Friday give the buyer 8 calendar days before losing funds for stock purchases. For a trade done on Friday, however, it takes 10 days due to the weekend. Buyers should therefore be prepared

[8] R. Thaler, " Anomalies", *Economic Perspectives*, Vol.1, No1, 1987, p169.

to pay more on a Friday due to the interest and should ask for more. Before 1968 a 4-day settlement was in effect therefore no different returns should be observed due to a different week day. Holidays should affect stock returns for the same reasons. The results of the tests revealed that returns, unadjusted for interest gains, on Mondays were significantly negative and on Fridays significantly positive. Adjusted returns were reduced, e.g. 1968-1973 period from 0.90 to 0.60, a reduction of 33%. The daily effect however was not eliminated.

Rogalski (1984) distinguished between trading-day and non-trading-day returns: while earlier studies measured the Monday return as the difference between Friday close to Monday close, he measured Monday returns as the difference between Monday open and Monday close. He discovered that prises tended to rise on Mondays and all the negative returns were measured between Friday close to Monday open, thus the Monday effect became the weekend effect. Furthermore, Rogalski, found that Friday close to Monday close returns were on average positive during Januarys, but negative during the rest of the year.

Jaffe and Westerfield (1985) examined daily stock market returns for UK, Japan, Canada and Australia. These countries account for nearly 87% of the worlds' market value of exchange-listed securities. They found a negative average Monday return and high average Friday and Saturday returns for each index. A difference in the means test confirmed the result. In addition a negative Tuesday return in Japan and Australia was detected. Lakonishok and Smidt (1988) noted that before June 1952 the NYSE was usually open for trading 6 days a week. So, they reported rates of return for two groups of Fridays: those followed by Saturdays and those followed by a long weekend. A dummy variable regression was used to test for the differences in the means. The null that all days of the week have the same rate of return was rejected and the Monday returns were found to be negative and significantly different from zero.

Chang, Pinegar, Ravichancram (1993) used daily returns on 22 foreign indexes and the US and found that under the classical approach 13 out of 22 countries exhibited Monday returns different from the rest of the weekdays. Also, Condoyianni, O'Hanlon and Ward (1987), examined the effect in three geographical areas: North America, Europe and Far East, for the period 1963 to 1984. They found, as expected, a negative return on Monday. Furthermore, they observed that Canada exhibits a Tuesday effect as well. In the UK due to the fact that stocks usually go ex-dividend on the first day (Monday) of the trading account they observed that all the "account Monday" returns were positive. Agrwal (1994) examined five seasonal patterns in eighteen markets. He reports that a Monday effect occurs in nine countries, the January effect occurs in most countries, the turn of the month effect (see below) occurs also in nine countries and the holiday effect (see below) occurs in seven countries.

3.2.4. The Holiday Effect.

Some studies have produced empirical evidence of higher stock returns on the days preceding holidays. This effect came to be known as the Holiday Effect.

It was Fields (1934) in his early study on stock returns who first reported that the Dow Jones Industrial Average Index experienced a high proportion of advances the day before holidays. Ariel (1985) used data for the period 1963-1982 and looked at the returns on the 160 days that preceded holidays. He found that the mean return on the preholiday period was 0.529% compared to 0.056% on other days, a ratio greater than 9 to 1.

Lakonishok and Smidt (1987) used the 90-years series of the Dow Jones Industrial Average and classified days as pre-holiday, post-holiday or regular without regard to the day of the week. They found an average pre-holiday rate of return of 0.220 percent compared with a regular daily rate of 0.0094 percent per day, i.e. the pre-holiday rate of return was 23 times larger than the regular daily return.

Cadsby and Ratner (1989) first defined a stock market holiday as a public holiday on which the local stock market is closed because of the holiday. Then they examined returns on days that were local holidays, on days that were US holidays, on days that were both and the returns on non-holidays. Preholiday returns on the US equally weighted index were 7.5 times as high as the non-holiday returns and 10 times on the value-weighted index. In all countries the returns on days just prior to joint local-US holidays were higher than any of the other returns. Furthermore, local pre-holiday returns were higher than non-holiday returns in all countries but UK, Germany, France.

Ariel (1990) employed the daily stock index returns from the CRSP value-weighted and equally-weighted index for the period 1962-1982. The 5020 trading days were divided into two subsets : the trading days prior to holidays (160), and the rest (4800). The means of the pre-holiday returns exceeded the means of the non-pre-holiday returns by factors of 9 and 14 (equally-weighted and value-weighted index). In addition the difference of the means were statistically significant. This holiday effect seemed to account for nearly 30% of the total monthly returns for the period 1961 to 1981. Also, this effect occurred only one day before the holiday.

3.2.5. The Turn of the Month Effect.

Ariel (1987) used the CRSP value- and equally-weighted indexes for the period 1963-1981 to documented a positive mean return for stocks only for days immediately before and during the first half of calendar months. The mean return was indistinguishable from zero during the rest of the month. Histograms of the arithmetic mean returns for the nine trading days before and after the start of each month showed positive returns at the beginning of the month, starting the last trading day of the previous month. Furthermore the mean daily return of the first half of the months significantly exceeded the mean daily return of the last half of the months. Lakonishok and Smidt (1988) used daily prices of the Dow Jones Industrial Average, for the period 1897 to 1986. They, however did not include the last trading day of the previous month when considering the first half of the months returns. Firstly, they found a positive average rate of return for both halves of the month. Secondly, the average difference for the entire period was 0.237. The null that both halves of the month had the same rate of return could not be rejected at the 5% level. When the last trading day of the previous month was included a turn of the month effect was detected.

Cadsby and Ratner (1992) used daily closing prices for 11 stock indexes: US, Canada, Japan, Hong-Hong, UK, Australia, Italy, Switzerland, Germany, France, for the period 1962 to 1989. For all cases they found that the average rate of return for turn of the month (TOM) exceeded the average rate of return of not turn of the month (NTOM) days. The null that the difference between TOM and NTOM returns equals zero was rejected for all countries but Hong-Hong, Japan, Italy France.

3.2.6. The Volatility Debate.

Perhaps the biggest challenge to the EMH theory comes from the excessive volatility that asset prices exhibit relative to their fundamental values. The empirical evidence on financial market volatility has accumulated over the last decade and suggests that equity prices deviate significantly from their fundamental values, as these are determined by well established Valuation Models and theories such as the EMH. The volatility tests of the EMH were initiated by LeRoy and Porter (1981) and Shiller (1979, 1981) and appeared to contradict the notion of the Efficient Markets. These early findings presented evidence that stock prices are too volatile and could not be reconciled with rational valuation models; stock price volatility was too much to be justified *ex post* by the variation in dividends[9]. Both studies examined the variance restrictions that are implied by the present value model of stock prices: they define the *ex post* market fundamental price as:

$$P^{*} = \sum_{j\,1}^{\infty} b_{i} D_{t+j} \qquad (3.1)$$

where P^* is the stock price based on the actual dividends (D_{t+j}), and a is a coefficent. If stock prices are determined by market fundamentals alone then $P_t = E_t (P_t^*)$ and $P_t^* = P_t + e_t$, where e_t is a forecast error uncorrelated with nothing in the time t. This implies the following variance relations:

[9] For a detailed literature review of the volatility debate see : Scott L., "Financial Market Volatility", *IMF staff papers* Vol 38, No 3, 1991, and West K., "Bubbles, Fads,.....Evaluation", *The Journal of Finance*, Vol XLII, No 3, 1988.

$$Var(P_t^*) = Var(P_t) + Var(e_t)$$

and
$$Var(P_t) \geq Var(P_t) \Leftrightarrow 1 \geq \frac{Var(P_t)}{Var(P_t^*)} \quad (3.2)$$

Most studies concentrate and test this variance restrictions, for if:

$$\frac{Var(P_t)}{Var(P_t^*)} > 1 \quad (3.3)$$

this indicates excess volatility.

Shiller (1981) constructed a time series for P_t^* and computed sample variances for the detrended versions of P_t and P_t^*, in order to test for (3.2). LeRoy and Porter (1981) estimated bivariate time series models and used the parameters to calculate the relevant variances Both had to reject the variance restrictions and concluded that the stock market was too volatile. LeRoy and Porter suggested that it could also be the case that it was the present value model that was rejected, or that their tests were invalid.

Shiller (1986) also used Monte Carlo simulation methods to determine the finite-sample behavior of (3.2) when the logarithmic levels of the dividends follow a Random Walk and the information content consists solely of lagged dividends. Blanchard and Watson (1982), in another study, compared variances of innovations rather than levels. All these studies used US data that covered the period between 1871-1985, and yielded similar results, i.e. excess volatility.

A severe criticism against these volatility tests was initiated from Kleidon (1986) and Marsh and Merton (1986). They mainly criticized the assumption that the variables do not have unit roots.[10] A second series of tests was initiated from this criticism which

[10] They argued that if P and P^* are not stationary time series and have to be differenced in order to induce stationarity, then the variances do not exist and the corresponding sample variances are meaningless.

addressed the issue of nonstationarity. For example, Mankiw, Romer and Shapiro (1985) developed an extension of the variance bound tests by considering the variability of P and P^* relative to a naive forecast; they assumed that dividends follow a Random walk. West (1988a) considered the variability of innovations in the dividend process and derived a relationship that holds even if dividends have to be differenced to become stationary. Both the former studies rejected the variance inequality but the rejection was not as dramatic as the initial tests.

Scott (1985) and Campbell and Shiller (1987) developed tests that were not based on the variance inequality. More specifically, Scott (1985) presented a test that was based on a single regression interpretation of the present value model; he argued that if asset prices reflect solely market fundamentals then the following must hold:

$$P_t^* = P_t + e_t$$

and (P_t^* - P_t) must be uncorrelated with any variables in the time t information set and the asset price should be an unbiased predictor of P_t^*. A simple way to confirm that statement is to test whether a = 0 and b = 1 in the following regression:

$$P_t^* = a + bP_t + e_t \qquad (3.4)$$

If prices and growth rates in dividends are stationary time series one could then deflate the P_t and P_t^* series by a measure of dividends. Scott used the dividends summed over the previous years and the above regression became:

$$(P_t^* \div D_t) = a + b(P_t \div D_t) + e_t \qquad (3.5)$$

This test examines simultaneously two implications of the present value model, namely whether asset prices are unbiased predictors of P_t^*, and whether there is some positive covariation between P_t^* and P_t, as it should be. Both restrictions were strongly rejected by the data.

Campbel and Shiller (1987) utilized cointegration theory and the implication of the present value model that P_t^* and P_t *are cointegrated*. First, they defined a spread variable (S):

$$S_t = (P_t - bD_t) \div (1 - b) \qquad (3.6)$$

If D_t is stationary, then S_t and DP_t are also stationary. Then they specified and estimated a Vector Auto Regressive (VAR) model for D_t and S_t. The present value model applied to S implies that $S_t = E(S_t^*)$, where:

$$S_t^* = 1/(1-b)\sum_{j=1}^{\infty} b^j DD_{t+j} \qquad (3.7)$$

This implication imposes a nonlinear restriction on the coefficients of the VAR for DD_t and S_t. Once more the restrictions implied by the present value model were rejected.

An explanation of excess price volatility according to some researchers could be movements in expected returns. Fama and French (1988a) examined stock return behavior over long horizons and found that serial correlation in stock returns was much greater if the returns are calculated over longer time horizons (one to ten years). In particular, they found that autocorrelations were close to zero for horizons of one year or less but for horizons between two and five years they were consistently negative and they returned to zero for periods between five to ten years. They concluded that their findings were consistent with the existence of a noise component and the existence of variation in expected returns.

Poterba and Summers (1988) examined along with autocorrelations, a variance ratio test which compares the variances of rates of return for different time horizons. They argued that if there is no serial correlation in the rates of return then the ratios should be close to unity. If there is a mean reversion pattern in the rates of return than the ratios will be reducing in value as the horizon is extended. They did find evidence of both serial correlation and mean reversion.

One theory that tried to explain the excess volatility in the equity markets within the context of the EMH was the theory of Rational Bubbles. Stochastic difference equations such as:

$$P_t = bE\left(P_{t+1} + D_t \middle| I_t\right) \qquad (3.8)$$

where b is a constant discount rate (b=1/(1+r)), r is the constant real expected return, E is the expectation operator, I_t is the markets information set at time t, have a unique solution if the condition

$$\lim_{n\to\infty} E(b^n P_{t+n}|I_t) = 0 \qquad (3.9)$$

which prevents rational bubbles, exist. However, if (3.9) does not hold then (3.8) has infinite solutions : $P_t = E(Sb^{j+1} D_{t+j}|I_t) + C_t \equiv P^f + C_t$ (3.10)

where, P^f_t is the price that depends only on fundamentals, C is any variable that satisfies $E(C_t|I_t) = b^{\ 1} C_{t+1} \equiv (1+r)C_{t\ 1}$ (3.11)

C is by definition a rational bubble, an extraneous event that affects stock prices because everyone expects it to do so[11].

West (1987, 1988) gives an example of a strictly positive bubble:

$$C_t = \begin{cases} (C_{t-1} - C^*) / pb & \text{with probability p} \\ C^* / [(1-p)\, b] & \text{with probability (1-p)} \end{cases}$$

where, $0 < p < 1$, $C^* > 0$.

The bubble will burst with probability (1-p) and has an expected duration of $(1-p)^{-1}$. While the bubble floats it grows at a rate of $(bp)^{-1} = (1+r) / p > (1+r)$, i.e. investors will receive an above average return to compensate them for the high risk of the bubble bursting. Whether or not the bubble will burst will depend on the fundamentals (e.g. new information about the Trade Balance, etc.).

The price solution (3.10) of the difference equation in (3.8) satisfies the definition of the EMH, since the *current price P_t incorporates all relevant information about future expectations, future dividends and the expected evolution of the bubble*, and at the same time it seems a satisfactory explanation of the excess volatility relative to market fundamentals.

West (1987), at first in favor of the Rational Bubble explanation, constructed a test of the present value model such that a rational bubble was incorporated as part of the alternative hypothesis and his results supported the rational bubble concept, however, later (West 1988), he argued that: a) while tests were able to detect something that

[11] For a more detailed discussion on the rational bubbles see West (1988).

looks like a bubble, they were unable to discriminate between a rational bubble and "noise", which is almost, but not quite, a bubble; b) bubbles suggest that stock prices should grow at a rapid rate; if dividends grow more slowly than the rate of return, (implicitly assumed in (3.10)), the dividend / price ratio should fall and capital gains should take an increasingly large share of *ex post* returns, something that is not the case for US data; c) earlier studies (Mankiw et al. (1985), etc.), have allowed bubbles under the null and still the results did not change.

Another explanation of the excess volatility of stock prices was that of "fads" or in other words noise trading by "naive" investors. De Bont and Thaler (1985) argued that psychological and sociological reasons could be instigating "irrational" behavior to naive investors, such as overreaction to news announcements. This behavior cannot be adequately captured by sophisticated valuation models and will generate wide variations in expected returns. For example, they presented evidence of overreaction in equity markets, and evidence that abnormally high returns could be earned by following a contrarian strategy of buying assets that had recently exhibited a poor performance and going short in assets that had recently performed well.

3.3. ASSET PRICING MODELS.

2.2.2. The Capital Asset Pricing Model (CAPM).

The CAPM is a model of capital market equilibrium which attempts to measure and price risk. It was initially developed by Sharpe (1964), Linter (1965) and Treynor (1967). The CAPM relates the expected return on an asset to its systematic risk. It merely states that in equilibrium the rates of return on all risky assets are a function of their covariance with the market portfolio.

For the derivation of the model a frictionless world is assumed, where transactions costs and taxes are absent, information is costless and equally available to all investors. Investors are also assumed to have homogeneous expectations about asset returns (which are assumed to be normally distributed), to be price takers and risk averse individuals who maximise the expected utility of their end-of-period wealth. Furthermore, assets are assumed to be marketable and perfectly divisible and there also exists a risk free asset such that investors may borrow or lend unlimited amounts at the risk free rate.

More specifically the model states that the required expected rate of return on any asset, $E(r_i)$, equals the risk free rate of return, r_f, plus a risk premium:

$$E(r_i) = r_f + \beta_{im} + \left[E(r_m) - r_f\right] \quad (3.12),$$

where r_m is the rate of return on the market portfolio.

The risk premium can be thought of as the extra compensation, above the risk free rate, that the investors require for investing in the market portfolio. It is the product of the quantity of risk and the price of risk. The price of risk is the difference between the expected rate of return on the market portfolio and the risk free rate. The quantity of risk, usually called beta, is defined as the covariance between the returns on the risky asset and the market portfolio divided by the variance of the market portfolio:

$$\beta_{im} = \frac{Cov(r_i, r_m)}{Var(r_m)} \tag{3.13}$$

The beta factor is the appropriate measure of risk for a single asset and has some interesting properties: when the assets returns are independent from the market then the covariance of the asset with the market is zero and beta equals zero.

Consequently the mean return on the asset equals the risk free rate of return. When the asset moves with the market then: $cov(r_i,r_m) = var(r_m)$ and $\beta=1$. It follows that $E(r_i) = E(r_m)$ and the asset can be considered of average riskiness. If $\beta>1$, the asset is above average riskiness and if $\beta<1$ below average riskiness.

It is important, at this point, to make the distinction between the total risk of an asset and its systematic risk. The total risk (i.e. its variance) of an asset can be divided into two elements: the unsystematic risk of the asset which is independent of the economy (and which can be eliminated through diversification) and the systematic risk, the beta, which is the risk of the economy (and cannot be diversified away). Furthermore when the assets are combined into portfolios all we need to know in order to determine the beta of the portfolio is the individual betas of the assets because betas have the valuable property of being linearly additive.

When the capital asset pricing model holds internationally, the expected return from a domestic portfolio of assets (R_i) is:

$$E(R_i) = R_f + \beta_{iw} + \left[E(R_w) - R_f\right] \tag{3.14}$$

where R_w is a world 'market' portfolio and R_f is a world portfolio of risk-free assets.

Naturally, many researchers have tested the validity of the assumptions of the CAPM. For example, Brennan (1970) has examined the effect of introducing taxes, more specifically taxes that are caused by the differential tax rate on capital gains and dividends, since no one has examined the model in a world with personal and corporate taxes. He concluded that the only change required in the CAPM is the addition of an extra term in equation (1): a dividend payout variable. So now the expected return on an asset depends not only on the systematic risk, but also on the dividend yield.

The existence of nonmarketable or perfectly divisible assets (e.g. human capital) and their impact on the model was examined by Myers (1972). He showed that because these nonmarketable assets will differ in riskiness investors will hold different portfolios of risky marketable assets. He developed a model similar to the CAPM where the beta measures along with the covariance with the market portfolio the payoff from the nonmarketable assets. Myers model, however, has been tested by Fama and Schwert (1977) who found no evidence that it provides a better explanation of returns than the original CAPM.

The assumption of homogeneous expectations about future returns has been tested by Linter (1969) He demonstrated that the existence of heterogeneous expectations does not critically alter the CAPM, except that returns and covariances becomes complex weighted averages of investors diverse expectations. In this case, however, the market portfolio is not necessarily efficient, which makes the CAPM untestable.

In another study Merton (1973) has derived an alternative CAPM in which trading takes place continuously over time. If the risk free rate is non-stochastic then we can extend the model in a continuous form. If the risk free rate is stochastic then the portfolio investors will hold a portfolio which will consist of three funds: the risk free asset, the market portfolio and a portfolio with returns which have a perfect negative correlation with the risk free rate. Concerning the risk free asset there are two points that bring the relevant assumption at odds with reality: first, inflation will influence the real return from that asset and make it difficult to identify and second, for most investors in the real world, the borrowing rate does not equal the lending rate. Black (1972) suggested that the risk free asset should be replaced with a zero-beta portfolio (which is by implication uncorrelated with the market portfolio) constructed by short selling. He proposed a model (known as the zero-beta CAPM) where the expected rate of return on any asset is a linear combination of the expected rate of return of the market portfolio and a unique minimum variance zero beta portfolio:

$$E(r_i)=r_z+\beta_{im}+\left[E(r_m)-r_z\right] \tag{3.15}$$

where E (r_z) is the expected return on a zero-beta portfolio.

In an earlier study, Fama (1965) considered what would happen if returns were not normally distributed. He showed that as long as returns are stable and distributed symmetrically, investors can use measures of dispersion other than the variance, and that the portfolio theory as well as the CAPM is still valid.
In the case where investors are not price takers, Linzenberg has shown that the model is still valid only that the market price for risk (i.e. the expected return on the market above the risk free rate) will be lower than usual.

In conclusion, we can say that the results of different tests concerning the relaxation of the assumptions of the CAPM, indicate that the model does not change drastically if the assumptions are violated. As Jensen (1972) put it after reviewing the studies that relax the assumptions, the theory is "reasonably robust" with regard to the violations of the assumptions.

3.3.2. CAPM: The empirical tests.

The CAPM is a model that is expressed in terms of expected returns. Data, however, about investors expectations are not available. Therefore, researchers involved in tests of the model must transform it from an *ex ante* form to an *ex post* form, i.e. a form that uses observed data. In so doing they have to make an important assumption, that the rate of return on any asset is a fair game, i.e. that investors expectations are realised, on average. If markets are efficient it is not unreasonable to assume that even though there will be a difference between the realised returns and the expected returns, this difference will not be statistically different from zero. In testing the CAPM there are usually two approaches: A two-stage cross-sectional approach and a time series approach.

In the former approach, estimates of the betas are first obtained from a regression of the returns for an individual asset i, on the returns from the market portfolio, i.e. from the market model[12]:

$$R_t = a_i + b_{im} R_{mt} + e_t \qquad (3.16)$$

where R_t the rate of return on asset R, and R_{mt} the return on the market portfolio.

In the second stage these estimates are used in the regression equation

$$R_{it} = \gamma_o + \gamma_1 b_{it} + e_t \qquad (3.17)$$

which is the way the CAPM is usually written when it is tested empirically. This is done in order to get estimates of γ_0 and γ_1, i.e. the intercept and the slope and then compare them with their hypothesised values, the R_f and the $[R_m-R_f]$, respectively. The intercept must equal the risk free rate of return and the slope must equal the risk premium on the market portfolio, for the CAPM to be valid.

In the time-series approach an indirect test of the CAPM is conducted by comparing the model

$$E(r_i) - r_f = b_i\left[E(r_m) - r_f\right] \qquad (3.18)$$

with the model:

$$r_i - r_f = a_i + b_i\left[r_m - r_f\right] + e_i \qquad (3.19)$$

in order to see whether the intercept a_i is significantly different from zero. Many studies have been conducted to test the CAPM. The most important ones will be reviewed below.

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[12] The market model is not supported by any economic theory. The market factor can be any stock market index. On the other hand, the market portfolio in the CAPM must be a weighted average of all risky assets. If however, the capital markets are informationally efficient, then the market model is equivalent to the CAPM.

Jensen (1966) tested the CAPM for a sample of 115 mutual funds using a two stage cross sectional methodology. He reported a linear relationship between returns and systematic risk and also that the systematic risk of the mutual funds was stationary over time. Douglas (1969) used a sample of 616 common stocks for the period 1926 - 1960 and he reported that returns have a linear relationship with total risk rather than systematic risk. Linter (1970) used data for 301 common stocks for the period 1954 - 1963 and the results revealed that average annual returns were a linear function of both total and systematic risk, a result inconsistent with the CAPM theory.

Miller and Scholes (1972) used the returns of 631 stocks from the NYSE for the period 1954 - 1963, to replicate Linter's study. Their results were similar to Linter's findings, i.e. returns were correlated to both systematic and unsystematic risk. They argued, however, that many statistical problems can arise with respect to the methodology used, namely errors in measurement in beta, skewness in the return distributions, etc.

Black, Jensen and Scholes (1972) in an effort to reduce the bias caused by errors in measuring betas and the problem of correlation of individual stocks used portfolios of securities rather than individual securities. They estimated the systematic risk for all stocks using monthly data from the previous 5 years. Next, by ranking the securities according to their betas and dividing them into deciles they were able to construct a portfolio for every decile. Then for each portfolio they estimated the following time-series regression :

$$R_{it} - R_{ft} = a_i + b_i\left(R_{mt} - R_{ft}\right) + e_{it} \qquad (3.20)$$

Their sample included all stocks traded on the NYSE from 1926-1966. Their findings were inconsistent with Sharpe's CAPM: the high-risk portfolios experienced lower returns than those implied by the CAPM and the low-risk portfolios experienced systematically greater returns than those predicted by the model. Then they performed a cross-sectional analysis of the data and found a significant intercept term and a beta coefficient systematically below the average risk premium of the market portfolio. They rejected Sharpe's version of the CAPM but concluded that the results were more consistent with the Black's version of the CAPM, which replaces the risk-free rate with the expected return on a zero-β portfolio.

Fama and MacBeth (1973) tested the relationship between average return and risk for common stocks. The theoretical basis of their tests was the "two parameter" model. They argued that the model had 3 testable implications: first that the relationship between risk and expected return was linear, second that the beta coefficient was a complete measure of risk and third that higher risk should be associated with higher returns. What they did was to test the following generalisation of the model:

$$R_{it} = \gamma_{ot} + \gamma_{1t} b_i + \gamma_{2t} b_i^2 + \gamma_{3t} S_i + n_{it} \qquad (3.21)$$

In this model two terms are added: one term to measure possible nonlinearities (β^2) and another term to capture possible influence of unsystematic risk (S_i). The above hypotheses were tested plus two further hypotheses were examined: that the intercept is equal to the risk-free rate (a hypothesis of the Sharpe-Linter CAPM) and that the coefficients: γ_{0t}-$E[R_{0t}]$, γ_{1t}- [$E(R_{mt})$ - $E(R_{ot})$], γ_{2t} , γ_{3t} and n_{it} are fair games i.e. requirements for capital market efficiency in a two parameter model.

The data for the study involved monthly percentage returns (including dividends and capital gains) for all common stocks traded in the NYSE during the period between Jan 1926 and June 1968. They constructed 20 portfolios on the basis of ranked values of β's for individual securities. They formed portfolios from ranked estimates of β computed from data for one period but then used a subsequent period to obtain the portfolio betas that were used to test the two parameter model. So, with fresh data within a portfolio, errors in the individual security β_i were to a large extent random across securities. Their results supported all the implications of the model: the relationship between expected return and betas was linear, no measure of risk, except beta, systematically affected returns and on average there was a positive trade-off between risk and return. The Sharpe-Linter hypothesis that the constant term is equal to the risk-free rate was not supported by the data. Finally the fair game hypothesis was supported by the data, i.e. the view of efficient capital markets was supported.

Basu (1977) attempted to find whether the investment performance of common stocks was related to their PE ratios. His data consisted of firms traded in the NYSE for the period 1956-1971. He computed a wide range of measures of portfolio performance (annual rate of return, Treynor's reward to volatility, Sharpe's reward to variability measure, systematic risk, etc.). His results indicated that average annual rates of return declined as one moved from low PE to high PE portfolios. Furthermore, higher returns on the low PE portfolios were not associated with higher systematic risk. These results were generally true even when risk was taken into account. Basu concluded that the results suggested a violation of the joint hypothesis that the asset pricing models have descriptive validity and that security price behaviour is consistent with the efficient market hypothesis. PE information was not "fully reflected" in security prices in as rapid a manner as suggested by the semi-strong form of the EMH.

Banz (1981) examined the empirical relationship between return and the total market value of common stocks (see above-size effect) and reported that shares of firms with large market values had smaller returns, on average, than similar small firms. He concluded that the CAPM was misspecified, but was unable to explain the "size effect". Reinganum (1981) investigated empirically whether securities with different estimated betas systematically experience different average rates of return, a necessary condition for the validity of the CAPM. He called this the beta hypothesis. He used daily returns (1964-1979) and found that low-beta portfolios experience greater average returns than high-beta portfolios, a result similar for all estimation procedures.

Gibbons (1982) used an alternative conceptual framework to (I) avoid the errors-in-variables problems associated with previous studies, and (I) to increase the precision of estimates of the parameters for the risk premiums, namely a non-linear multivariate regression model. His tests rejected the mean-variance efficiency of the market proxy. Also graphs of the departure of the data from the theoretical model were presented. They revealed that high beta stocks tended to fall below the straight line while the reverse was also true for low beta stocks. In other words the CAPM tended to mis-price all securities for some subperiods.

Ceccheti and Mark (1985) described an alternative, 4 step strategy for testing asset pricing models. They used US data for the period 1989-1987 and they found a risk-free rate of approximately 1% and an equity premium that exceeded 6%. In addition the standard deviation of the equity premium was more than 3 times that of the risk-free rate.

Rubio (1988) used a multivariate framework to study the price formation of risky assets in a "thin" capital market, such as the Spanish stock exchange. His sample consisted of 160 securities that were listed in the Spanish Stock Exchange during the period 1963-1982. The results were as follows: the market risk premiums were always positive but small, mean-variance efficiency. The test was then replicated for securities ranked on the basis of beta and the results were quite similar.

Ostermark (1991) estimated the CAPM with comparable Finish and Swedish data. He used a similar methodology to that of Fama and MacBeth (1973). The data consisted of daily, weekly, monthly price indexes over the period 1970-1983 (Finland) and of daily price index series for the period 1977-1987 (Sweden). The results revealed that the CAPM seemed to work better with Swedish data than with Finish data.

Cadsby (1992) examined some empirical anomalies in the context of the CAPM. He used US data for the period 1963-1985. He used a methodology similar to the one used by Fama and MacBeth in 1973. The results confirmed the validity of the CAPM and the existence of a January seasonality in the data. By using daily data, he was able to report that the January effect is really a turn-of-the-year effect which should include the last week of December together with the first four weeks of the new year. The important result from this study was that for every calendar effect on stock returns a corresponding calendar effect was reported on the risk premium relationship, i.e. the estimate of the CAPM risk premium is significant and positive during periods such as the turn of the year, etc.

Fama and French (1992) evaluated the joint roles of market beta, size, E/P, leverage and book to market equity in the cross section of average returns on NYSE, AMEX and NASDAQ stocks for the period 1963-1990. Their asset pricing tests used the cross-sectional regression approach of Fama and MacBeth (1973). Their results suggested that beta does not help to explain the cross section of average returns, (see above-size effect).

3.3.3. The Consumption CAPM.

Rubinstein (1976), Breeden and Litzenberger (1978) and Breeden (1979), have shown that in an intertemporal economy expected returns are proportional to their ***consumption betas***. They developed a Consumption-oriented CAPM (hereafter CCAPM) which suggests that the covariance of an asset with aggregate consumption growth is a better measure of systematic risk than the return on a market index. The CCAPM is often considered to be a theoretically-superior model because of its derivation in a multiperiod context, however it has not been firmly supported by empirical studies.

Mankiw and Shapiro (1986) examined 464 companies listed in the NYSE for a sample period from 1959 to 1982 and found no support to the CCAPM as compared to the traditional formulation. They found a stock market beta to contain more information than a stocks consumption beta.

Breeden, Gibbons and Litzenberger (1989) examined the implications of the CCAPM and investigated its performance relative to the CAPM. They estimated the CCAPM after adjusting for measurement problems associated with reported consumption data and tested using betas based on both consumption and a portfolio having a maximum correlation with consumption. They found the predictions of the CCAPM of a positive market price for risk and a close to zero estimate of the real rate of interest to be valid. Furthermore they found the performance of the CAPM and CCAPM to be about the same.

Saver and Murphy (1992) in a study on the German Stock market used 249 German stocks continuously traded for the period 1968 to 1988. They followed a methodology similar to Mankiw and Shapiro. They found evidence that the CAPM was a better indicator of capital asset pricing in Germany than the CCAPM. Their test, however, indicated that deviations from the CAPM relationship may exist.

Chen, Roll, Ross (1986) in a paper that tested whether innovations in macroeconomic variables are risks that are reward in the stock market, reported that the rate of change in consumption did not seemed to be significantly related to asset pricing.

Bossard (1990) used data from 4 countries USA, Germany, UK and Switzerland, and his results supported the CCAPM. The point estimates for the parameters all fell within ranges that were economically plausible. However, the overall explanatory power of the model was low and only a few parameter estimates were statistically significant.

Breeden, Gibbons and Litzenberger (1989) while testing the CCAPM identified four major econometric problems associated with measured consumption:

1) the CCAPM prices assets with respect to changes in aggregate consumption between two points in time while the available data on aggregate "consumption" are total expenditures on goods and services over a period of time,

2) the data included consumption of durable goods (i.e. goods and services may not be consumed the same period they are purchased) so the reported number becomes actually the reporting of expenditure rather than consumption,

3) consumption data are not reported as frequently as stock returns. Consumption data are not available for as long a time span as data on assets and in addition they are reported less frequently (quarterly).

4) pure sampling error may exist on reported aggregate consumption since only a subset of the total population of consumption transactions is measured. Another source of measurement errors in aggregate consumption data involve interpolation, i.e. when the expenditures for all items are sampled every month etc.

In conclusion, we can say that the consumption asset pricing model summarises, in the consumption beta, all the incentives to hedge uncertainty about consumption and investment opportunities and from that fact stems the elegance of the model. At the same time, however, this elegance means that consumption betas are difficult to estimate because they vary through time (Cornell, 1981).

3.3.4. The Arbitrage Pricing Model.

The Arbitrage Pricing Theory (APT) was formulated by Ross (1976) and offers a testable alternative to the CAPM; the APT is based on similar grounds to the CAPM. The assumptions behind the model are that of perfect competition and a frictioneless market, and homogeneous expectations of agents beliefs about the fact that returns are indeed driven by a model such as (3.23).

The theory basically states that the rate of return on any security is a linear function of k factors instead of just one as in the CAPM. If R_i is the random rate of return on the ith asset, $E(R_i)$ is the expected rate of return on the ith asset, b_{ik} the sensitivity of the ith asset's return to the kth factor, F_k the mean zero kth factor common to the returns of all assets under consideration, and e_i a random zero mean noise term for the ith asset, then the APT in an equation form states that:

$$R_i = E(R_i) + b_{i1}F_1 + \ldots\ldots + b_{ik}F_k + e_i \qquad (3.22)$$

The basic implication of the theory is that all portfolios that use no wealth and have no risk, must earn no return, on average, (the arbitrage portfolios).
The APT theory makes no assumptions about the empirical distributions of assets returns, it allows the equilibrium returns of assets to depend on many factors, has no special role for the market portfolio (the CAPM theory require this portfolio to be efficient), it is easily extended to a multiperiod context, and finally it makes no strong assumptions about individual' utility functions.[13]

The APT attributes cross-sectional differences in expected returns in differences in betas. A generalisation of a factor sensitivities pricing model states that there exist expected premiums λj, j = 0,...,k ; so that expected returns can be written as :

[13] For a full description of the model see A. Ross, "The Arbitrage Theory of Capital Asset Pricing", *Journal of Economic Theory*, 1976, pp343-362

$$E(R_i) = \lambda_0 + \sum_{j=1}^{k} b_{ij}\lambda_j \tag{3.23}$$

The b_{ij} are the factor sensitivities (multiple regression coefficients) of the R_{it} on the K risk factor, and the λ_j is the risk premium associated with the jth factor ; it is the premium (or return) an investor will earn if he or she assumes one unit of risk from the jth factor, i.e. it is the *price* of risk for the factor j, and λ_0 is a risk free rate. The implication of the above expression is that the *excess returns* (ρ_i) are given by :

$$\rho_i = \sum_{j=1}^{k} b_{ij}\lambda_i \tag{3.24}$$

Roll and Ross (1980), Brown and Weinsten (1983), Chen (1983), Cho et.al. (1984), Kryzanowski and To (1983), Dhrymes, Friend and Gultekin (1984), are among the first researchers that tested the APT. In most of the initial studies factor analysis was first used in order to estimate the (the b's), and then used in cross sectional regressions in order to obtain estimates of the λ's. At this stage usually portfolios of assets were employed to account for the errors in variables problem.

The factor analysis methodology suffers from both economic and econometric difficulties. As McElroy and Burmeister (1988)[14] point out: a) the estimators of the b_{ij}'s will have unknown properties, if the errors are not jointly normal, b) the estimates of the b_{ij}'s will not be unique[15], c) there is no way of knowing whether a factor that was identified for one portfolio is the same as a factor identified for another portfolio, d) the estimated risk premiums are not invariant with respect to the arbitrary partitioning of assets into portfolios, and e) the factor scores and the associated λ's do not have any straight forward economic interpretation.

[14] See McElroy M., Burmeister E., "Arbitrage Pricing Theory as a Restricted Nonlinear Multivariate Regression Model", *Journal of Business & Economic Statistics*, 6, January 1988, p29-42.

[15] if B denotes the matrix of b_{ij}'s, BG is equivalent to B for any orthogonal transformation with $CC' =$ I.

Chen, Roll, and Ross (1986) were the first to use observable macroeconomic factors in an APT model. They utilised a dividend discount model to identify the macro-variables that could affect equity prices. They used USA data, and focused on industrial production, (MP), inflation, (UI), the change in expected inflation, (DEI), risk premia, (UPR), the term structure of interest rates, (UTS), stock market indices, Consumption, and oil prices. They constructed a model of the form:

$$R = a + b_{MP}MP + b_{DEI}DEI + b_{UI}UI + b_{UPR}UPR + b_{UTS}UTS + e \qquad (3.25)$$

The methodology they used was similar to the Fama and MacBeth (1973) two stage methodology. Their results indicated that the significant variables were industrial production, changes in the risk premium, shifts in the yield curve, and more weakly, changes in the expected inflation.

McElroy and Burmeister (1988) used an Iterated Nonlinear Seemingly Unrelated Regression methodology, and monthly returns on 70 stocks from January 1972 to December 1982 to obtain joint estimates of asset sensitivities and their associated APT risk values. As macroeconomic factors they used short and long interest rates, unexpected inflation, unexpected growth in sales, and a market index. Their results supported the APT.

In a more recent study, Ferson and Harvey (1994), examined multifactor pricing models for the returns and expected returns on eighteen national equity markets, also using the SUR technique. Their factors, which were chosen to measure global economic risks, were: a world equity market in excess of a short term interest rate, the trade-weighted US dollar price of the currencies of 10 industrialised countries, a monthly global inflation measure, a monthly change in long-term inflationary expectations, the change in the spread between a 90-day Eurodollar deposit and a 90-day US Treasury Bill yield, a weighted average of short term interest rates in the G7 countries, and a weighted average of industrial production growth rates in the G7 countries. They found that the world market betas provided a poor explanation of the average returns across countries, however, when the rest of the factors were added then much of the abnormal performance of the markets could be explained as compensation for global economic risk.

Antoniou, Garret and Priestley (1994), used a Nonlinear 3 Stage Least squares ,NL3SLS, estimator (which allows idiosyncratic returns to be correlated across assets), and unanticipated inflation, changes in expected inflation, unanticipated shocks to industrial production, unanticipated shocks to retail sales, unanticipated shocks to money supply, unanticipated shocks to commodity prices, unanticipated shocks to the term structure, unanticipated shocks to default risk, unanticipated shocks to exchange rate, and a market portfolio, as their macroeconomic variables, in order to examine the empirical validity of the APT, for the London Stock Exchange, between 1980-1993. They found that five factors can be used to price securities, but only three of these factors (unexpected inflation, money supply, and excess returns on a market portfolio) carried the same premia in a different (validation) sample. Further, after correcting for two 'outlier' companies, they found that the 3 unique factors could explain a substantial amount of the cross-sectional variation in average excess security returns, thus the APT appeared to be robust.

In the international version of the model, the usual APT factors are a set of international factors (e.g. inflation, oil prices), a set of domestic factors, and a set of industry factors. For the development of the models in an international context strong assumptions are needed : perfect equity market integration is required, with no barriers to extranational equity investments, no taxes, no transaction costs, no information costs, etc. It is obvious that such assumptions are often very difficult to hold and therefore we must be very careful in the interpretation of results.

The APT theory was challenged by Shanken (1982) who argued that the usual formulation of the testable implications of the APT was inadequate, for it preludes the very expected return differentials which the theory attempts to explain. He agreed that the competitive-equilibrium extension of the APT could be testable in principle, however, for the implementation of such a test the observation of the return on the true market portfolio is necessary.

3.4. RECENT STUDIES ON THE EMERGING MARKETS.

In more recent tests of the EMH theory, Dawson (1984) tested for the existence of a trend toward strong or semi-strong market efficiency in the Hong-Kong stock exchanges for the period 1974-1982. The method was to observe the stocks recommended by large Hong-Kong brokerage firms. If a trend exists, it should become increasingly difficult for the recommended stocks to outperform the market. His evidence supported the hypothesis of an efficient market.

Barnes (1986) also examined the efficiency of the Kuala Lambur stock exchange, for the period 1974-1980. He analysed thirty companies and six sector indexes and conducted a series of serial correlation tests, runs tests, and spectral analysis tests. He found evidence supporting the weak form of the Efficient Market Hypothesis.

Lee et.al. (1990) investigated day-of-the-week patterns (such as the Monday-effect) in the security returns of some emerging Asian markets. Their results suggested that such effects were strong and persistant in these markets, however, they were of a lower order of magnitude than the patterns of the US and the Japanese market. Their results also indicated independence between the markets, and therefore evidence that international portfolio diversification among thse markets will be beneficial.

Young et.al. (1992) investigated whether any cross-sectional and intertemporal regularities existed in the Korean stock market returns. Their results suggested that January and March stock returns were significantly higher than those of the other months, for the 1984-1988 period. However, for the 1980-1983 period stock returns were higher in January, April and June. This study has implications for the Tax loss selling hypothesis for the January-effect since Korea has neither a capital gains tax nor a tax benefit for losses, for individual investors.

Ho et.al. (1992) argued that because of different market microstructures, in that the Hong Kong stocks can continue to trade in the London market after the Hong Kong market is officially closed, the open-to-close return variance is not significantly different from the close-to-open return variance while the return variance during the lunch break is found to be significantly lower than that in the morning and in the afternoon trading sessions.

Ayadi and Pyun (1994) examined whether the Efficient Market Hypothesis is a valid statement, by applying the recently introduced Lo-MacKinlay variance ratio test. They examined a typical emerging market, that of Korea, for the period 1984-1988. Under the assumption of homoscedastic error term the random walk hypothesis was rejected. However, under the assumption of heteroscedastic stochastic error term, the random walk hypothesis was not rejected.

Lau, Diltz, and Apilado (1994) examined a data set consisting of 346 US firm stock listings on ten different stock exchanges, in order to determine the valuation consequences of listing on a foreign stock exchange. They found that abnormal returns in US trading were positive around the date of acceptance on the foreign exchange, negative on the first trading day, and negative for the post-listing period for firms listing on the Tokyo and Basel exchanges.

Herrera and Lockwood (1994) tested for the firm size effect in the Mexican stock market, during the period 1987-1992. Their initial tests indicated that average stock returns were positively related to market betas. Also, average returns were negatively related to firm size. They also formed portfolios based on both the size and beta, in order to measure the effects of betas, on the returns, that are unrelated to size. They found that beta is priced in addition to firm size in the Mexican stock market, even after separating the effects of beta and size.

Newton da Costa, Jr. (1994) examined the overreaction hypothesis for the Brazilian stock market, over the period 1970-1989. He used both the market adjusted returns and the CAPM adjusted returns, and he detected price reversals in 2-year returns. Also, differences in beta, as measured by the CAPM method, cannot account for the overreaction effect. The researcher also found evidence that the price reversals are asymmetric.

Ferson and Harvey (1994) empirically examined multifactor asset pricing models for the returns and expected returns on eighteen national equity markets, such as Austria, Australia, Belgium, Hong-Kong, Italy, Singapore, etc., for the period between 1970-1989. The factors were chosen to measure global economic risks. They found that the world market betas do not provide a good explanation of cross sectional differences in average returns. Multiple beta models provide an improved explanation of the equity returns.

Lam, Mok, Cheung, Yam (1994) proposed to construct efficient portfolios in the Hong-Kong stock market, by making use of a homogeneous grouping of stocks based on common family ownership. After taking family grouping into account, it was found that correlation structure of stock's price movements can be predicted more accurately.

Agrawal and Tandon (1994), examined five seasonal patterns (weekend, turn-of-month, end-of-December, monthly and Friday-the-thirteenth effects) in the stock markets of eighteen markets. Among them were the emerging markets of Brazil, Hong-Kong, Mexico, Singapore and New Zealand. They found a daily seasonal in nearly all the countries; a weekend effect in only nine countries; large returns and low variance in the last trading day of the month in most countries; large Decemeber inrer- and pre-holiday returns; and a January-effect in 10 countries.

Claessens et.al.(1995) investigated for return anomalies and predictability in the stock returns of the twenty stock markets represented in the International Finance Corporation's Emerging Markets Data Base. Using statistical methodologies that have identified seasonal and size-based return differences, as well as general return predictability in industrial markets, they found that these emerging markets display few of the same anomalies. In particular, they found limited evidence of turn-of-the-tax-year effects and small-firm effects, however, they reported evidence of return predictability.

Buckberg (1995) investigated whether emerging stock markets are a part of the global financial market and also examines the return behavior in these markets. Tests of the conditional International Capital Asset Pricing Model (ICAPM) revealed that eighteen of the twenty largest emerging markets were integrated with the world market between December 1984 and December 1991, but that many of the same markets rejected the model when data for 1977-84 are used. These results suggested that large capital inflows from industrial economies, beginning in the late 1980s, caused prices in emerging markets to reflect covariance risk with the world portfolio, thus inducing their consistency with the ICAPM.

Harvey (1995), argued that the high expected returns as well as the high volatility and the low correlations of emerging markets with developed countries' equity markets (which significantly reduces the unconditional portfolio risk of a world investor) have made them very attractive for global investors. However, standard global asset pricing models (which assume complete integration of capital markets) failed to explain the cross section of average returns in emerging countries. An analysis of the predictability of the returns revealed that emerging market returns were more likely than developed countries to be influenced by local information.

Korajczyk (1996), argued that a wide array of official capital controls across countries makes it difficult to perform cross-sectional analysis of the effects of market segmentation and therefore he constructed a measure of deviations from capital market integration that can be consistently applied across countries. Applying the measure to stock returns from twenty-four national markets suggested that market segmentation tends to be much larger for emerging markets than for developed markets, and that the measure tends to decrease over time.

Fraser and Power (1996) investigated the relationship between the expected return and risk for nine emerging equity markets. They employed a GARCH in mean model (GARCH-M) and their results suggested that there was no evidence of a significantly positive risk-return relationship. Also, they report a tendency of volatility shocks to to persist over time (in eight out of nine markets considered), however, when a proxy for the flow of information was included in the model the ARCH effects tended to dissapear

Richards (1996) examined the volatility and predictability of emerging stock markets. His results indicate that that despite perceptions to the contrary, the volatility of emerging markets may have fallen rather than risen on average. Also, although the autocorrelations in emerging market returns appeared to turn negative at horizons of a year or more, the magnitude of these return reversals is not that much larger than reversals in some mature markets. One of the interpretation of these results that the author proposed is that emerging markets have not consistently been subject to fads or bubbles, or at least no more so than in some industrial countries.

Choudhry (1996) used a GARCH in mean model (GARCH-M) to examine the volatility, risk premia and the persistence of volatility in the stock markets of Argentina, Greece, India, Mexico, Thailand and Zimbabwe, before and after the 1987 stock market crash. The results indicated changes in the ARCH parameter, risk premia and persistence of volatility before and after the 1987 crash. But these noted changes were not uniform and depend upon the individual markets. Factors other than the 1987 crash may also be responsible for the changes.

Bekaert and Harvey (1997), examined the volatility in the emerging markets, and provide an approach that allowed the relative importance of world and local information to change through time in both the expected returns and conditional variance processes. Their time-series and cross-sectional models analyzed the reasons that volatility is different across emerging markets, particularly with respect to the timing of capital market reforms, and the results suggested that capital market liberalizations often increase the correlation between local market returns and the world market but do not drive up local marker volatility.

Chaudhuri (1997) investigated the number of common trends in stock returns in seven Asian emerging markets and finds evidence of a single common trend. He also provided graphic evidence is provided in favour of market interdependence.

3.5. CONCLUSION.

In this chapter I reviewed a series of theoretical issues in Finance; the Efficient market Hypothesis, the market anomalies, and Asset Pricing Models such as the CAPM, the APT, and the relevant empirical studies that have appeared in the literature.

Most of these issues will be empirically examined in the subsequent chapters, for a sample of 10 emerging markets. As we have seen there is a strong body of evidence concerning these theories, however, very few studies (if any at all) have been concerned with the emerging markets. Most concentrate in the industrialised markets of USA, Japan, UK, Germany, etc.

I have argued that emerging markets are (and will be) important in the international financial environment in the previous chapter and now it is time to move on and examine some of these statements and see whether the behaviour of the emerging financial markets is consistent with the Finance Theory.

CHAPTER IV.

RANDOM WALKS

AND EQUITY RETURN PREDICTABILITY

IN THE EMERGING EQUITY MARKETS.

4.1. INTRODUCTION.

A stock market is said to be *informationally efficient* when at every moment in time the current price of the stocks fully reflects all available and relevant information. Information efficiency refers to the performance of a market as an information processor and a price setter. On the other hand *operational efficiency* refers to the performance of a market as an exchange system.

The main implication of the semi-strong form of the EMH is that investors cannot use publicly-available information to earn abnormal returns. The idea behind the theory is quite straightforward: if all information is readily available to a large number of rational, profit-seeking investors then arbitrage operations should drive the current price of a security toward its true value.

However, a growing number of recent studies have produced evidence that contradicts the notion that markets are informationally efficient. These empirical studies find persistent cross-sectional and time-series patterns in security returns that are not predicted by any theory. The main implication is that these studies suggest that equity returns are predictable, a fact that directly contradicts EMH in its weak-form. For example, recurrent seasonality in stock returns means that, on average, stock market returns differ according to which day of the week returns are measured (day-of-the-week effects) or which month of the year returns are calculated (month-of-the-year effects). What this means is that investors can predict higher or lower returns for specific time periods.

In this chapter I examine some issues that are related to the Efficiency of the emerging equity markets: firstly, I test the Random Walk Hypothesis of stock price changes and secondly, I concentrate on two seasonal effects; one monthly (the January effect) and one daily (the weekend or Monday effect). The evidence on such effects for the developed markets is extensive, however, for the emerging markets it is scarce.

The theory of Random Walks (RW) is related to the weak-form EMH: if prices follow a RW then price changes over time are random (independent).The price change of today is unrelated to the price change of yesterday, or any other day. If new information arrives randomly in the markets and investors react immediately to it then price changes should also be random. So, in effect when one tests for RWs one simultaneously tests for weak form efficiency.

The Monday effect that has been documented in earlier studies (i.e. statistically significant and positive returns on Fridays and negative returns on Mondays) is a violation of the weak form of the EMH since mean daily returns should be the same among all the days of the week. Implicitly, I also test here two theories that consider stock returns around the weekend (French (1980)): the first, the *calendar time hypothesis*, asserts that if the process that generates stock returns operates continuously, then the excepted return on Mondays should be three times as large as for the other days of the week, in order to compensate for the three-day holding period (assuming that trading takes place from Monday to Friday, as in the majority of the markets). The second, known as the *trading time hypothesis*, asserts that returns are generated only during active trading and therefore the expected returns should be the same for each of the five days of the week. In other words, the first hypothesis predicts a larger return on Mondays, and the second hypothesis predicts equal returns on Mondays, relative to the rest of the weekdays. However, most of the earlier evidence finds that in many developed countries the stock returns on Mondays are, on average, negative. There is not an adequate explanation of this pattern, yet, and the fact that it persists across so many industrialised markets makes it even more difficult for researchers to come up with a convincing explanation for this "anomaly".

The January effect that has been documented statistically by many empirical studies (statistically significant and positive returns during the month of January) consists a violation of the weak form of the EMH since mean monthly returns should be the same across all the months of a year. Many hypotheses have tried to explain the January effect. The most prominent ones are the Tax Loss Selling Hypothesis (TLSH) and the Information Hypothesis, (IH).

The TLSH was initially suggested by Branch (1977) and Dyl (1977) and the idea was based on a year end tax loss selling of shares that had declined in value over the previous year. Investors wish to realise their losses before the new tax year and this creates a downward pressure on these stocks near the end of the year and a price rebound at the beginning of the new tax year as the selling pressure dissipates. The information hypothesis was based on the fact that January marks the beginning and the end of several potentially important financial informational events (Rozeff & Kinney, 1976). January is the beginning of the tax and accounting year for many firms, the start of the tax year for many investors, the time when announcements of previous years' accounting earnings are made, etc. A third explanation of the effect is the portfolio rebalancing hypothesis proposed by Hougen and Lakonishok (1987). Money managers engage in "window dressing" i.e. they rebalance their portfolios prior to year end to remove securities which might be embarrassing if they appear in the year-end balance sheets. As soon as December 31 passes they rebalance their portfolios investing in more speculative securities including high risk small securities. Another explanation of the effect, the Risk Mismeasurement Hypothesis, was proposed by Rogalski and Tinic (1986). They showed that during the month of January small firm stocks have significantly higher total, systematic and residual risks, thus, the equilibrium rate of return that investors require during that month may be considerably higher.

The remainder of the chapter is organised as follows: section 2 discusses the data and the methodology, section 3 presents the results, section 4 concludes the chapter, and section 5, presents the Tables and Figures.

4.2. DATA AND METHODOLOGY.

The main set of data I use in the study are 10 emerging stock market indices and two developed stock market indices. More specifically, I use the national equity indices of Brazil, Argentina, Chile, Mexico, India, South Korea, Malaysia, Thailand, Taiwan and Philippines.

I obtained end of month observations for the period between January 1976 to December 1994, with the exception of Philippines, Malaysia, and Taiwan, which started from January 1985. The reason for choosing the end of month price over an average price of the month is that the average price will introduce a degree of smoothness in the series, and this might result in a loss of information. The indices, are all expressed in a common currency, the US $. The indices are constructed by the International Finance Corporation (IFC) as part of their emerging market indices[17] , and were obtained from Datastream. All indices were subjected to the logarithmic transformation, and the returns were defined as the first difference of the log price levels. Plots of the returns of the 12 equity indices for the entire sample period are presented in section 6. The daily indices were also obtained from Datastream, and cover the period between 01/01/1990 and 01/01/95. With the exception of Brazil (Bovespa), India (IPSE National), and Korea (SE Composite), all indices are the Datastream calculated Total Market Indices.

The first step in the examination of the behaviour of the emerging equity markets is to test whether the presence of a trend in the evolution of the prices is due to a stochastic or a deterministic element. Traditionally, this is done with the well known Dickey Fuller (DF) tests (see next chapter). However, although often used for this purpose, these tests are not actually particularly suited to the task of determining whether (log) prices are Random Walks. The reason for this is that unit root tests do not rule out increments being correlated since they are concerned with whether shocks have a permanent or temporary impact, that

[17] The IFC is an affiliate company of the International Bank of Reconstruction and Development, i.e. the World Bank.

is, whether a series is difference stationary or trend stationary. This procedure does not therefore rule out the possibility that a difference stationary process is not a Random Walk.

Therefore, since the results of this test might be misleading under certain conditions, thus researchers have utilised different tests based on the variance of the series that avoid many methodological problems of the DF test. These tests can be "... more powerful than the traditional Dickey-Fuller, or Box-Pierce tests under alternative hypotheses involving AR(1), ARIMA(1,1,0), or ARIMA(1,1,1)........ For example there are some important departures from the random Walk that the Dickey Fuller tests cannot detect" and perhaps more importantly, "when the attribute of interest is uncorrelatedness of increments, the variance ratio test is more appropriate than the unit root tests"[18].

[18] Ayadi F. and Pyun C., "An application of variance ratio test to the Korean securities market", *Journal of Banking and Finance*, Vol.18, 1994, p648.

4.2.1. Cochrane's measure of persistence.

The first test that I utilise for testing for the magnitude of the random walk component in the emerging equity market indices is based on the analysis of Cochrane (1988).

A random walk model with a drift of a series y_t can be represented as:

$$y_t = \mu + y_{t-1} + e_t \qquad (4.1)$$

The fluctuations in this model are permanent, in the sense that if y_t falls one unit below last period's expected value, the forecasts $E_t(y_{t+j})$ fall by one unit for the infinite future. In addition the random walk process is nonstationary.

A series y_t with temporary fluctuations can be represented as:

$$y_t = bt + \sum_{j=0}^{\infty} a_j e_{t-j} \qquad (4.2)$$

where $\sum_{j=0}^{\infty} a_j e_{t-j}$ is a stationary stochastic process, and the series is called trend stationary.

If the log of a series follows a first difference stationary linear process, it has a Moving Average representation of the form:

$$\Delta y_t = (1 - L)y_t = \mu + A(L)e_t = \mu + \sum_{j=0}^{\infty} a_j e_{t-j} \qquad (4.3)$$

where, L is the lag operator.

The random walk process of (4.1) obviously has a representation of the form of (4.3), and the trend stationary case (4.2) is a special case of (4.3), when $\mu = b$.

Cochrane (1988)[19] begins from this point to establish 3 facts: a) any first difference stationary process can be represented as the sum of stationary and random walk components, and the innovation variance of the random walk component is a natural

[19] For a detailed discussion and proofs of the facts see: Cochrane J., "How big is the Random Walk in the GNP?", *Journal of Political Economy* 1988, vol.96, no.5, pp893-919.

measure of the importance of the random walk component; b) in every decomposition of a process into stationary and random walk components, the innovation variance of the random walk component is the same; c) the innovation variance of the random walk component is equal to the spectral density of Δy_t at frequency zero.

Cochranes' technique was to measure the size of the random walk component in US GNP from the variance of its long run differences. The intuition behind that was (as Malliaris and Urrutia (1991) argued) that if the natural logarithm of a time series (y_t) is a pure random walk then the variance of its q difference is q times the variance of its first difference, i.e. the variance of its q-differences grows linearly with the difference q:

$$Var(y_t - y_{t-q}) = qVar(y_t - y_{t-1}) \tag{4.4}$$

or equivalently:

$$q^{-1}Var(y_t - y_{t-q}) = Var(y_t - y_{t-1}) \tag{4.5}$$

Therefore, if the series is a random walk 1/q times var (y_t-y_{t-q}) should be constant at var (y_t-y_{t-1}).

Cochrane developed a framework for testing for the magnitude of the random walk component in a series, based on the spectral density of Δy_t, a test of the persistence of shocks. The variance of shocks to the random walk component captures all the effects of a unit root on the behaviour of a series in a finite sample. He shows that the variance of the q-differences of y_t could be used to estimate the innovation variance of a random walk component, and *that 1 q times the variance of the q-differences [q^{-1} var (y_t-y_{t-q})] is asymptotically equivalent to the Bartllet estimator of the spectral density at frequency zero*[20].

The estimates of the spectral density are standardised by the unconditional variance of Δy and if evaluated at zero frequency give consistent estimates of Cochrane's measure of persistence; *for a random walk the estimates for different q's should be close in value.*

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[20] The estimation proccedure of the spectral density function is presented in the Appendix.

4.2.2. The variance ratio test.

A second test, closely related to the above, is the variance ratio test for RWs, recently developed by Lo and MacKinlay (1988). The variance ratio test is very similar to the Cochrane measure of persistence in the sense that it divides the 1/q times the variance of the q difference with the variance of the first difference: the ratio should be close in value to unity[21]. The variance ratio of q observations is defined as:

$$VR(q) = \frac{\sigma_c^2(q)}{\sigma_e^2(q)} \tag{4.6}$$

where $\sigma^2_c(q)$ is an unbiased estimator of 1/q of the variance of the qth difference of stock price and $\sigma^2_e(q)$ is an unbiased estimator of the variance of the first difference of stock price:

$$\sigma_c^2(q) = \left(\frac{1}{m}\right)\sum_{t\;q}^{nq}\left(X_t - X_{t\;q} - q\mu\right)$$

$$\sigma_e^2(q) = \left(\frac{1}{nq-1}\right)\sum_{t\;1}^{nq}\left(X_t - X_{t-1} - \mu\right)$$

where $m=q(nq-q+1)(1-(q/nq))$

$\mu= (1/nq)\,(X_{nq}-X_0)$

The standard Z test statistic is $Z(q) = VR(q)-1 / [\phi(q)]^{1/2} \approx N(0,1)$

where, $\phi(q) = [2(2q-1)(q-1)] / [3q(nq)]$

Under the null hypothesis of Gaussian Random Walk the two estimators $\sigma^2_c(q)$ and $\sigma^2_e(q)$ should be close in value to each other.

[21] For a full discription of the test and a discussion see Ayadi and Pyun (1994), footnote 18.

Thus testing for Random Walks is equivalent to testing the null hypothesis :

$$VR(q) = 1 \tag{4.7}$$

against the alternative

$$VR(q) \neq 1 \tag{4.8}$$

4.2.3. The parametric tests.

With the parametric tests we intend to analyse the mean monthly (daily) returns and compare the magnitude of the differences and the significance of different mean monthly (daily) returns. As a formal test for the hypothesis of equal mean returns for all months of the year, the following seasonal (monthly) dummy variable regression was used:

$$R_{it} = a_1 D_{1t} + a_2 D_{2t} + ... + a_{12} D_{12t} + u_t \qquad (4.9)$$

where R_{it} is the return index of the ith country, D_{1t} is a dummy variable that equals 1 if the month is January and 0 otherwise, D_{2t} is a dummy variable that equals 1 if the month is February and 0 otherwise, ..., u_t is the error terms. The coefficients a_1 to a_{12} represent the mean return of the respective month. The method of estimation was Ordinary Least Squares, (OLS).

For the examination of the Monday or Weekend effect the above regression took the form:

$$R_{it} = a_1 D_{1t} + a_2 D_{2t} + ... + a_{12} D_{5t} + u_t \qquad (4.10)$$

where R_{it} is the daily return index of the ith country, D_{1t} is a dummy variable that equals 1 if the day of the week is Monday and 0 otherwise, D_{2t} is a dummy variable that equals 1 if the day of the week is Tuesday and 0 otherwise, ..., u_t is the error term.

4.4.4. The non-parametric tests.

Parametric tests of hypotheses and significance require various assumptions about the distribution of the population from which the samples are drawn, as for example, normal or nearly normal population distributions. In practice, however, often such assumptions may not be justified. For example, the examination of the sample statistics (Table 1) and a more formal test for normality (Table 2) suggest that almost all of the return distributions of the sample are non normal. Statisticians have devised various tests and methods that are independent of population distributions and associated parameters. These are called non parametric tests.

In the present study, I am going to utilise a test developed by Kruskal and Wallis (1952), (henceforth, K-W). This test is essentially the Mann-Whitney test for two independent samples, extended to k independent samples.

The experimental situation is one where k random samples have been obtained, one from each of k possibly different populations, and we want to test the null hypothesis that all of the populations are identical against the alternative that some of the populations tend to furnish greater observed values than other populations. It is a test that uses " ranks " and requires no distributional assumptions other than the random variables are continuous and measurable on an ordinal scale.

Furthermore, as Rozeff and Kinney (1976) note: "*....the K-W statistic......may more loosely be regarded as a test of the hypothesis that all the distributions have equal means* "

For the implementation of the K-W procedure consider an arrangement of monthly stock market returns, for a given country, as a [T x 12] matrix, $R=[r_{tm}]$. Rows of R represent the years and columns of R represent the months of the year. Each element, r_{tm}, of the matrix R, then, is the return realised in month m of the year t. The basic model of returns for each country is :

$$r_{tm} = \mu + T_m + e_{tm}, \quad (4.11)$$

$t = 1, 2,.., t_m$, $n = 1, 2,..., 12$, where μ is the (unknown) overall mean, T_m is the unknown month m effect and $\Sigma^{12}_{m\ 1} T_m=0$.

We assume that the error terms for each country, e_{tm}, are independent of the other error terms of that country. Moreover all of the error terms for a country are drawn from the same continuous distribution. Note that these assumptions are consistent with the premise that the stock prices follow a multiplicable random walk.

For each country we test the hypothesis that:

$$H_0 : T_1 = T_2 = ... = T_{12} = 0, \qquad (4.12)$$

against the alternative that all T's are not equal. Rejection of the null hypothesis implies that stock returns in a given country exhibit seasonality.

The K-W test first ranks the M observations jointly from least to greatest. Let x_{tm} denote the rank of r_{tm} in this joint ranking ; the test statistic is:

$$H = \left[\frac{12}{M(M+1)}\right]\sum_{m-1}^{12} T_m\left(X_m - X\right)^2 \qquad (4.13)$$

where X_m is the average rank received by the returns in the mth month such that:

$$X_m = \left(\frac{1}{T_m}\right)\sum_{t=1}^{tm} X_{tm} and, X = \frac{(M+1)}{2} \qquad (4.14)$$

which is the average rank of all M observations. When H_0 is true the H statistic has an asymptotic χ^2 distribution with 11 degrees of freedom. The appropriate a-level test is reject H_0 if $H>\chi^2\ (11,a)$, where the $\chi^2(11,a)$ is the upper a percentile point of a χ^2 distribution with 11 degrees of freedom. The test is not sensitive to outliers since it uses ranks and furthermore it requires no distributional assumptions about the stock returns (such as a normal distribution), and therefore it is a less restrictive test than the parametric tests. The K-W statistic is distributed as a χ^2 with N-1 degrees of freedom.

4.3. RESULTS.

4.3.1. Sample statistics.

Table 4.1, presents the descriptive statistics (mean, standard deviation, skewness, kurtosis-3) of the monthly return distributions for the 10 equity indices. The highest mean monthly return is observed in Philippines and the second highest in Thailand. however, the highest standard deviation is that of Argentina and the second highest in Brazil. The lowest mean monthly returns was observed in Brazil and Malaysia. Taiwan is the only market which has a negative mean return during the sample period. The skewness statistic (which indicates the degree of symmetry - or lack of symmetry - of a distribution) as well as the kyrtosis statistic (which indicate the extent to which a distribution is peaked or flat) indicate that the rates of return may not be drown from a normal distribution; a result confirmed by the normality tests below. For exampe, the kyrtosis measure is for all cases (exept for Malaysia) away from the value of 3 that is associated with the normal distribution.

Table 4.1

Sample statistics of returns, monthly data, 1976M1-1994M12

Country	Mean	St. Deviation	Skewness	Kurtosis-3
Brazil	0.00239	0.16830	-0.37489	2.6407
Argentina	0.01759	0.24990	0.04169	3.9679
Chile	0.01955	0.10553	0.33983	1.3131
Mexico	0.01092	0.13757	-2.15280	10.861
India	0.10950	0.07739	0.19421	1.7025
Korea	0.00641	0.08745	0.52738	1.0427
Malaysia	0.00924	0.08046	-0.97647	3.1452
Thailand	0.09186	0.07882	-0.31951	4.1242
Taiwan	-0.02234	1.18040	-0.14630	13.868
Philippines	0.03031	0.10379	-0.01170	2.2727

4.3.2. Testing for normality.

Table 4.2, presents an extra test for the normality of the monthly return distributions: I regressed all indices on a constant, in order to obtain an estimate of the mean return over the sample period, for each country. The model of the regression was of the form:

$$R_{it} = a_i c_t + e_t \tag{4.15}$$

were R_{it} the return series for each country, a_{it} the OLS estimate of the mean, c_i is a constant and e_t the residuals. Table 2 also reports the estimated χ^2 statistic for non-normality, (Bera-Jarque Test). The null hypothesis is that the residuals of the model are normally distributed and it is rejected for all indices, a fact suggesting that a non parametric testing procedure, for the investigation of seasonal effects, would be more appropriate (note that the situation is the same for the daily returns). Nevertheless I shall proceed with the parametric tests first, but I will interpret the result with caution.

Table 4.2

Normality tests on the returns.

	Mean	**χ^2 (2)**
Brazil	.00239	71.275
Argentina	.01759	148.98
Chile	.01955	20.678
Mexico	.01092	1291.2
India	.01095	28.840
Thailand	.00918	164.74
Malaysia	.00924	67.961
Taiwan	-.02234	954.12
Korea	.00641	20.806
Philippines	.03031	25.613

The 5% critical value for the χ^2 (2) is 5.41.
The 10% critical value for the χ^2 (2) is 4.61.

4.3.3. Cochrane's test for Random Walks.

Table 4.3 presents the results for the Cochrane measure of persistence, i.e. the Bartllet estimators of the spectral density of the variables, at frequency zero, and their asymptotic standard errors, for the monthly data.. The estimates indicate that 1/q times the variance of q-differences grows with the number of q, for all the variables, suggesting that the null hypothesis of a random walk is rejected by the data, since for a random walk series these estimates should be close in value.

Table 4.3

Bartllet estimators of spectral densities at frequency zero, for q=1,3,6,12 (monthly data).

Market	q (differences)			
	q=1	q=3	q=6	q=12
Brazil	.60897	1.7741	3.5839	5.7911
	(.25563)	(.74801)	(1.5213)	(2.4921)
Argentina	.67486	1.7804	3.2005	6.3124
	(.28329)	(.75068)	(1.3585)	(2.7164)
Chile	2.6029	5.8185	10.0025	14.7519
	(1.0926)	(2.4533)	(4.2458)	(6.3482)
Mexico	1.4615	3.3262	6.3769	10.7241
	(.61351)	(1.4024)	(2.7068)	(4.6149)
India	.43702	1.1687	2.3547	3.8028
	(.18345)	(.49275)	(.99954)	(1.6365)
Thailand	1.5945	3.9199	7.4112	13.2783
	(.66932)	(1.6528)	(3.1459)	(5.7141)
Taiwan	.17890	.24727	.49892	1.2268
	(.088819)	(.12381)	(.25308)	(.60961)
Malaysia	.43871	1.1324	2.1352	4.7474
	(.21781)	(.56699)	(1.0831)	(2.3590)
Korea	1.6184	4.5075	8.0169	13.4140
	(.67938)	(1.9005)	(3.4030)	(5.7725)
Philippines	1.8357	3.8695	6.4565	10.0951
	(.91142)	(1.9375)	(3.2751)	(5.0163)

Asymptotic standard errors appear in parenthesis.

4.3.4. The Variance Ratio test.

Table 4.4 present the results of the variance ratio test, VR(q), for Random Walks and the associated Z-test statistic. We can see that, for all markets, the null hypothesis of VR(q)=1 is rejected, for the alternative VR(q)≠1. In other words, the null hypothesis of a Random Walk is strongly rejected.

Table 4. 4

Variance ratios for various q-differences, q=3,6,12

(monthly data)

		VR(q)	
	q=3	**q=6**	**q=12**
Brazil	2.913	5.885	9.50
	(33.3)	(72.15)	(115.62)
Argentina	2.634	4.74	9.35
	(28.39)	(55.28)	(113.5)
Chile	2.235	3.84	5.66
	(21.56)	(41.99)	(63.41)
Mexico	2.27	4.36	7.37
	(22.26)	(49.67)	(86.11)
India	2.67	5.38	8.7
	(29.21)	(64.8)	(104.6)
Thailand	2.43	4.67	8.32
	(22.45)	(53.18)	(99.8)
Taiwan	1.382	2.78	6.85
	(4.8)	(18.92)	(56.26)
Malaysia	2.58	4.86	10.82
	(19.8)	(40.84)	(94.3)
Korea	2.68	4.95	8.28
	(29.41)	(58.39)	(99.0)
Philippines	2.10	3.51	5.49
	(13.93)	(26.6)	(43.22)

Z test statistics for the null that Variance Ratio =1 appear in parenthesis.

4.3.5. Testing for the January effect.

Tables 4.6 and 4.7, present the results of the regression with the 12 seasonal dummies for the 4 Latin America markets (Table 4.6) and the 6 Asian markets (Table 4.7). In addition Table 4.5, reports the K-W tests.

Table 4.5

Kruskall-Wallis tests on returns.

COUNTRY	IFC indices, US$, monthly data 1976M1-1994M12	Local indices, US $, daily data 1990M1 - 1995M1
Brazil	5.95892	14.0827*
Argentina	10.3521	15.088*
Chile	17.4331	10.577*
Mexico	10.3860	10.932*
India	14.5583	35.678*
Thailand	7.61638	20.6249*
Korea	5.91574	37.6509*
Malaysia	34.1405*	25.8686*
Philippines	42.7358*	37.561*
Taiwan	10.9006	33.047*

Critical χ^2 (11) at 5% : 19.675, at 10% : 17.225.
Critical χ^2 (4) at 5% : 9.488, at 10% : 7.779.
* denotes significance at the 5%.

The results are quite interesting; the parametric tests for the monthly returns do not quite agree with the non-parametric, a surprising fact since in earlier studies (Rozeff and Kinney) both testing procedures yielded similar results. The K-W non-parametric test statistic indicates that for all markets we have to accept the null of identical populations (i.e. no seasonality), with the exception of Philippines and Malaysia. The parametric regression on the other hand indicates that there are statistically significant months (i.e. seasonal effects) in 50% of the markets of the sample: Chile (January and March), India (January), Argentina (September), Mexico (February), Philippines (July and August). Thus, the results of the testing proccedures agree in the case Brazil, Korea, Thailand and Taiwan (i.e. no seasonality), and in the case of Philippines (i.e. seasonality). As for the January effect a statistically significant January mean return is detected only in Chile and India, eventhough for all countries (except Brazil, Argentina, Mexico) the mean January return is much *higher* than the overall mean monthly return[22].

Table 4.6

Dummy variable regression results for Latin America markets.

	Brazil	Argentina	Chile	Mexico
JAN	-.00387	-.00167	.06287	-.00320
	(-.096342)	(-.028557)	(2.5629)*	(-.098265)
FEB	.04902	.00692	.01950	.06512
	(1.2532)	(.12107)	(.81663)	(2.0523)*
MAR	.00590	.07723	.0796	.0329
	(.15097)	(1.3500)	(3.3350)*	(1.0369)
APR	-.02225	.05520	.01132	-.01221
	(-.56874)	(.96502)	(.47438)	(-.38492)
MAY	.0446	-.03462	.0358	-.0131
	(1.1422)	(-.60516)	(1.4995)	(-.41399)
JUN	.02277	.063911	.008774	.04229
	(.58216)	(1.1171)	(.36746)	(1.3330)
JUL	-.02049	.074109	.029120	-.008421
	(-.52373)	(1.2954)	(1.2195)	(-.26541)
AUG	.00818	-.03938	.01056	.02055
	(.20908)	(-.68837)	(.44225)	(.64763)
SEP	-.007800	.11837	.022664	.037705
	(-.19938)	(2.0689)*	(.94912)	(1.1883)
OCT	.00408	.008811	.001612	-.001507
	(.10440)	(.15402)	(.067524)	(-.047512)
NOV	-.00894	-.07117	-.02128	-.02663
	(-.22858)	(-1.2441)	(-.89117)	(-.83934)
DEC	-.04292	-.04764	-.02370	-.003141
	(-1.0972)	(-.83280)	(-.99285)	(-.098996)
R^2	.023391	.052660	.074573	.038444
F-test	.46814	1.0865	1.5750	.78145
DW	1.9735	1.9533	1.6464	1.4666

t-statistics appear in perenthesis,
* denotes significance at 5%, ** denotes significance at 10%.

[22] We also ran the regressions by replacing the dummy variable for January with a constant, i.e. the monthly returns of each market were regressed on a constant and 11 dummy variables (February to December). The results were essentially the same for Brazil, Korea, Thailand, Malaysia, Philippines and Taiwan. However, for the rest of the markets slightly different results were obtained: for Argentina and Mexico this proccedure revealed no significant coefficients; for Chile and India the coefficients on the constant and the November and December dummies was found significant.

Table 4.7

Dummy variable regression results for Asian markets

	India	Thailand	Taiwan	Malaysia	Korea	Philippines
JAN	.03382	.024793	.037707	.038968	.028691	.054115
	(1.8512)*	(1.3188)	(.093610)	(1.4492)	(1.3699)	(1.5626)
FEB	.02201	.016793	.069014	.0030032	.011019	.031094
	(1.2379)	(.91771)	(.18060)	(.11773)	(.54050)	(.94641)
MAR	.02898	-.005139	-.46856	.032052	-.002057	.04798
	(1.6297)	(-.28087)	(-1.2261)	(1.2564)	(-.10093)	(1.4606)
APR	.9546E-3	-.0057159	.083217	-.018941	.0069641	.036919
	(.33679)	(-.31237)	(.21776)	(-.74250)	(.34161)	(1.1237)
MAY	.007018	.007849	.28648	.025748	-.008132	.04520
	(.39465)	(.42899)	(.74967)	(1.0093)	(-.39894)	(1.3760)
JUN	-.0040116	.0048573	-.24686	.041782	.0054431	.031520
	(-.22557)	(.26545)	(-.64598)	(1.6379)	(.26700)	(.95938)
JUL	.022336	.019249	.45805	.0091396	.011986	.065489
	(1.2560)	(1.0519)	(1.1986)	(.35828)	(.58797)	(1.9933)*
AUG	.017699	.021570	-.0084892	.032343	.012558	.07203
	(.99523)	(1.1788)	(-.022215)	(1.2679)	(.61600)	(2.1925)*
SEP	.017135	.013108	.13874	-.018764	-.0055443	-.021003
	(.96352)	(.71633)	(.36306)	(-.73555)	(-.27197)	(-.63929)
OCT	.021799	.0099453	-.16582	-.001054	.8489E-3	-.03499
	(1.2257)	(.54350)	(-.43393)	(-041318)	(.041640)	(-1.0652)
NOV	-.018589	.021857	-.010325	.003213	-.0087706	.03274
	(-1.0452)	(1.1944)	(-.027018)	(.12599)	(-.43023)	(.99672)
DEC	-.016544	-.018113	-.43531	-.033546	.025206	.005051
	(-.93027)	(-.98985)	(-1.1391)	(-1.315)	(1.2364)	(.15376)
R^2	.045509	.025883	.049619	.088626	.017618	.091345
F-test	.93189	.51933	.50786	.94592	.35054	.97786
DW	1.8083	1.7786	2.5813	1.9297	1.9607	1.4129

t-statistics appear in parenthesis,
* denotes significance at 5%, ** denotes significance at 10%.

4.3.6. Testing for the Monday effect.

For the daily returns the parametric tests (Table 4.8) show that: a) 9 out of 10 countries have a negative Monday return and 6 out of 10 countries have a *significant* Monday return. Only India, Thailand, Korea, and Philippines, do not have a significant Monday effect. Note also, that Chile, Mexico, Thailand, and Malaysia, have significant Friday effects; b) 9 out of 10 countries have positive Friday mean daily returns, and also (as in earlier empirical studies on the industrialised markets) on average during the last three days of the week the mean returns are positive.

The K-W test for the daily returns suggests that the null hypothesis of no seasonality has to be rejected for all markets. These results agree with the parametric findings on the Monday seasonal. They also agree with earlier empirical findings, on the developed markets and some emerging markets of the Pacific rim, that have come to exactly the same conclusions.

Table 4.8

Dummy variable regression for the daily returns

	MON	TUE	WED	THU	FRI	R^2	DW	F(4,1299)
BR	-.0105	.0100	-.0012	.0068	-.0013	.0206	2.069	6.8506
	(-3.41)*	(3.26)*	(-.4112)	(2.23)*	(-.4479)			
AR	-.0080	-.0013	.0077	.0059	.879E-4	.0180	2.017	5.9723
	(-3.12)*	(-.5128)	(3.02)*	(2.29)*	(.0341)			
CH	-.0036	.0037	.0020	.0024	.0026	.01842	6.094	2.1951
	(-3.09)*	(3.16)*	(1.7)**	(2.07)*	(2.21)*			
ME	-.0021	.566E-4	.0016	.0025	.0018	.0113	1.687	3.7176
	(-2.18)*	(.0581)	(1.7)**	(2.61)*	(1.92)*			
IN	-.84E-3	.0013	-.61E-3	.0015	.0019	.0030	1.992	.98704
	(-.610)	(1.005)	(-.515)	(1.150)	(1.5)			
TH	-.48E-3	-.0013	99E-3	.0010	.0038	.0089	1.712	2.9242
	(-.4224)	(-1.149)	(.8644)	(.9519)	(3.33)*			
MA	-.0013	.36E-3	.0015	.14E-3	.0022	.0095	1.585	3.1285
	(-1.7)**	(.4618)	(1.99)*	(.1867)	(2.83)*			
PH	.0011	-.88E-3	.0011	.85E-3	.0010	.0031	1.629	1.0220
	(1.288)	(-1.03)	(1.3)	(.9935)	(1.172)			
KO	-.74E-3	-.30E-3	.34E-3	-.14E-3	.63E-3	.0010	2.082	.32826
	(-.7840)	(-.318)	(.3637)	(-.157)	(.6707)			
TW	-.0033	.80E-3	-.46E-3	.66E-3	.0010	.00427	1.943	1.3929
	(-2.15)*	(.5209)	(-.302)	(.4259)	(.7077)			

T-statistics appear in parentheses, critical value at 5% 1.96, at 10% 1.68.
* denotes significance at the 5%, ** denotes significance at the 10%.

4.5. CONCLUSION.

In this Chapter I presented evidence concerning the weak-form of the Efficient Market Hypothesis. More specifically, I used both monthly and daily data, for indices expressed in US$, utilised variance tests for Random Walks, and parametric and non-parametric testing procedures to test for two seasonal effects which imply that equity returns are predictable; the January effect and the Monday effect. The former implies that average returns are significantly different and, on average, higher in January than every other month in the year. The latter implies that mean daily returns are significantly lower or even negative on Mondays, than every other day of the week. Both effects contrast with the Random Walk and martingale theories of stock returns which state that returns should not exhibit such seasonal and predictable patterns in an efficient market. Both effects are well documented for the major international stock markets and some markets of the Asian Asian-Pacific region.

The results of the two variance tests indicate that the data reject the Random Walk hypothesis for the emerging market data, a clear violation of the weak form of the Efficient Market Hypothesis. Both the Cochrane's persistence measure and the variance ratio test rejected the notion that equity prices follow a Random Walk.

In addition, I found that mean daily returns in the emerging markets exhibit a strong seasonal pattern which manifestates in a different from all other weekdays and negative Monday return, (90% of the sample). Also, other earlier empirical findings, such as the positive returns of the last three weekdays (Wednesday, Thursday, and Friday) were found to be the case for the emerging markets as well. This evidence contradicts both the *calendar time hypothesis* and the *trading time hypothesis,* and suggests inefficiency and predictable patterns in daily returns. The first theory predicts Monday returns higher the rest of the weekdays, and the second theory predicts equal returns for all weekdays.

For the monthly data the results are puzzling. The non-parametric Kruskall-Wallis test indicate no significant seasonal patterns in the mean monthly equity returns of the emerging markets, with two exceptions: Malaysia and Philippines. The parametric tests, on the other hand, indicate that there is a significant seasonal effect in 50% of the sample markets, while a significant January effect exists only in the mean returns of Chile and India. The tests results agree in the case Brazil, Korea, Thailand and Taiwan (i.e. no seasonality), and in the case of Philippines (i.e. seasonality).

Overall, considering also the results of the normality test, I conclude that there is very *little statistical evidence* of monthly seasonal effects in the emerging markets of the sample (with the exception of Philippines), especially for a January effect.

Interpreting the results on the monthly data can be a tedious task; two possible explanations can be thought of at this stage: a) the case is that, there is no January Effect or seasonal effects in the majority of the Emerging Markets, and the markets are efficient relative to that anomaly, a fact predicted by Finance theory. This well documented effect perhaps exists only in the developed markets, b) the January effect documented in earlier studies could be the result spurious causes, having nothing to do with economic theories. For example, it could be the result of outliers, listings, delistings, data base errors, etc. Recall, that the first studies that documented the effect, and many after them, used the same database and the same indices. Here, a fresh database is used that incorporates markets that have not been included in previous tests (to the best of my knowledge).

Overall, the evidence presented in this paper, suggests that with the emerging equity market data, the weak form of the EMH is violated. Equity prices in the emerging markets do not appear to follow a Random Walk process, as suggested by the theory. Furthermore, a strong daily pattern was detected, thus suggesting that equity returns are predictable. However, the markets appeared efficient relative to the January anomaly.

4.5. FIGURES 1-10.

Figure 1. Brazil monthly returns, 1976-1994.

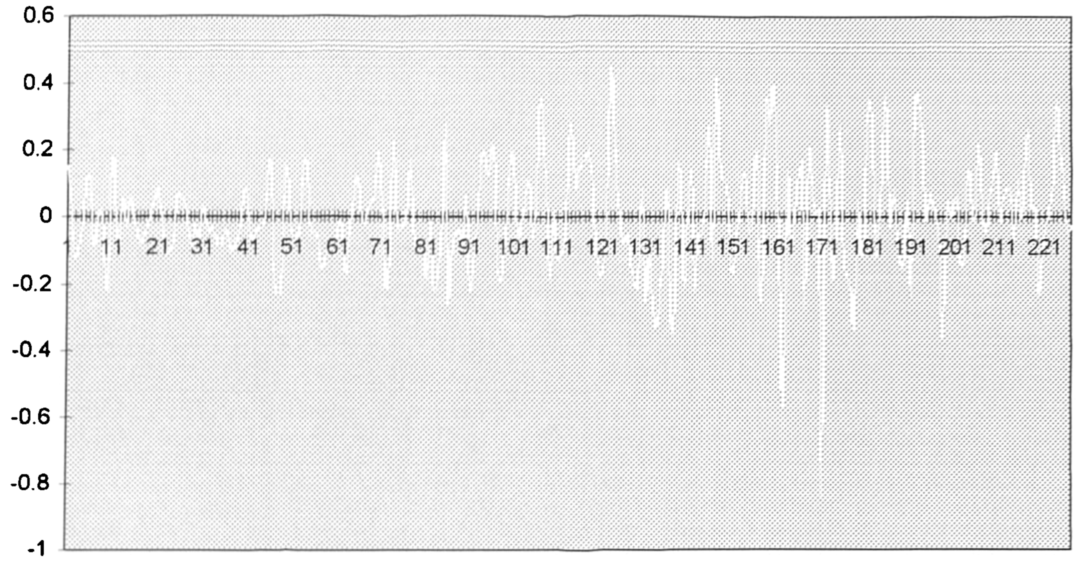


Figure 2. Argentina, monthly returns, 1976-1994.

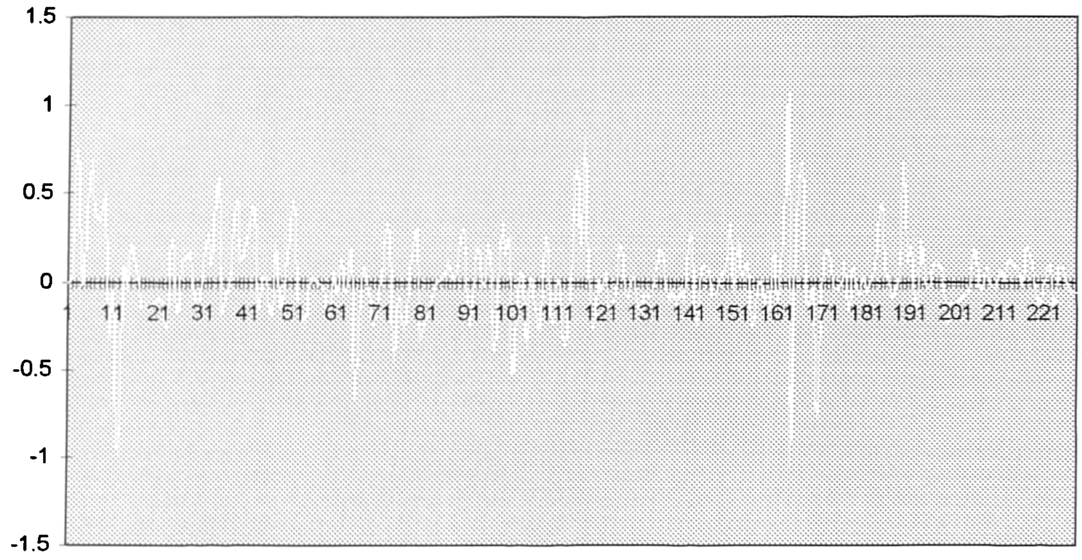


Figure 3. Chile, monthly returns, 1976-1994.

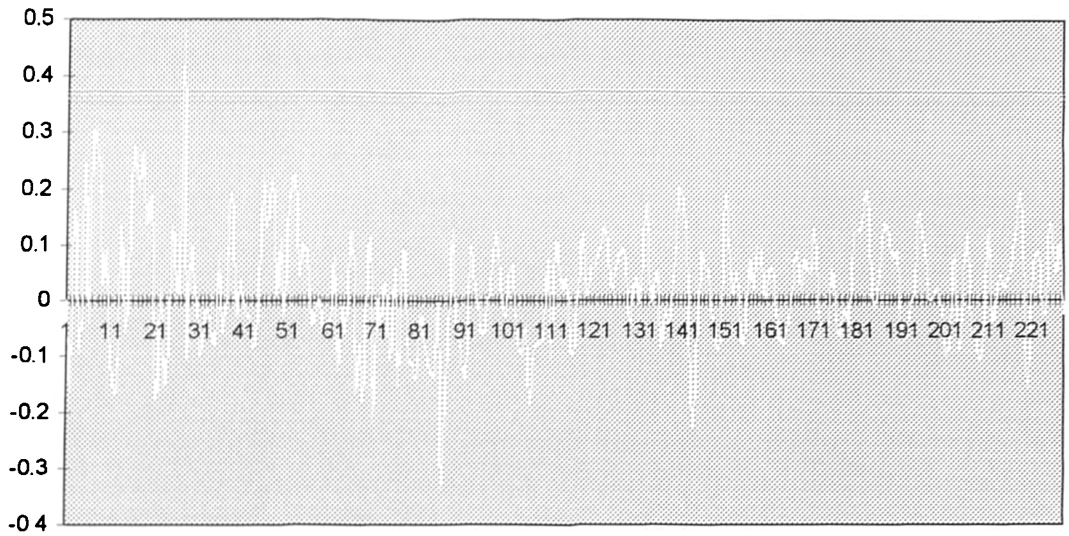


Figure 4. Mexico, monthly returns, 1976-1994.

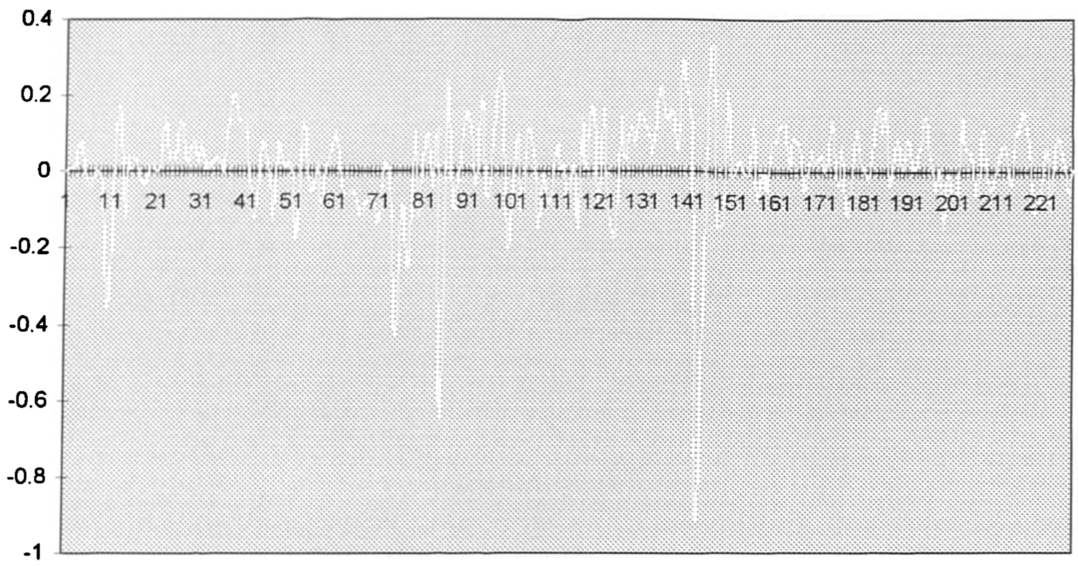


Figure 5. India, monthly returns, 1976-1994.

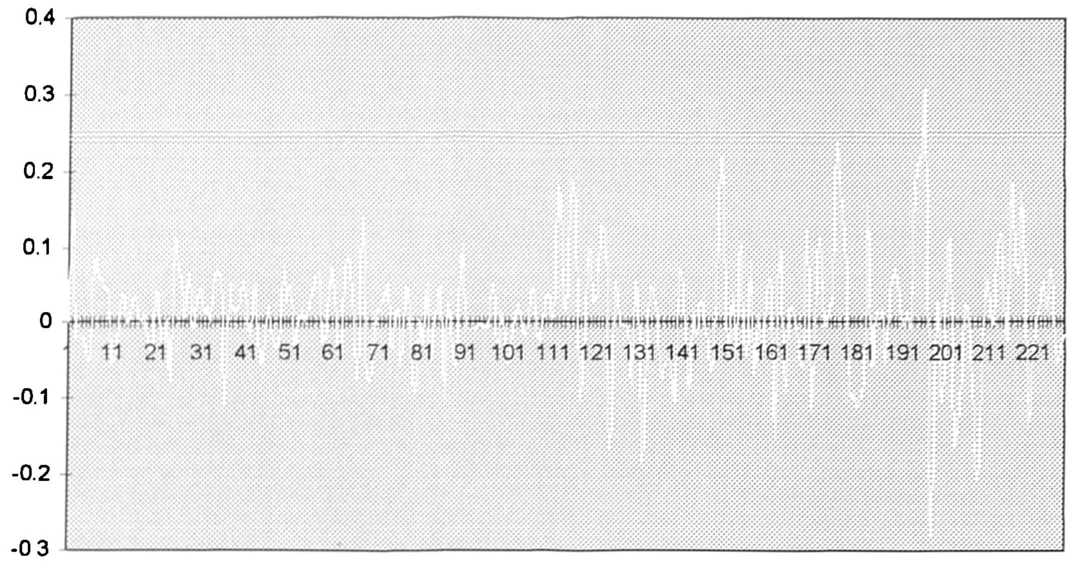


Figure 6. Thailand, monthly returns, 1976-1994.

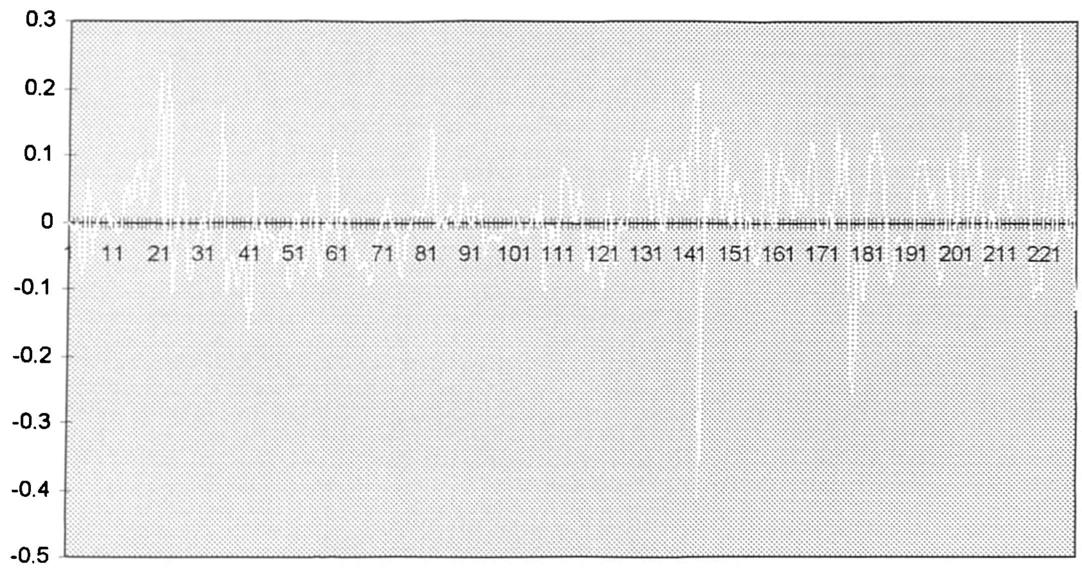


Figure 7. Korea, monthly returns, 1976-1994.

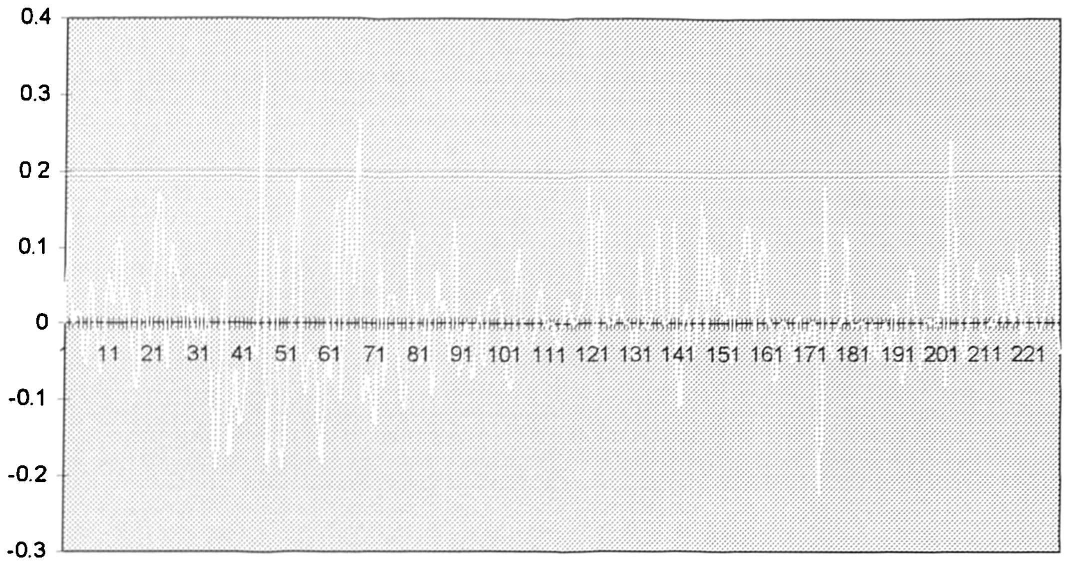


Figure 8. Malaysia, monthly returns, 1985-1994.

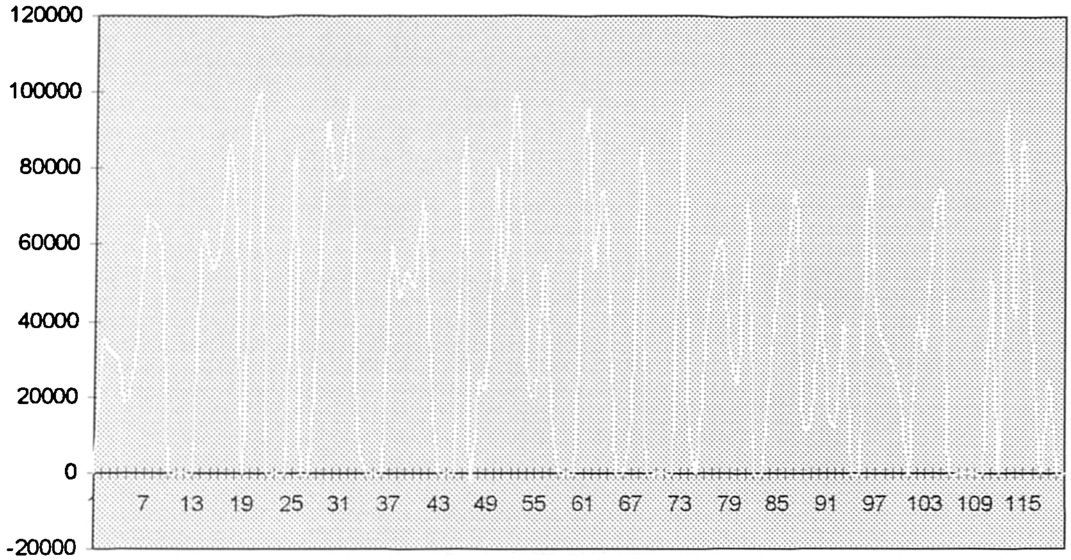


Figure 9. Taiwan, monthly returns, 1985-1994.

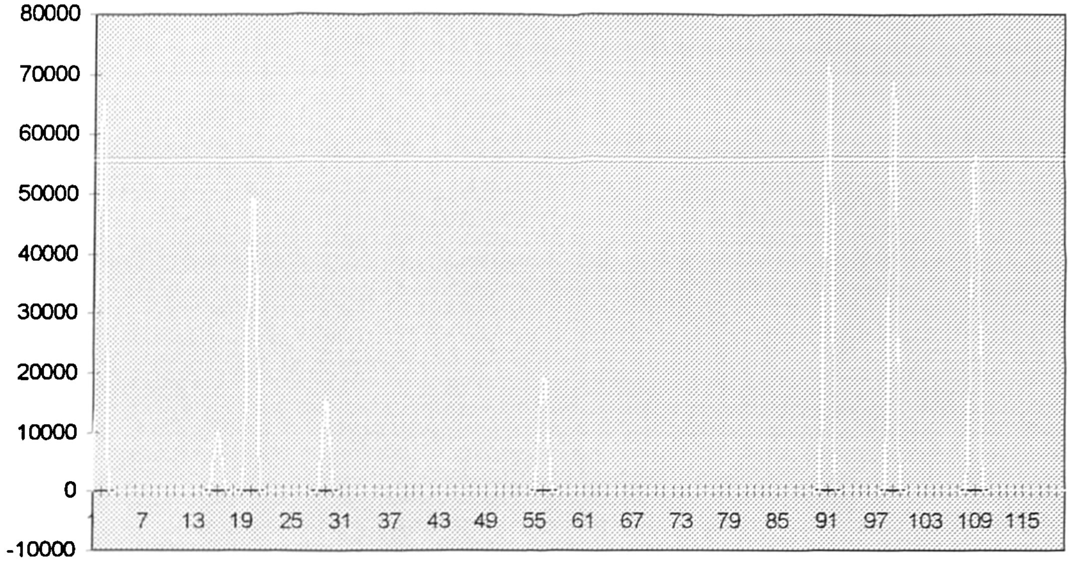
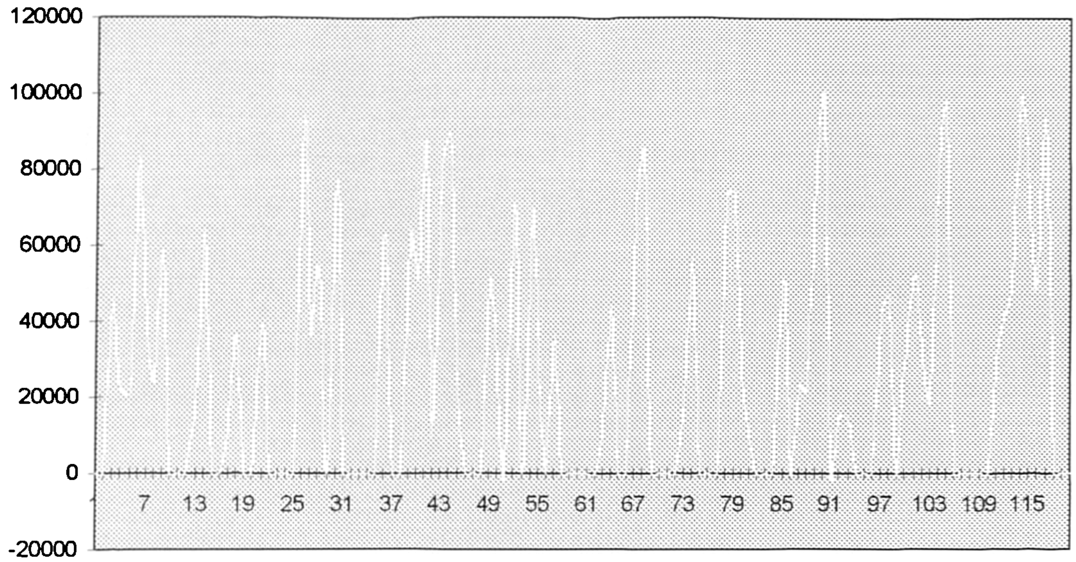


Figure 10. Philippines, monthly returns, 1985-1994.



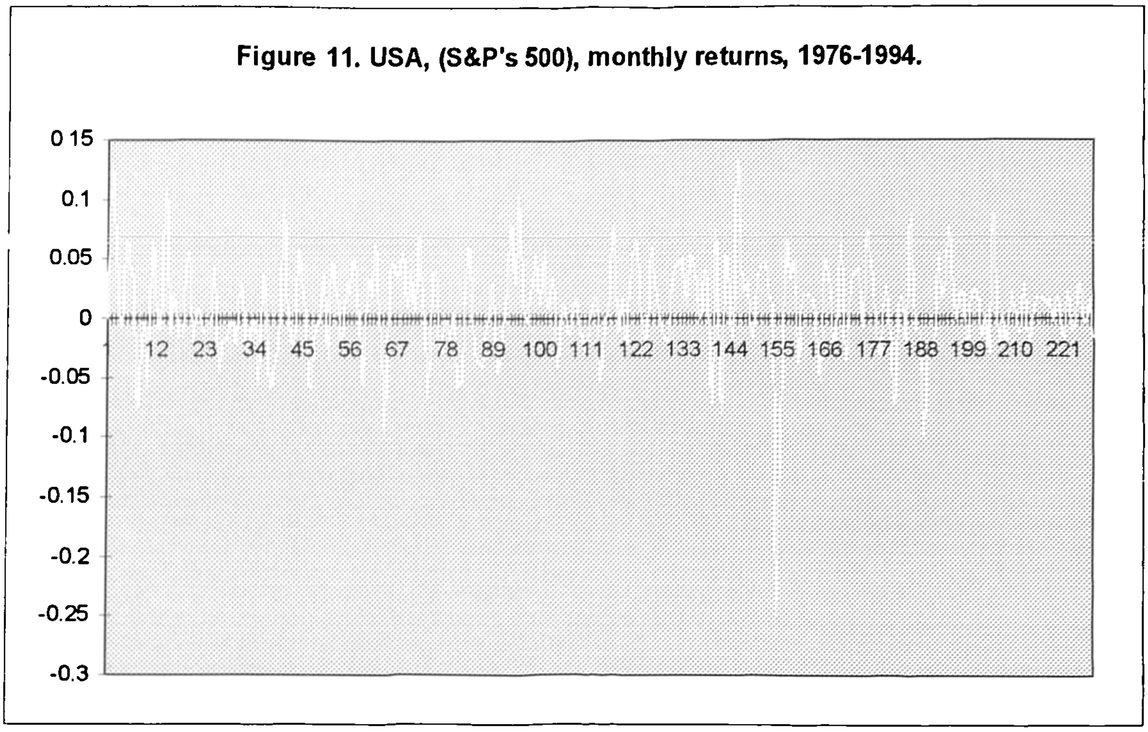


Figure 11. USA, (S&P's 500), monthly returns, 1976-1994.
0 15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
1 12 23 34 45 56 67 78 89 100 111 122 133 144 155 166 177 188 199 210 221

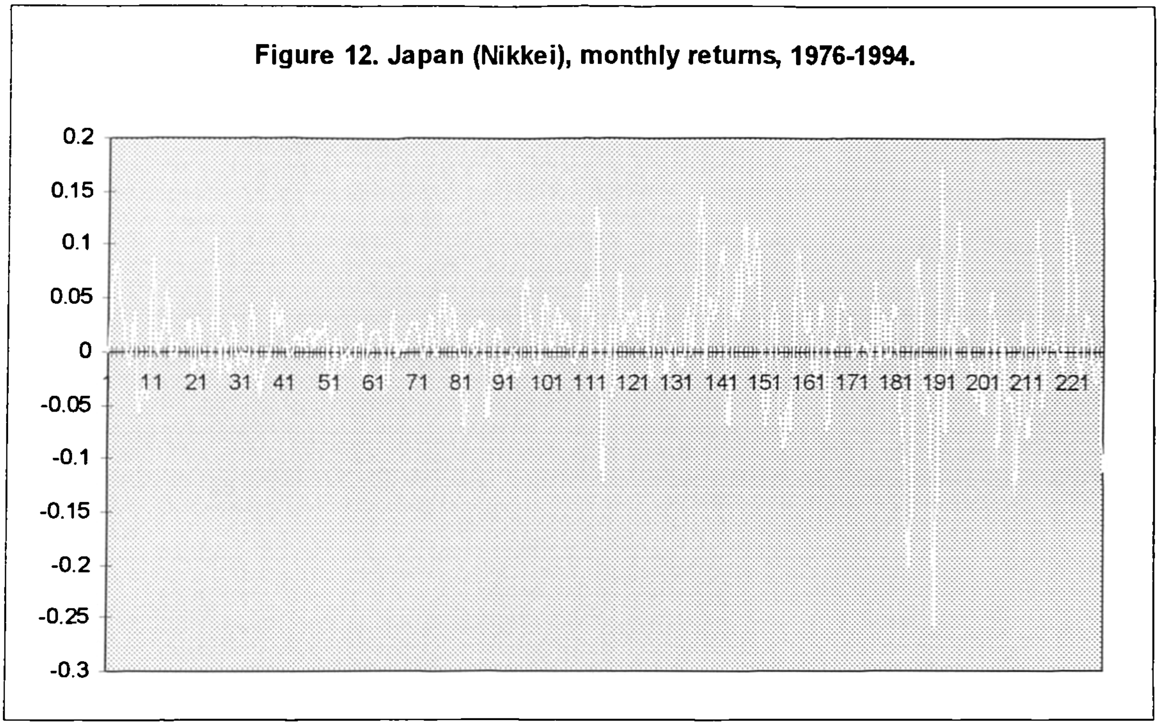


Figure 12. Japan (Nikkei), monthly returns, 1976-1994.
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201 211 221

4.6. APPENDIX.

For the implementation of Cochrane's (1989) testing procedure we shall utilise spectral analysis. The estimates of the standardised spectral density function of x_t, for the n observations $x_1, x_2 \ldots, x_n$, are estimated using the formula

$$f(\omega_j) = 1/\pi \left(\lambda_o R_o + 2 \Sigma_{k=1}^{m} \lambda_k R_k \cos(\omega_{jk}) \right)$$

where, ω_j $j\pi/m$, $j=0,1,\ldots,m$, m is the 'window size', R_k is the autocorrelation coefficient of order k and $\{\lambda_k\}$ are a set of weights called the 'lag window'.

The Bartlett lag window is defined as

$$\lambda_k = 1-k/m, \qquad 0 \leq k \leq m.$$

The standard errors for the estimates of the standardised spectrum are estimated according to the following formulae, which are valid asymptotically:

$$\text{S.E. } f(\omega_j) - \sqrt{(2/v)}\, f(\omega_j) \qquad \text{for } j=1,2,\ldots,m-1$$

$$= \sqrt{(4/v)}\, f(\omega_j) \qquad \text{for } j=0,m.$$

where, $v=2n/\Sigma_{k=-m}^{m} (\lambda_k^2)$ and for the Bartlett window $v=3n/m$.

[1] For an introductury discussion on the spectrum see Chatfield C: "The Analysis of Time Series: an Introduction", *Chapman & Hall*, 1989, ch7.

CHAPTER V.

COMMON STOCHASTIC TRENDS AND PRESENT VALUE MODELS IN THE EMERGING EQUITY MARKETS.

5.1. INTRODUCTION.

Over the past decade the world's capital markets have grown dramatically in size and become more integrated. This has mainly been the result of a combination of exchange rate developments, deregulation and common fiscal and monetary policies followed by the governments of many countries (EU, NAFTA, etc.). For example, in the UK the introduction of "Big Bang" led to increasing trading volume and rising market values of equities. In Japan the liberalisation of the equity markets also resulted in an increase in trading volume and a growth in market prices as well as a rise in interest among foreign investors. Furthermore, as a result of technological advances in the field of telecommunications, individual and institutional investors from many industrialised countries are now able to trade world-wide on a 24-hour basis in equities, derivatives, commodities and bonds. Therefore, one could argue that markets are more integrated than they used to be (for evidence on the international integration of markets see Errunza and Losq (1985), Taylor and Tonks (1989), etc.).

The interesting point here is that increased market integration seems to be occurring not just in developed markets but also in emerging capital markets. For example, in December 1993, the Mexican government devalued the Mexican peso. Soon, equity and bond markets in Hong Kong, Thailand, and much of the rest of Asia and Latin America fell sharply, and governments rushed to defend their currencies. Some weeks later, following the earthquake in Japan many stock markets fell again. A number of Goverments, including the Thailand authorities, blamed the so-called emerging-market mutual funds that invest in emerging market bonds and equities, for the downward move in the markets. In Thailand the bond market was hit by a wave of sell orders, putting the Thai baht under pressure. The argument by many locals was that fund managers in America, unnerved by their Mexican losses, may simply have decided to sell other emerging market holdings too[23].

In this chapter I examine an issue that has received very little attention in the literature so far, that of the integration and interdependence of *emerging* equity markets and any

[23] *Economist,* January 1995, p85.

subsequent implication this may have for international portfolio diversification. I do this by examining whether equity prices for different groups of emerging markets exhibit a common trend, that is whether they move together, in the long run. The reason for analysing this is that if investors have long horizons and equity markets share a common trend, conclusions about the benefits of international portfolio diversification based on cross-country correlation might be misleading. The gains from diversification will come from the low correlations that exist between different markets. If two or more markets are cointegrated, then in the long run their equity returns will tend to move together thus eliminating any gains for the investor (Taylor and Tonks (1991)).

Related to this is the question of whether the behaviour of stock prices in the emerging markets are consistent with the present value model of asset pricing. For example, Kasa (1992) has shown that a way to (indirectly) test the predictions of the present value model of asset pricing is to compare the cointegration structure of prices to the cointegration structure of their dividend payments. Evidence supportive of this hypothesis exists only for the developed markets (see Kasa (1992)).

This chapter is organised as follows: section 2 presents some earlier empirical research on international equity markets, section 3 discusses the methodology of the study and the econometric techniques involved, section 4 discusses the data and section 5 presents the results. Finally, section 6 concludes the chapter and section 7 presents the plots of the indices.

5.2. SOME EARLIER STUDIES ON INTERNATIONAL EQUITY MARKETS.

Most of the studies that analyse the integration and interdependence of financial markets typically utilise cointegration analysis to examine for the number of the cointegrating relationships among the financial markets.

5.2.1. On common stochastic trends.

Arshanapalli and Doukas (1994) investigate the temporal relationship between interest rates on Eurodeposit instruments ranging in maturity from seven days to one year for seven different currencies, between the period 1986 to 1992. The results of cointegration tests strongly indicate the presence of common factors in the univariate time series representation of each Eurocurrency term structure. Caporale and Pittis (1993) examine the issue of common stochastic trends and the inflation convergence in the European Monetary System. The authors took the view that as long as convergence is still in the process of being achieved, inflation differentials between the member countries are likely to be non-stationary, and if so, to exhibit common stochastic trends. However, tests based on the Johansen procedure rejected their hypothesis.

The common stochastic trends among the equity prices of USA and five East Asian countries, (Japan, Hong Kong, Singapore, Taiwan and S. Korea) are examined by Chung and Liu (1994). Their Johansen tests for cointegration reveal two cointegrating relationships among the six countries, in other words, four common stochastic trends. They conclude that all the markets, except the USA and Taiwan, belong into a common stock region. In addition, they find that most variables have the same adjustment speed in moving from short-run disequilibria toward the common trend.

In another study, Kasa (1992) presents evidence concerning the number of common stochastic trends in the equity markets of Japan, USA, UK, Germany, and Canada. He uses monthly and quarterly data, on national stock indices, for the period 1974-1990, to undertake Johansen (1990) tests for common trends. His results indicate the presence of a single stochastic trend driving these countries' stock markets. He also argues that under weak conditions the cointegration structure of the stock prices should mirror the cointegration structure of their dividend payments. Tests revealed that the dividends were also driven by a single stochastic common trend.

Also, Cohray, Pad and Urbain (1993) examine whether stock price indices of major European markets display a common long - run trending behaviour. Using cointegration analysis they provide empirical evidence of common stochastic trends among the biggest five European markets, for the period 1975 - 1991. Koch and Koch (1991) investigate how dynamic linkages among the daily returns of eight national stock indices have evolved during 3 different years. They construct and estimate a simultaneous equations model, in order to describe the contemporaneous and lead-lag relationships across the equity markets of Japan, Australia, Hong-Kong, Singapore, Switzerland, W.Germany, UK, and USA, over 3 different years : 1972, 1980, 1987. Their results reveal growing market interdependence within the same geographical region over time. Also, while they find many significant intermarket relationships within the same 24-hour period, the significant lagged responses across markets beyond 24 hours are only a few.

Hung and Cheung (1995) examine the existence of long term relationships among five Asian equity markets during the 1980s and report that the markets are not cointegrated.

5.2.2. On the integration of international financial markets.

Errunza and Losq (1985) conduct a theoretical and empirical investigation of the pricing and portfolio implications of investment barriers in the context of international capital markets. They argue that the postulated market structure -labelled "mildly segmented"- leads to the existence of "super" risk premiums for a subset of securities and to a breakdown of the standard separation result. They use data from many LDC's like Argentina, Brazil, Chile, Greece, India, Korea, etc., and the USA, for the period during 1976-1981, and their evidence suggests that markets are "mildly segmented. Jorion and Schwartz (1986) examine the issue of integration versus segmentation of the Canadian equity market relative to a global North American market, for the period 1968-1982. They compare the international and the domestic versions of the CAPM, and find that integration, or the mean-variance efficiency of the global market index, is rejected by the data. Segmentation was the preferred model, based on a maximum likelihood procedure correcting for thin trading. Further, integration is even rejected for the securities that were interlisted in both the Canadian and the USA markets.

5.2.3. On causality relationships between international markets.

Malliaris and Urrutia (1992) use Granger-causality methodology, to analyse lead-lag relationships for six major stock market indices : S&P500, Nikkei Dow, FT-30, Hong Kong Hang Seng, Singapore Straits Times and Australia All Ordinaries. They analysed the international propagation of the 1987 stock market crash. Daily data were used for a sample period between May 1987 to March 1988. This period was divided into 3 subperiods: before, during and after the stock market crash. They found no lead-lag relationships for the pre-crash and post-crash periods. For the month of the crash important feedback relationships and unidirectional causality was detected, however. Chowdhury (1994) uses Granger causality tests to analyse the cause and effect relationship between external debt and economic slowdown, for the developing countries of the Asia and Pacific. The results of the tests are mixed: they reject the Bulow-Rogoff proposition that the external debts of the developing countries are a symptom rather than a cause of economic slowdown. The results also reject the Dornbusch-Krugman proposition that external debt lead to economic slowdown. Gallinger (1994) examines, using Granger causality tests, the cause and effect relationship between real stock returns and real activity. He uses an S&P500 index, deflated by the Consumer Price Index, , the Federal Reserve Board Index for Industrial Production to measure real activity and National Association of Purchasing Management, (NAPM), data for production, commodity prices, inventory positions, imports, employment, etc, for a period from 1948 to 1990. He finds that real stock returns Granger-cause demand for consumption and investment goods, future capital investment, and leading economic indicators by a minimum of three months. He also reports contemporaneous causality between real stock returns and real activity. Fase (1994) using the same methodology, examines the interaction between trading volume of stocks and options, in the Amsterdam stock market. He uses daily data for the period between 1985 and 1989, of a sample of 5 firms listed at the Amsterdam Stock Exchange and additionally listed for call and put option trading at the European Options Exchange. He finds that often causality runs from options traded to the stock market. However, in a large number of cases no interaction was established at all.

5.2.4. On international portfolio diversification.

Taylor and Tonks (1989) use cointegration techniques to asses the impact of the abolition of UK exchange control (1979) on the degree of integration of the UK and overseas stock markets. They use monthly data from 5 capital markets : UK, USA, Germany, Japan, Netherlands, for the period 1973 to 1986. They find that after the abolition of the UK exchange control there was an increase in the degree that the stock markets of the sample moved together, in the long run.

Clare et al (1993) use the same cointegration methodology to examine the integration and efficiency of international bond markets, by examining the USA, UK, German, and Japanese bond markets, for the period 1978 to 1990. They find that the markets were not well integrated, a result suggesting that diversification between these markets could bring considerable benefits to the sterling investor.

Koch and Koch (1991) investigate how dynamic linkages among the daily rates of return of eight national stock indices, (Japan, Australia, Hong-Kong, Singapore, Switzerland, West Germany, UK, USA), have evolved since 1972. They find growing market interdependence within the same geographical region over time. Of the possible 56 same-day relationships across these markets, the number of significant ones increases from 15 in 1972 to 22 in 1987, which reveals that international markets have recently grown more independent. Also most of the significant same-day impacts appeared within blocks of countries in the same geographic region, whose trading hours overlap each day. They also find evidence consistent with the proposition of efficient intermarket relationships, since few significant leads beyond 24 hours appeared, i.e. the markets adjusted rapidly to new information. They use a dynamic simultaneous equations model to describe the lead-lag relationships across the markets.

5.3. TESTING METHODOLOGIES.

The first step in the examination of the emerging equity markets is to test for the degree of integration of the individual series, in other words I test for the presence of a unit root in the autoregressive representation of each country's price index. This is done using the well known Dickey Fuller tests.

In order to examine the interdependence of the equity markets I use the Johansen (1990) methodology for estimating the number of cointegrating vectors that exist between the variables of interest. The procedure (which is discussed below) essentially boils down to determining the rank of the matrix Π. If Π has a rank of r, then we can conclude that there are r cointegrating relationships among the elements of X_t (see below for details) or equivalently n-r common stochastic trends.

The same procedure is used to compare the cointegration structure of the prices with the cointegration structure of their dividend payments, as an indirect test of the present value model. Theoretically the two structures should be similar. Kasa (1992)[24] shows that as long as discount rates follow stationary processes and a transversality condition holds which rules out bubbles then the unit root and cointegration properties of stock prices should mirror the unit root and cointegration properties of their dividend payments. Kasa begins his analysis by first assuming that each country is specialised in the production of a unique good which it exchanges for goods produced in other countries. Then, the price of equity in this country represents the price of a claim to the stream of profits or dividends generated by producing this good. So the ex-dividend price of equity in country i is:

$$P_{it} = E_t\left\{\sum_{j=1}^{\infty}\left(\prod_{k=1}^{j} m_{it+k}\right)D_{it+j}\right\} \tag{5.1}$$

[24] For a detailed discussion see: Kasa K., "Comon stochastic trends in the international equity markets" *Journal of Monetary Economics*, vol29, 1992, pp95-124.

where, m_{it} is the stochastic discount factor in the country and D_{it} is the dividend process in the country. Equation (1) is obtained by iterating forward the investor's Euler equation and imposing the transversality condition: $\lim_{j\to\infty} E_t\ (\ \Pi_{k=1}^{j}\ m_{it+k}\ )\ P_{it+j} = 0$, which rules out bubbles from stock prices. To allow for unit roots the previous model can be rewritten as Campbell and Shiller's (1989) " dividend payout ratio model ":

$$\frac{P_{it}}{D_{it}} = E_t \sum_{j=1}^{\infty} \left(\prod_{k=1}^{j} m_{it+k} n_{it+k} \right) \qquad (5.2)$$

where $n_{it} = D_{it} / D_{it-1}$, the gross rate of growth in country's i dividend. If we finally assume that the dividend growth and the discount factor are stationary then the last model can be approximated by the following first-order Taylor series:

$$p_{it} = d_{it} + \ln\left(\frac{\omega_i}{1-\omega_i}\right) + \left(\frac{1}{\omega_i}\right) E_t \sum_{j=1}^{\infty} \omega_i^j \left(n_{it+j} - r_{it+j}\right) \qquad (5.3)$$

where p_{it}, d_{it} are the natural logs of P_t, D_t, $n_{it}=\ln n_{it}$, $r_{it}=\ln r_{it}$, and $\omega_i = \exp\{E(n_i)-E(r_i)\}$.
It is apparent from the last equation that, to a first order approximation, the logs of the stock prices and dividends should have the same cointegrating properties, that is, vectors.

5.3.1. The concept of stationarity. Unit root tests.

A process is said to be stationary when the stochastic properties of the process that generated the series are invariant with respect to time. If the characteristics of the process change over time the process is said to be nonstationary. Thus a time series (x_t) is stationary if its mean, $E(x_t)$, is independent of t, and its variance, $E[x_t-E(x_t)]^2$, is bounded by some finite number and does not vary systematically with time. A non stationary series, will have a time varying mean (or variance) and so we cannot refer to it without reference to some particular time period.

Probably very few of the time series one meets in practice are stationary. However, if the nonstationary time series is differenced one or more times the resulting series will usually be stationary. Such a series is called homogeneous. The order of homogeneity is simply the number of times the original series must be differenced before we get a stationary series. A useful notation is that x_t is I(d), denoting that x_t has to be differenced d times to achieve a stationary series. A procedure for determining whether we have a stochastic or a deterministic trend was provided by D. Dickey and W. Fuller (1979, 1981). The Dickey-Fuller tests (DF hereafter) works as follows:
Suppose that the procedure can be described by equation

$$Y_t = \alpha + \beta T + \rho Y_{t-1} + \lambda_1 \Delta Y_{t-1} + e_t \qquad (5.4)$$

where $\Delta Y_{t-1} = Y_{t-1}-Y_{t-2}$. (The test is the same if additional lags are included on the right hand side). Using OLS one runs the unrestricted regression

$$Y_t - Y_{t-1} = \alpha + \beta T + (\rho - 1) Y_{t-1} + \lambda_1 \Delta Y_{t-1} + e_t \qquad (5.5)$$

and then the restricted regression: $Y_t - Y_{t-1} = \alpha + \lambda_1 \Delta Y_{t-1} + e_t$ (5.6)

Then one calculates the F ratio to test whether the restrictions $\beta=0$, $\rho=1$ hold. The F ratio is calculated as $F=(N-K)(ESS_R-ESS_{UR})/q(ESS_{UR})$, where ESS_R and ESS_{UR} are the sums of squared residuals from the restricted and the unrestricted model, respectively, N is the number of observations, K the number of the estimated parameters in the unrestricted regression, and q the number of the parameter restrictions. The ratio is not distributed as the standard F distribution, under the null hypothesis. One must use the distributions tabulated by Dickey and Fuller. These critical values are much larger than those in the F table. The null hypothesis of a unit root implies a random walk, nonstationarity of the series. To test whether a series is stationary or not one can also use the Autocorelation Function. However, testing for a unit root is a more formal test.

5.3.2. Cointegration.

Often economic theory suggests that there is a long-run relationship between two variables. However, most economic time series seem to follow a random walk and regressing one against the other will often lead to spurious results, i.e. conventional significance tests will tend to indicate a relationship between two variables when none exists. Differencing might be a solution but it also may lead to a loss of information, about the relationship.

There are few simple rules concerning linear combinations of integrated series (when I(0) and I(1) are considered as the only alternatives possible). For example, if x_t, is I(1), y_t is I(0) then $\alpha x_t + \beta y_t$ is I(1), which suggest that I(1) is a dominant property. Also, it is *generally* true that if x_t, y_t are both I(1) then $\alpha x_t + \beta y_t$ is I(1).

There is a case, however, in which two variables will be non stationary but a linear combination of these variables will be stationary and this is when the variables are cointegrated (Engle and Granger, 1987): if x_t, y_t are both I(1), but there exists a linear combination such as: $z_t = y_t - \alpha - \beta x_t$, which is I(0) then x_t, y_t are said to be cointegrated.

One of the most important results in cointegration analysis is the Granger representation theorem (Granger 1983, Engle and Granger 1987). This theorem states that if a set of variables are cointegrated of order 1, then there exists a valid error-correction representation of the data. These error-correction models are given by, (in the two variable case) :

$$\Delta x_t = \mu_1 + \rho_1 z_{t-1} + lags(\Delta x_t, y_t) + e_{xt} \qquad (5.7)$$

$$\Delta y_t = \mu_{21} + \rho_2 z_{t-2} + lags(\Delta x_t, y_t) + e_{yt} \qquad (5.8)$$

where (e_{xt}, e_{yt}) is the bivariate white noise, $z_t = y_t - Ax_t$, and further at least one of ρ_1, ρ_2, is non-zero. If x_t, y_t are cointegrated then each component of the equation is I(0) and so the equations are balanced. If x_t, y_t are I(1) but not cointegrated, then z_t will be I(1) and as an

I(1) variable (which is long-memory) it cannot explain a short memory, I(0), variable, the equations can only hold if both ρ_1, ρ_2, are zero, which is excluded by assumption. It is thus seen that cointegration is a necessary assumption for the error-correction equation to hold. It can be shown that the reverse also holds, cointegrated variables can always be thought of as being generated by error-correction equations.

There are two alternative approaches for testing for cointegration: the Engle and Granger (1987) methodology and the Johansen (1988, 1990b) methodology. The Johansen methodology has a main advantage over the bivariate approach; the procedure is organised such as to estimate the number of the cointegrating vectors present in the system. It is this methodology that I utilise in the present study instead of the bivariate Engle and Granger proccedure, since it is a natural vechicle for multivariate analusis, as is the case here.

5.3.3. The Johansen Methodology.

Johansen (1988) procedure of testing for cointegration begins with the definition of a general polynomial distributed lag model of a vector of variables X such as:

$$X_t = \pi_1 X_{t-1} + ... + \pi_k X_{t-k} + e_t, t = 1, ... T \qquad (5.9)$$

where X_t is the vector of the N variables of interest, the π_i are NXN coefficient matrices, and e_t is the independently identically distributed N-dimensional vector with zero mean and covariance matrix Ω. The long-run, or cointegrating matrix, will be given by $I - \pi_1 - \pi_2 - ....$ $- \pi_k = \pi$, where I is the identity matrix. π therefore will be an NXN matrix, The number, r, of distinct cointegrating vectors which exists between the variables of X will be given by the rank of π. It must be noted that, in general, if the variables that constitute vector X are all I(1), then, at most, the number of cointegrating vectors, r, must be equal to N-1, so that $r \leq$ N-1. Now if we define two matrices α, β both of which are Nxr such that $\pi = \alpha \beta'$, the rows of β form the r distinct cointegrating vectors.

The implementation begins with the reparametrization of (5.9), into an ECM of the form:

$$\Delta X_t = \Gamma_i \Delta X_{t-1} + \ldots\ldots\ldots + \Gamma_{k-1}\Delta X_{t-k+1} + \Gamma_k X_{t-k} + e_t$$
$$where, \Gamma_i = -I + \pi_1 + \pi_2 + \ldots\ldots + \pi_i, i = 1, \ldots, k \qquad (5.10)$$

The equilibrium matrix π is defined as $-\Gamma_k$.

Johansen suggested to regress ΔX_t and X_{t-k} on ($1, \Delta x_{t-1}, \ldots, \Delta X_{t-k+1}$) which defines the residual vectors R_{0t} and R_{kt}. The concentrated likelihood function then has the form of a 'reduced rank regression'(see Velu et.al (1986)):

$$R_{0t} = a\beta' R_{kt} + error \qquad (5.11)$$

The problem of estimating α, β is thus simplified to a standard nonlinear optimization problem. If β were fixed we can use (5.11) to estimate α by a linear regression, which gives:

$$a(\beta') = -S_{0k}\beta(b' S_{kk}\beta)^{-1}$$

and $\Sigma(\beta) = S_{oo} - S_{ok}\,\beta(\beta' S_{kk}\,\beta)^{-1}\,\beta' S_{ko}$

where $S_{ij} = T^{-1}\sum_{t-1}^{T} R_{it}R_{jt}', i, j = 0, \ldots k.$

and so maximising the likelihood function may be reduced to minimising:

$$\left| S_{oo} - S_{ok}\,\beta(\beta' S_{kk}\,\beta)^{-1}\,\beta' S_{ko} \right| \qquad (5.12)$$

This can be minimised when:

$$\left| \beta' S_{kk}\,\beta - \beta' S_{ko}\, S S_{oo}^{-1}\, S_{ok}\,\beta \right| / \left| \beta' S_{kk}\,\beta \right| \qquad (5.13)$$

attains a minimum with respect to β.

We now define a diagonal matrix D which consists of the ordered eigenvalues $\lambda_1 > ... > \lambda_N$ of $(S_{ko}\, S_{oo}^{-1}\, S_{ok})$ with respect to S_{kk}. That λ_i satisfies:

$$|\lambda S_{kk} - S_{ko}\, S_{oo}^{-1}\, S_{ok}| = 0. \tag{5.14}$$

Define E to be the corresponding matrix of eigenvalues so that

$$S_{kk}\, ED = S_{ko}\, S_{oo}^{-1}\, S_{ok}\, E, \tag{5.15}$$

where we normalise E such that: $E'S_{kk}\, E = I$. The maximum likelihood estimator of β is then given by the rows of E, that is, the first r eigenvectors of $(S_{ko}S_{oo}^{-1}S_{ok})$ with respect to S_{kk}. These are the canonical variates and the corresponding eigenvalues are the squared canonical correlations of R_{kt} with respect to R_{ot}. These eigenvalues may then be used in the likelihood ratio to test either for the existence of a cointegrating vector r=1 or the number of the cointegrating vectors N>r>1.

4.4. THE DATA.

The main set of data I use in the study are monthly price observations on the 10 emerging stock market indices, as described in Chapter IV, i.e. the national equity indices of Brazil, Argentina, Chile, Mexico, India, South Korea, Malaysia, Thailand, Taiwan, Philippines. The period covered is January 1976 to December 1994 with the exception of Philippines, Malaysia and Taiwan, which started from January 1985. [25] In addittion, the Standard & Poors 500 index is employed as a proxy for the USA market. Plots of the log price levels of the 10 equity indices for the entire sample period are presented in section 7.

For the dividend payments I was unable to obtain reliable figures that cover the entire sample period and all the sample countries. Therefore, I used the International Finance Corporations' dividend yield series (12 month rolling dividend) and the IFC emerging stock market indices (both expressed in US $) to construct a dividend payments series.

[25] As in the previous chapter the data are all expressed in a common currency, the US$, and are the International Finance Corporations', IFC, emerging market indices and were obtained from Datastream. Returns were defined as the first difference of the log price levels.

5.5. RESULTS.

The first step in examining the trends in the emerging equity markets is to see whether the series are stationary or nonstationary, i.e. to test for the presence of a unit root in the autoregressive representation of each country's stock price index (log levels). We took the alternative of the unit root hypothesis to be that of stationary fluctuations around a deterministic linear trend.

Table 5.1, presents the Dickey Fuller (DF) and the Augmented Dickey Fuller (ADF(4)) unit root tests[26]. All series appear to be I(1), i.e. the log price levels are nonstationary, but their first differences are stationary. For the log price series we accept the null hypothesis of a unit root for all markets. For the first differences of the log levels (i.e. the returns) we reject the null for all countries. Therefore, we conclude that the price indices are all nonstationary but their returns are all stationary, i.e. the indices are all I(1).

Table 5.1

Unit root tests (Dickey Fuller), monthly data.

Country	Log price levels		First differences (returns)	
	DF	ADF(4)	DF	ADF(4)
Brazil	-2.0822	-1.7858	-14.9089	-7.3766
Argentina	-2.5895	-2.2831	-14.6496	-7.5971
Chile	-1.2297	-1.4562	-12.8169	-7.9804
Mexico	-1.2456	-1.4577	-11.5457	-5.9503
India	-3.4477	-3.3216	-13.8331	-6.8233
Korea	-1.2986	-1.5131	-14.9027	-6.1296
Malaysia	-2.8181	-3.2637	-10.6789	-4.8908
Thailand	-.85877	-0.9536	-13.5168	-7.6535
Taiwan	-7.3675	-2.8940	-15.2124	-7.2542
Philippines	-1.7890	-2.3005	-8.1386	-4.0661
USA	-2.0960	-2.7040	-14.8060	-6.7327

The critical value is : -3.44 at the 5%.

[26] ADF(4) was used because it took 4 lags for the residuals to become white noise.

The next step in the analysis is to test for cointegration among the variables of interest and this is done using the Johansen method. A major problem with the empirical application of this method is the establishment of the maximum lag length. If the analysis is exclusively concerned with the estimation and identification of a cointegrating vector the problem is solved by allowing for relatively long lags since these might approximate the possible autocorrelation structure of the error terms. However, if the estimated cointegrating vectors are used for further analysis of the VAR model this may be inconsistent with economic sense, since the lag length corresponds to the length of adjustment to a deviation from the long run path, which is usually assumed to occur after a relatively short period of time. A simple solution to this problem is to compare estimates of the model for both small and large lags. For a properly formulated model the long run relationship should not depend on the lag length but the the estimates of the adjustment matrix should. Hence, if the estimated cointegrating vectors are similar for two VAR models with a different lag length we may choose the model with the shorter length, if we feel that the economic interpretation of the adjustment matrix is more sensible (Charemza and Deadman, 1992).

In this study, we estimated VAR models with both a large and small lag lengths in order to see whether the cointegration structure varies with the lag length and we report that it does not: the situation is similar for almost all lags (the results of these estimations appear in the Appendix).

Then, we identified the correct lag length for each model on the basis of F-tests for the significance of lags: for the four Latin American markets, a VAR(2) is found to be appropriate and Table 5.2 reports the results of the cointegration tests. We can see that the null hypothesis $r=0$ is rejected for the alternative $r\leq1$. Therefore we conclude that there is one cointegrating relationship ($r=1$) among the Latin America markets.

The two test statistics that we use here for deciding on the number of cointegrating vectors are the L_{max} and the Trace statistic. The main difference between them is that the L_{max} has as a null hypothesis that there are r cointegrating vectors and as an alternative that there r+1 exists. The Trace statistic has as a null hypothesis that there are *at most* r cointegrating vectors. Testing starts from r=0, that is, that there are no cointegrating vectors in the VAR model. If this cannot be rejected, the proccedure stops here since that means there does not exist a cointegrating vector. If it is rejected, we examine sequentially the hypothesis that $r \leq 1$, $r \leq 2$, etc. If the null hpothesis cannot be rejected for, say $r \leq r_0$, but it has been for $r \leq r_{0-1}$, we can concude that the number of cointegrating vectors (i.e. the rank of β) is r_0[26]. Table 5.3 reports the results for the Asian, Asian-Pacific markets and for these markets a VAR(1) is found to be an appropriate formulation. We can see that the null hypothesis of r=0 is rejected for the alternative of $r \leq 1$.

Table 5.2

Johansen tests of cointegration for Latin American markets, VAR(2)

	Lmax			Trace		
null	-Tlog(1-μ)	T-nm	Critical 95%	-Tlog(1-μ)	T-nm	Critical 95%
r = 0	36.94**	35.62**	27.1	66.53**	64.15**	47.2
r≤1	20.48	19.75	21.0	29.59	28.54	29.7
r≤2	9.08	8.76	14.1	9.11	8.78	15.4
r≤3	0.02	0.02	3.8	0.27	0.26	3.8

Table 5.3

Johansen tests of cointegration for the Asian markets, VAR(1)

	Lmax			Trace		
null	-Tlog(1-μ)	T-nm	Critical 95%	-Tlog(1-μ)	T-nm	Critical 95%
r = 0	43.64*	41.44*	39.4	109.3**	103.8**	94.2
r≤1	22.92	21.76	33.5	65.7	62.38	68.5
r≤2	18.77	17.82	27.1	42.78	40.62	47.2
r≤3	15.72	14.93	21.0	24.01	22.8	29.7
r≤4	7.53	7.15	14.1	8.29	7.87	15.4
r≤5	0.75	0.71	3.8	0.75	0.71	3.8

[26] Also, note here that all the tests that follow were repeated for different subperiods, and with the Crash of 1987 eliminated; however, similar results were obtained.

Therefore, the results of the cointegration analysis suggest that the emerging markets of the sample are cointegrated, and in addition that there is one cointegrating vector among the markets of each group.

However, the evidence in favor of cointegration is not in itself enough to say that the benefits from international portfolio diversification will disappear. We have to look in greater detail at the nature of the cointegrating vectors since these vectors might have no impact on all the markets. Furthermore, we have to look at the adjustment matrices, since not all markets may adjust to equilibrium.

In order to examine this issue we place and test zero restrictions on both the β and α matrices. First, we test the null hypothesis that each market, in turn, does not enter the cointegrating vector, i.e. that the individual β_i's are zero. The results and the relevant statistics are reported in Table 5.4.

Table 5.4

Testing zero restrictions on β.

Null hypothesis: (H_0: $\beta_i = 0$)	χ^2 (1)
Brazil does not enter cointegrating vector	0.8156
Argentina does not enter cointegrating vector	1.2029
Chile does not enter cointegrating vector	11.662*
Mexico does not enter cointegrating vector	14.214*
India does not enter cointegrating vector	0.00037
Thailand does not enter cointegrating vector	1.8111
Malaysia does not enter cointegrating vector	0.85614
Philippines does not enter cointegrating vector	0.6152
S.Korea does not enter cointegrating vector	13.974*
Taiwan does not enter cointegrating vector	11.414*

Critical valuesof χ^2 (1) at 5%: 3.841, at 10%: 2.706.

We can see from the above table that the null hypothesis that Brazil, Argentina (in Latin America), and India, Thailand, Malaysia, Philippines (in the Asia-Pacific) do not enter the cointegrating vectors cannot be rejected at the 5% level of significance. Therefore, we may conclude that these markets do not belong in the common region with the rest.

Next we test whether all the markets adjust to the long run equilibrium, i.e. whether the α_i's are zero. Table 5.5 reports the results of this test.

Table 5.5

Testing zero restrictions on α.

Null hypothesis: (H_0: α_i =0)	χ^2 (1)
Error correction term has no impact on Brazil	0.00109
Error correction term has no impact on Argentina	5.128*
Error correction term has no impact on Chile	9.102*
Error correction term has no impact on Mexico	2.6509
Error correction term has no impact on India	0.75313
Error correction term has no impact on Thailand	2.617
Error correction term has no impact on Malaysia	1.5712
Error correction term has no impact on Philippines	11.409*
Error correction term has no impact on S.Korea	0.41309
Error correction term has no impact on Taiwan	16.18*

Critical valuesof χ^2 (1) at 5%: 3.841, at 10%: 2.706.

Again, we observe that not all markets adjust to the long run equilibrium: the null hypothesis that the error correction term has no impact can be rejected only for Chile and Argentina (Latin America) and Philippines and Taiwan (Asia-Pacific).

The perspective of the US investor.

As noted earlier, the benefits of diversification may be critically dependent upon the correlation between the emerging markets and the market from which the international investor operates. To investigate this issue, we added a proxy of the US market in the sample and reestimated the cointegrating relationships. Tables 5.6 and 5.7 present the results of the analysis.

Table 5.6 reports the results for the Latin American and the US markets and we can see that the null hypothesis of $r=0$ is rejected for the alternative of $r\leq1$. Table 5.7 reports the results for the Asian and the US markets and again the null hypothesis of $r=0$ is rejected for the alternative of $r\leq1$. One exception is the test based on the Trace in which the null $r\leq2$ is marginally accepted.

Table 5.6

Johansen tests of cointegration for Latin American markets and the US

null	λ_{max}	Critical 95%	λ_{Trace}	Critical 95%
$r = 0$	38.1*	33.4	76.2*	64.8
$r\leq1$	24.6	27.1	38.1	47.2
$r\leq2$	8.3	21.0	13.4	29.7
$r\leq3$	4.8	14.1	5.0	15.4
$r\leq4$	0.2	3.8	0.2	3.8

Table 5.7

Johansen tests of cointegration for the Asian markets and the US

null	λ_{max}	Critical 95%	λ_{Trace}	Critical 95%
r = 0	74.9*	45.2	170.3*	124.2
r≤1	38.9	39.4	95.3*	94.2
r≤2	19.9	33.5	56.4	68.5
r≤3	17.3	27.1	36.4	47.2
r≤4	10.5	21.0	19.1	29.7
r≤5	8.3	14.1	9.8	15.4
r≤6	0.7	3.8	0.7	3.8

Next, we place and test a zero restriction on the β matrix, i.e we test the null hypothesis that each market does not enter the cointegrating vector, i.e. that the individual β_i's are zero. The results and the relevant statistics are reported in Table 5.8 and indicate that even when USA is added to the sample, in both regions, very few markets are significantly influenced by the common trend: Mexico and Chile for the Latin America region, and Taiwan for the Asia-Pacific region.

Taken together the results of the last two sections indicate that any cointegration between the USA and the emerging markets is limited, and the impact any common trends have on the these markets is not particularly substantial.

Table 5.8

Testing zero restrictions on β.

Null hypothesis: (H_0: β_i =0)	χ^2 (1)
USA does not enter cointegrating vector[1]	0.0076
USA does not enter cointegrating vector[2]	0.3713
Brazil does not enter cointegrating vector	1.7890
Argentina does not enter cointegrating vector	0.5591
Chile does not enter cointegrating vector	7.4688*
Mexico does not enter cointegrating vector	11.698*
India does not enter cointegrating vector	0.1980
Thailand does not enter cointegrating vector	0.0454
Malaysia does not enter cointegrating vector	0.2459
Philippines does not enter cointegrating vector	1.7164
S.Korea does not enter cointegrating vector	0.3134
Taiwan does not enter cointegrating vector	35.546*

Critical valuesof χ^2 (1) at 5%: 3.841, at 10%: 2.706.
1. Refers to Latin America vector
2. Refers to Asian-Pacific vector

The dividend payments.

In Table 5.9 the results of the unit root tests of the log dividend levels and the respective first differences of the dividends series are presented. We can see that the unit root tests indicate that all dividend series are nonstationary, I(1), with their first differences stationary I(0).

Tables 5.10 and 5.11 present the results of the Johansen tests on the dividend series for the Latin American markets and the Asian markets, respectively. The results of the analysis for the dividend payments in the Latin America indicate that the null of r=0 must be accepted, therefore we have no cointegration among the Latin America dividend payments. For the Asian, Asian-Pacific dividend payment series, the case is similar since the null of r=0 is accepted in all cases. Thus, we conclude that we have no cointegration among the Asian, Asian-Pacific dividend payment series as well.

Table 5.9

Unit root tests on dividend payment series

Country	Log levels	First differences
	ADF(4)	ADF(4)
Brazil	-2.3103	-8.0049
Argentina	-1.1645	-6.0686
Chile	-2.8498	-8.6649
Mexico	-2.9298	-8.3067
India	-2.9298	-8.3067
Korea	-3.3756	-10.3312
Malaysia	-2.9200	-8.4744
Thailand	-3.3689	-8.4099
Taiwan	-2.9178	-9.0870
Philippines	-2.8765	-10.3710

The critical value at the 10% is -3.4519.

Table 5.10

Johansen tests of cointegration for Latin American dividends, VAR(2)

	λ_{max}			λ_{Trace}		
	-Tlog(1-μ)	T-nm	Critical	-Tlog(1-μ)	T-nm	Critical
null			95%			95%
r = 0	19.05	17.76	27.1	35.91	33.47	47.2
r≤1	10.47	9.75	21.0	16.85	15.73	29.7
r≤2	5.76	5.37	14.1	6.38	5.94	15.4
r≤3	0.61	0.57	3.8	0.61	0.57	3.8

Table 5.11

Johansen tests of cointegration for Asian, Asian-Pacific dividends, VAR(1)

	λ_{max}			λ_{trace}		
	-Tlog(1-μ)	T-nm	Critical	-Tlog(1-μ)	T-nm	Critical
null			95%			95%
r = 0	26.8	25.9	39.3	93.9	93.2	94.1
r≤1	22.4	21.5	33.4	67.9	67.6	68.5
r≤2	19.5	18.5	27.1	46.8	46.3	47.2
r≤3	17.3	16.1	21.0	28.4	28.0	29.7
r≤4	8.4	7.4	14.1	13.0	12.0	15.4
r≤5	4.9	4.5	3.8	4.8	4.5	3.8

5.6. CONCLUSION.

Previous research documented that there is a single common stochastic trend driving the equity markets of the most developed countries. Furthermore, the cointegration structure of their prices mirrored the cointegration structure of their dividend payments, as predicted by standard asset pricing theories. The gains from diversifying internationally among these countries seem, therefore, to be somewhat limited, (Kasa 1992).

In this study we have investigated the issue of integration for some of the most important emerging markets from the Latin America and the Asian, Asian-Pacific region. The results suggest that there exists a single cointegrating relationship among the 4 Latin American equity markets. The situation is similar (one long run relationship) among the 6 Asian equity markets. Tests for the significance of these long-run relationships for the individual markets revealed that for the Latin American markets the relationship is most significant for Chile and Mexico, and that for the Asian markets the relationship is most significant for South Korea and Taiwan. The rest of the markets do not belong in the common equity region.

In addition, in this paper, we examined the cointegration structure of the emerging market dividend payments and report that, unlike in previous studies, the cointegration structure of the equity prices does not mirror that of the dividend payments, thus suggesting that the international present value model of asset pricing might not be valid in the emerging markets of the sample.

In conclusion, evidence of cointegration is presented in this study suggesting, at first glance, limited gains for international portfolio diversification. However, further tests that look more closely to the nature of the cointegration indicate that not all markets belong in that common equity region or adjust to equilibrium, thus suggesting that a carefully diversified portfolio, in the emerging markets of the sample, will be beneficial.

5.7. FIGURES 1-10.

Figure 1. Logarithmic price levels of Brazil, monthly data, 1976-1994.

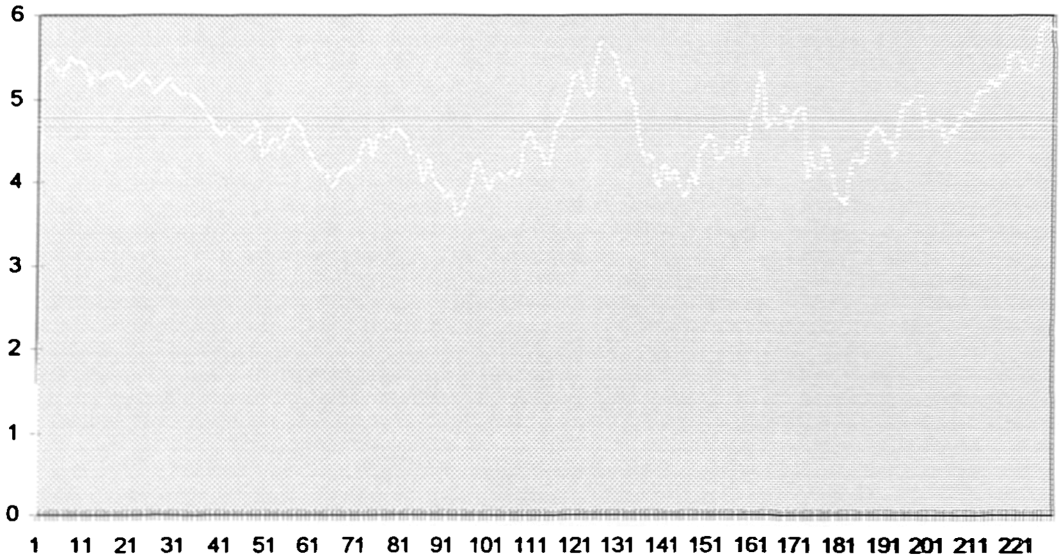


Figure 2. Logarithmic price levels of Argentina, monthly data, 1976-1994.

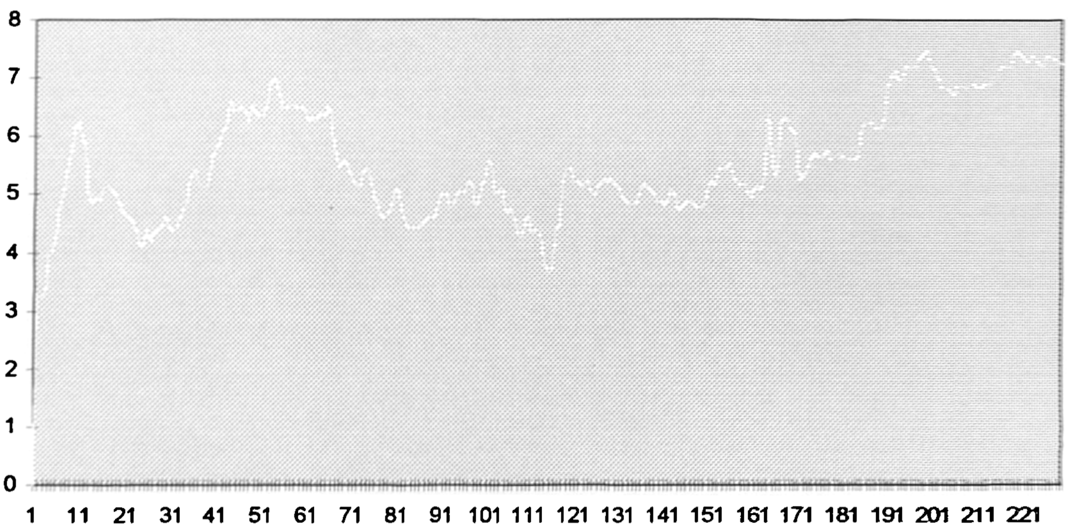


Figure 3. Logarithmic price levels of Chile, monthly data, 1976-1994.

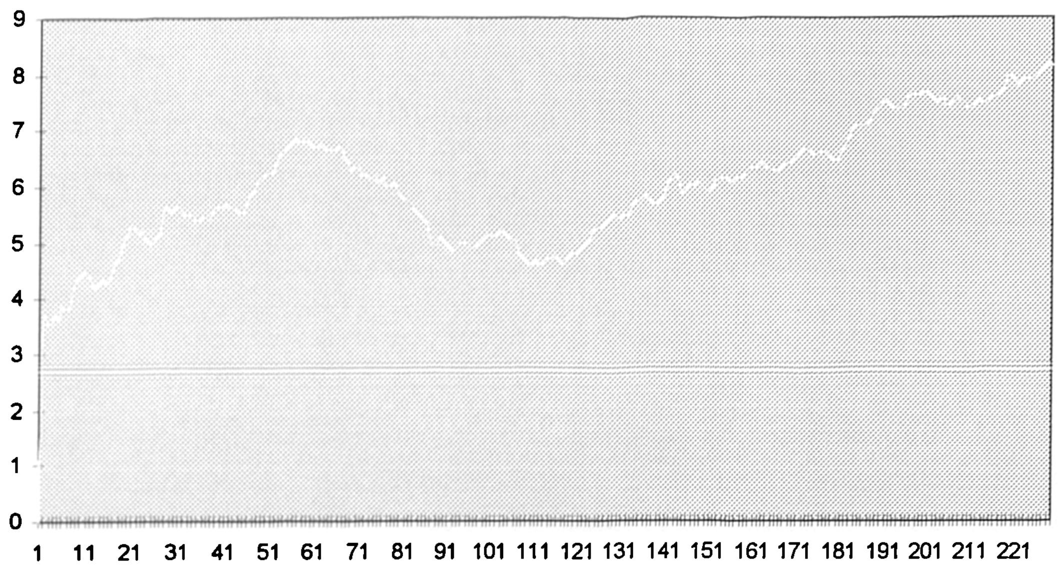


Figure 4. Logarithmic price levels of Mexico, monthly data, 1976-1994.

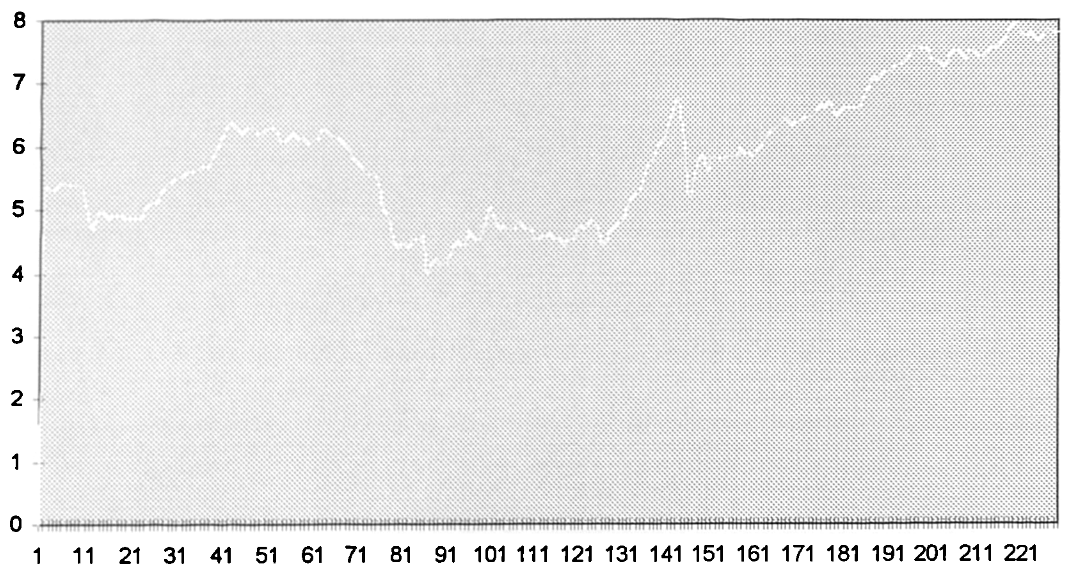


Figure 5. Logarithmic price levels of India, monthly data, 1976-1994.

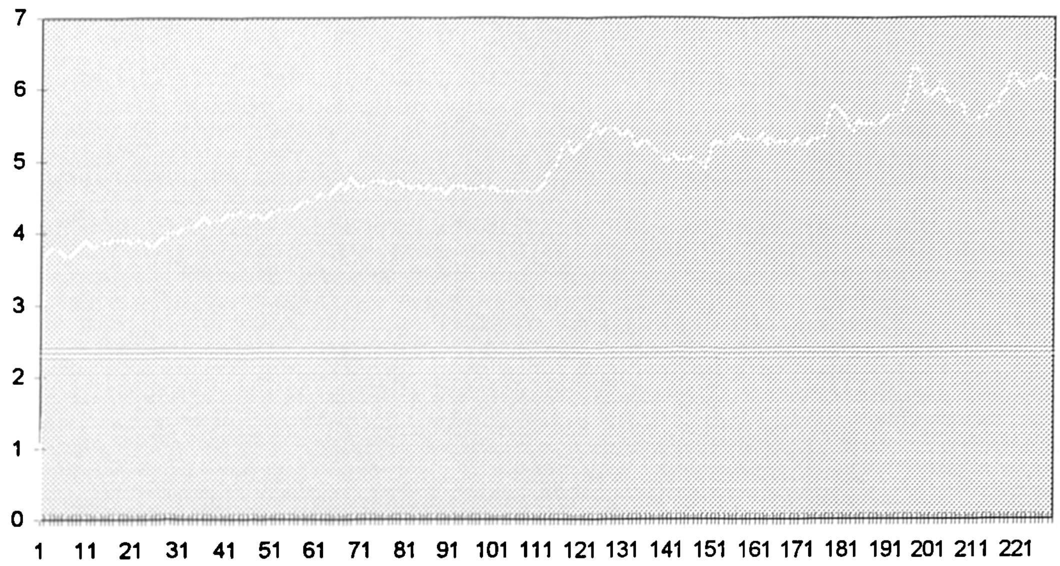


Figure 6. Logarithmic price levels of Thailand, monthly data, 1976-1994.

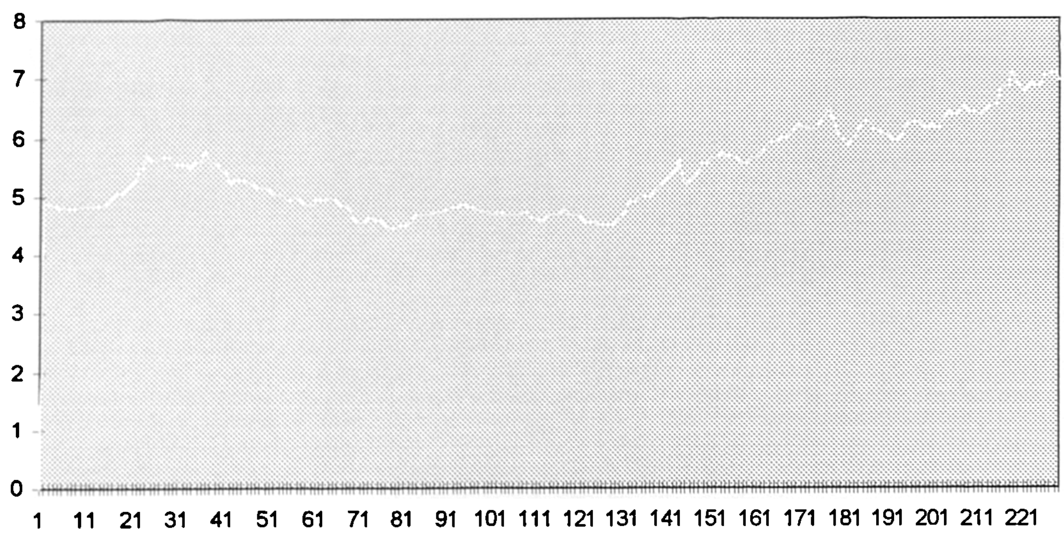


Figure 7. Logarithmic price levels of Korea, monthly data, 1976-1994.

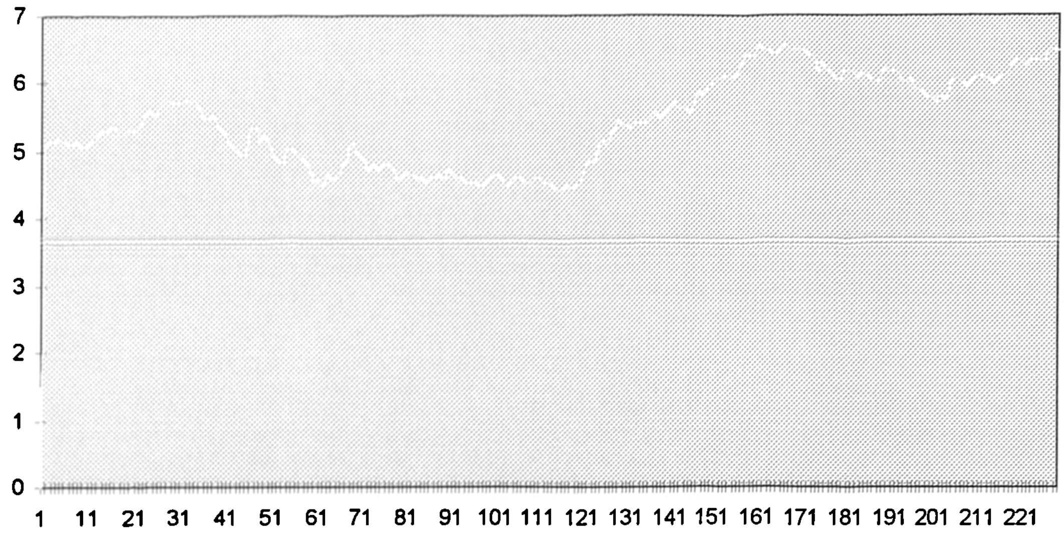


Figure 8. Logarithmic price levels of Philippines, monthly data, 1985-1994.

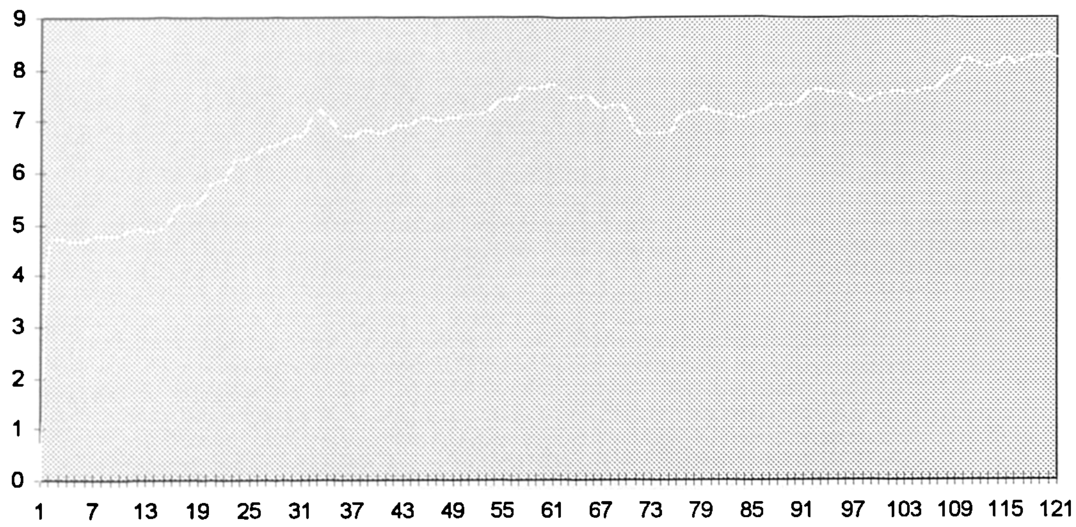


Figure 9. Logarithmic price levels of Malaysia, monthly data, 1985-1994.

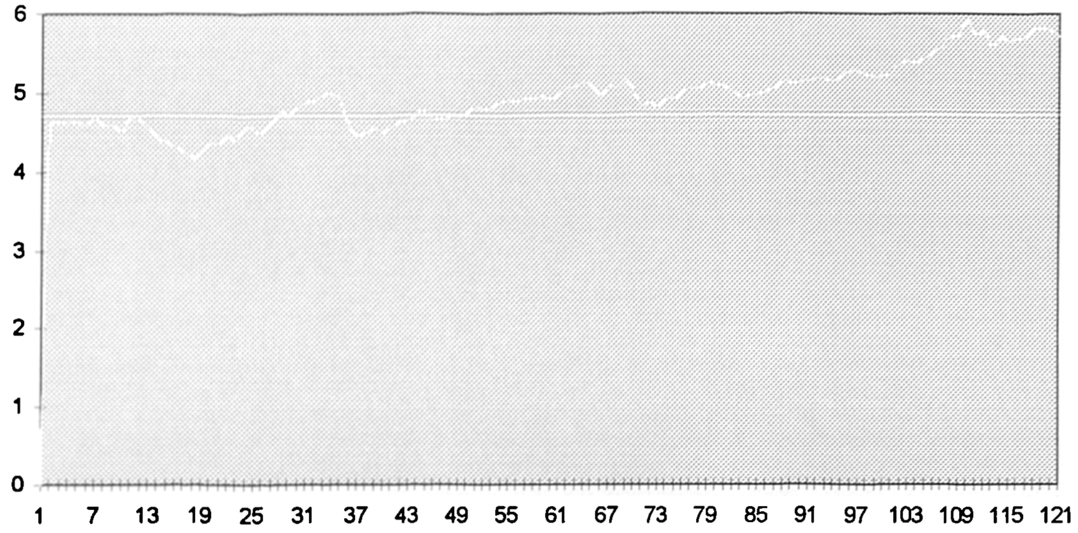
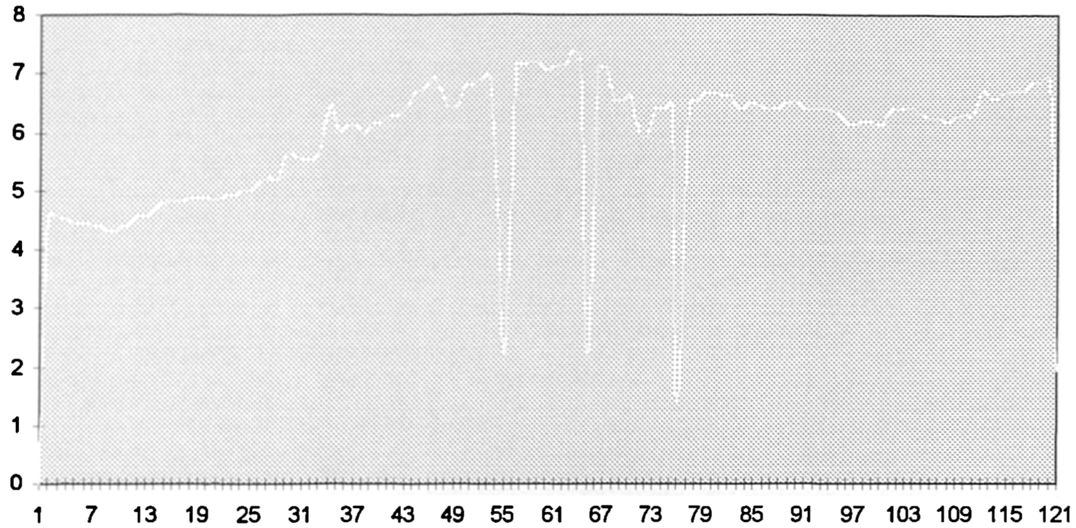


Figure 10. Logarithmic price levels of Taiwan, monthly data, 1985-1994.



5.8. APPENDIX.

Johansen analysis for long and short lags.

Johansen tests of cointegration for Latin American markets.

	k = 8		k = 1		Critical values k = 8, k = 1			
	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}		λ_{Trace}	
null					95%	90%	95%	90%
r = 0	28.25	56.36	35.91	65.19	27.06	24.73	47.21	43.94
r≤1	19.51	28.11	20.85	29.28	20.96	18.59	29.68	26.78
r≤2	8.58	8.59	7.36	7.423	14.06	12.07	15.41	13.32
r≤3	0.161	0.162	0.651	0.650	3.76	2.68	3.76	2.68

Johansen tests of cointegration on Asian markets.

	k = 7		k = 1		Critical values k = 7, k= 1			
	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}		λ_{Trace}	
null					95%	90%	95%	90%
r=0	36.82	110.4	73.81	143.4	39.37	36.76	94.15	89.48
r≤1	26.68	73.69	27.52	69.59	33.46	30.90	68.52	64.84
r≤2	25.81	47.01	18.18	42.07	27.06	24.73	47.21	43.94
r≤3	12.88	21.19	14.41	23.88	20.96	18.598	29.68	26.78
r≤4	7.90	8.31	8.53	9.47	14.06	12.071	15.41	13.325
r≤5	0.404	0.404	0.941	0.941	3.76	2.68	3.762	2.687

CHAPTER VI.

SOURCES OF RISK
AND MULTIFACTOR ASSET PRICING MODELS
IN THE EMERGING EQUITY MARKETS

6.1. INTRODUCTION.

A central intuition of international asset pricing models is that common sources of risk may command an expected return premium, while risks that can be diversified internationally will not. In the previous chapter we detected the existence of one cointegrating relationship among the four Latin America equity markets and one cointegrating relationship among the six Asian-Pacific equity markets. The above relationships cannot not be eliminated with international portfolio diversification, i.e. are not diversifiable, and therefore might represent a potential source of systematic risk for the national equity markets.

One important question stems from this observation: Are the risk-premia associated with these trends significant in an asset pricing model, i.e. is the systematic risk of the long run trends priced in the international equity markets? Further, what are the sources of risk and average returns that are priced in the emerging equity markets? Can we identify a set of global or domestic economic risks and then find to what extend they explain fluctuations in the equity markets? Typically, one-factor international asset pricing models state that in equilibrium the rates of return of a domestic equity index will be a function of its covariance with a global market portfolio[27]. Multifactor asset pricing models state that the rate of return on any security or portfolio of securities is a linear function of k factors instead of just one. However, the theory is silent as to what these factors are.

Most of the earlier studies that are concerned with the identification of these factors begin their analysis with the Present Value Model of Asset Pricing and try to identify the factors that affect this model. Here, a different approach is adopted in an attempt to find which global or domestic factors affect international equity prices. At the center of this approach lies the Keynsean model of National Income Determination.

[27] The International version of the CAPM.

According to Riccardo's comparative advantage theory each country specializes in the production of the good (or the goods) that it produces more efficiently and effectively, or in other words it specialises in the production of goods that it produces at a lower opportunity cost than any other country. The price of the equity in this country is then the price of the claim on the stream of the cash flows (dividends) that are generated by producing that good (or goods). For a single stockholder who holds one stock these cash flows are the expected dividends, which are the only cash flows that he or she will directly receive from the company. For a single country, these cash flows are the country's aggregate income, which is the value of the country's output, in other words the GNP. Although the profits of the corporate sector are only a part of the GNP, the permanent components of the two should be similar. *Therefore, one should expect that the factors that affect a country's GNP must also affect a country's price of equity.*

Using the Keynsean model of National Income determination the aggregate income is calculated by adding together consumer's expenditure (C), investment (I), government purchases of goods and services (G) and exports (X), and then from that sum subtracting imports (M):

$$GNP = C + I + G + (X - M) \tag{6.1}$$

Aggregate C is mainly determined by the interest rates, people's expectations about their future earnings potential, the level of savings and taxation. Investment is determined by interest rates, inflation, expected profits and depreciation. Exports are determined by decisions made in the rest of the world and are mainly influenced by the level of income in the rest of the world, the degree of specialization, domestic prices relative to the prices in the rest of the world, and the exchange rates. Imports are determined by the level of the domestic real income, foreign prices relative to the domestic prices, the degree of specialization and exchange rates. Government expenditure is determined exogeneously, mainly by political decisions of the domestic government, fiscal and monetary policies and the targets of government policies.

Therefore, the quantifiable factors than can affect a country's price of equity and by implication its returns are: i) the level of consumption, or alternatively the level of savings which also determines the level of investment ii) the Balance of Trade, iii) domestic and international prices, iv) domestic and international interest rates, v) exchange rates. To identify which of these factors are risks that are rewarded in the markets a multifactor asset pricing model, is employed. In addition, two more factors are added to the set of factors identified above: the long run relationships that were detected in the previous chapter and a 'global' equity portfolio.

The rest of the chapter is organized as follows: section 2 presents the data, discusses the testing methodologies and builds up the econometric models. Section 3 presents the results whilst section 4 concludes the chapter.

6.2. DATA AND TESTING METHODOLOGIES.

The data used in this chapter were all obtained from the International Monetary Fund Statistical Yearbook and due to the fact that most macroeconomic variables are reported quarterly all the data are in quarterly observations that cover the period between the first quarter of 1977 and the last quarter of 1994, giving 71 observations. The respective stock indices are the end of quarter values of the International Finance Corporation's Emerging Market Indices The countries are Brazil, Argentina, Chile, Mexico, Thailand, Malaysia, Korea, Philippines. India and Taiwan were dropped from the sample because there were significant gaps in the reported macroeconomic figures.

The factors employed to explain the returns of a national equity index are the following: expected and unexpected changes in consumer prices, expected and unexpected changes in interest rates, expected and unexpected changes in the exchange rates, expected and unexpected changes in the rate of Savings, expected and unexpected changes in the Trade Balance, expected and unexpected changes in the returns of a world market portfolio, expected and unexpected changes on a global index of interest rates, expected and unexpected changes in global consumer prices, and finally, the long-run undiversifiable trend common to a group of markets

In an efficient market expected changes should have been anticipated i.e. should not receive a reward for risk. In efficient markets only unanticipated, unexpected, changes should have a significant effect. Why then include expected changes in the model ? Because the evidence from chapter 4 suggests that the emerging markets of the sample may not efficient and therefore even expected shocks may be priced.

More specifically, the variables are [28] :

i) a measure of global inflation as reported in the IMFSY[29] line 001 (EGIN, UGIN).

[28] Note that each factor is represented as follows: the first letter is either E or U, for Expected and Unexpected. The following two letters denote the country i.e. BR=BRazil, or G for Global, and the last letters denote the variable, i.e.RIR= Real Interest Rates, TB=Trade Balance. For example UARTB is unexpected changes in the Trade Balance for Argentina.

[29] IMFSY=Internatinal Monetary Fund Statistical Yearbook.

ii) a measure of the domestic inflation rate for each country derived from the IMFSY, first section, Global Statistics (EXXIN, UXXIN).

iii) a measure of the domestic levels of real interest rates. For each country I obtained quarterly data on the short term deposit rate (line 60, in IMFSY) and deflated with (ii), (EXXRIR, UXXRIR).

iv) a measure of the global level of short term interest rates. To construct this variable I obtained quarterly data on the 3-month Treasury Bills of the four biggest industrialised countries, i.e. the USA, Japan, UK, and W. Germany (line 60bs, in IMFSY) and constructed an equally weighted index of global interest rates (EGRIR, UGRIR).

v) a measure of the level of the exchange rate fluctuations, i.e. the dollar exchange rate (line ae, in IMFSY) for each country (EXXE, UXXE).

vi) a measure for the Trade Balance. Trade Balance figures were all expressed in million of US$ (line 77acd, in IMFSY). This figure was not reported as such before 1983, so in order to obtain the observations before 1983 I constructed the series by subtracting from the merchandise exports the merchandise imports[30], (XXTB).

vii) a measure for the level of Savings. This measure was obtained as the figure that corresponds to line 32a in the IMFSY, (i.e. claims on Private Sector). This figure includes interest-bearing deposits in Savings and Loan Institutions, Post Office Savings Institutions, Development Banks, Building and Loan Associations, and Life Insurance Companies. It is reported in local currencies, so (v) was used to expressed it in US$, (EXXS, UXXS).

viii) a measure for the returns on the national equity indices. The returns are the first differences of the log levels of the IFC emerging market indices, (DLXX).

ix) a measure for a global portfolio. As a measure for a global portfolio I used the Morgan Stanley Capital International Index (MSCII).

Finally, for all data changes are defined as the first difference of the logarithmic levels, except for the Trade Balance which was defined as $[(x_t - x_{t-1})/ x_{t-1}] * 100$ (because it includes negative values and we cannot have the log of a negative number).

[30] Line 77aad-77abd, in the IMFSY.

6.2.1. Factor regressions.

The first step in the analysis is to examine factor model regressions of the form

$$r_{it} = \alpha_i + \sum_{j=1}^{k} \beta_{ij} F_{jt} + u_{it} \qquad (6.2)$$

where r_t the returns on the IFC index, F_{jt} the factors, β_i the sensitivity of retruns to the ith factor. These regressions will provide information about the usefulness of the factors chosen for controlling the risks of international equity investments, although they don't provide prices for risk.

6.3.2. Asset Pricing Models and the Seemingly Unrelated Regressions.

The second step is to estimate the international APT for all markets. In order to estimate the APT for the emerging equity markets, with the observed factors identified above, the Seemingly Unrelated Regression (SUR) methodology is employed.

Formally, to arrive at the APT substitute (3.24) into (3.23) to obtain:

$$R(t)_i = \lambda_0 + \sum_{j=1}^{k} b_{ij} \lambda_j(t) + \sum_{j=1}^{k} b_{ij} F_j(t) + e_i(t) \qquad (6.3)$$

i=1,.....,N, t=1,.....,T.

Equation (6.3) entails T observations on N returns from which NKb_{ij}'s and $K\lambda_j$'s have to be estimated. The term $\Sigma^{k}_{j=1} b_{ij} \lambda_j$ is a parametric representation of N-K nonlinear across-equation restrictions expressing the N intercepts of (6.3) in terms of the K parameters $\lambda_1 ... \lambda_k$ and the observed variable λ_0. The macroeconomic variables ($f_j(t)$s) are assumed to be observed and were identified in the introductory analysis. The $f_j(t)$s in the APT need not be orthonormal and the covariance matrix of the error terms need not be diagonal. Now equation (6.3) is a multivariate nonlinear regression model for which McElroy et al. (1985) showed that conditional on the factor relations a NLSUR technique can be used in order to obtain *joint* estimates of the b_{ij}'s and λ_j's.

The assumptions we make are that the factor matrix F and the sensitivities matrix B are of full column rank, that T>N>K, and that NT>K(N+1). The NLSUR estimators are strongly consistent and asymptotically normal even if the distribution of the error terms is nonnormal.[31]

[31] See, Gallant and Holly (1980), Gallant and Jorgensen (1979), Gallant (1987), for details.

6.3. RESULTS.

Tables 6.1 and 6.2 report the results of the factor regressions[32] of the returns on all factors, domestic and global, for the Latin America markets and the Asian markets, respectively. The variables and the relevant statistics (R^2, DW, χ^2 for serial correlation and heteroscedasticity) are reported in the first column.

We see that in the Latin America markets, when all factors expeceted and unexpected[33] and domestic and international are included, the trade balance, savings, exchange rates, global inflation, and global interest rates (with the exception of Chile) are not significant. Only for Brazil are savings and exchange rates significant. The changes in the global portfolio are significant only for Brazil (expected changes) and Mexico (unexpected). Also, unexpected shocks in domestic inflation and real interest rates are significant for Argentina and Chile. For the Asian countries we can see that the domestic and global interest rates, trade balances, and global inflation are insignificant for all countries. Only for Thailand domestic interest rates (expected), trade balance (expected), inflation (expected), the changes in the global portfolio (expected), and the global interest rates (unexpected) are significant. Also, unexpected shocks in savings are significant for Malaysia and Korea.

The R-squared ranges for all markets from 0.26 to 0.68 and the DW statistics range from 1.96 to 2.50, suggesting no first order residual serial correlation. However, the LM test for serial correlation (null hypothesis: zero autocorrelation of succesive residuals) is significant and the null is rejected. The F-test is significant for all markets except Malaysia, Argentina and Mexico, suggesting that the null hypothesis that $R^2=0$ (alternatively: the regression coefficients are jointly zero) must be accepted for the later. The null of no heteroscedasticity is accepted for all models, by the LM statistic which is not significant.

[32] Before any estimation of models I perform Johansen cointegration tests on the equity indexes to see whether anything has changed in the long run relationships among the countries of the sample due to the fact that we have shifted from monthly observations to quarterly. I find that the situation is similar with quarterly data, (see chapter 5 for details).
[33] To generate the anticipated and unanticipated components, autoregressive models [AR(1)] were found to be sufficient.

Table 6.1

Factor regression for the returns of the Latin America markets

(1977Q1-1994Q4)

Variable	DLBR (Brazil)	DLAR (Argen.)	DLCH (Chile)	DLME (Mexico)
C	.069164 (.25061)	-.85681 (-.72551)	.42777 (.33044)	.37900 (.20725)
EXXRIR	.0051924 (1.3791)	-.050309 (-1.3150)	-.56169 (-1.7517)**	-.16214 (-.33575)
UXXRIR	.0015136 (1.3864)	-.02049 (-1.782)**	-.98397 (-3.1134)*	-.53033 (-1.2714)
EXXS	4.4367 (3.0302)*	8.3452 (1.4606)	-2.8993 (-.22388)	.064584 (.00468)
UXXS	.10056 (2.1129)*	.051075 (.84488)	.073727 (.27465)	.21004 (.69003)
EXXTB	.037269 (.15596)	-.44337 (-.66482)	.013096 (.39784)	-.10035 (-.45747)
UXXTB	.026146 (1.2646)	.0027961 (.73380)	-.1937E-3 (-.0923)	.012950 (.49917)
EXXE	20.2527 (3.0336)*	1.5430 (.57027)	-.80387 (-.084897)	2.3785 (.21724)
UXXE	.11110 (2.2564)*	.033378 (.62557)	-.10970 (-.30111)	.17386 (.56798)
EXXIN	-.00540 (-.69144)	-.011133 (-1.0111)	.27601 (1.5019)	-.16847 (-.80355)
UXXIN	-.010708 (-1.1712)	-.02591 (-2.1633)*	-1.5224 (-3.8155)*	-.20020 (-.46223)
EDLWO	-10.428 (-2.2740)*	9.2568 (1.4128)	-.98077 (-.37655)	3.8753 (.79416)
UDLWO	-.041893 (-.078235)	.60976 (.77780)	.19582 (.59293)	1.5044 (2.4440)*
EGIR	-1.5327 (-.68422)	-3.1047 (-1.0844)	.053730 (.039037)	-2.8955 (-1.2462)
UGIR	6.5796 (1.1422)	10.3269 (1.2967)	7.4727 (2.1001)*	5.1444 (.78407)
EGIN	1.9410 (.93206)	-1.7781 (-1.2634)	.017942 (.025729)	-.73345 (-.62916)
UGIN	.29812 (.11464)	-1.4412 (-.37419)	1.1125 (.80807)	-.64709 (-.24898)
R^2	.39725	.26953	.46483	.23679
F(16, 53)	2.1832*	1.2223	2.8771*	1.0277
DW	2.5092	2.2409	1.9641	2.3569
Serial correlation	7.0954*	7.2710*	4.7887*	4.6362*
Heteroscedast.	1.3782	.24667	1.5693	3.3602

t-statistics appear in parentheses, critical value at 5% 1.99, critical value at 10% 1.66, (two tail t-test). Critical value for F-test: 1.99. * denotes significance in 5%, ** denotes significance in 10%.

Table 6.2

Factor regression for the returns of the Asian markets

(1977Q1-1994Q4)

Variable	DLTH (Thailand)	DLMA (Malays.)	DLKO (Korea)	DLPH (Phillipin.)
C	.66056 (3.2399)*	.28561 (1.4409)	2.9768 (1.6362)	-.17766 (-.39331)
EXXRIR	-3.5462 (-2.5840)*	-1.3718 (-.86979)	1.9739 (1.3121)	1.6034 (.72489)
UXXRIR	.30365 (.10743)	2.7948 (.88316)	2.7430 (1.3423)	-1.5950 (-.99418)
EXXS	-.30861 (-.73006)	-1.1090 (-.54250)	-9.6094 (-1.1153)	.91274 (.38235)
UXXS	-.068156 (-1.1611)	.99439 (1.8154)**	-1.5769 (-1.865)**	-.74894 (-1.3766)
EXXTB	-.33345 (-2.0458)*	.49101 (1.1250)	6.5820 (1.5276)	.019861 (.22311)
UXXTB	-.005443 (-.41451)	-.021155 (-.50377)	-.3480E-3 (-.2293)	.003691 (.10224)
EXXE	1.1102 (.052369)	2.2379 (.31269)	-6.3043 (-.55674)	29.2277 (1.5795)
UXXE	-.32440 (-.45490)	1.0276 (.78567)	-2.9843 (-2.9791)*	-2.4460 (-2.4197)*
EXXIN	-3.9626 (-2.9337)*	.47182 (.15933)	1.7801 (1.6700)**	.31554 (.15391)
UXXIN	-1.2198 (-.39477)	2.2248 (.39689)	1.8746 (.94726)	-2.4456 (-1.1580)
EDLWO	-3.6727 (-1.6992)*	-2.2343 (-.73548)	-1.7885 (-.82995)	-6.1703 (-1.9324)*
UDLWO	.18428 (.73113)	.47524 (1.2932)	.43933 (1.5924)	.76647 (2.0974)*
EGIR	1.1313 (.88281)	-.66439 (-.28190)	-.94071 (-.66879)	-1.1373 (-.24457)
UGIR	-2.2386 (-.74181)	-2.8330 (-.52554)	-3.2733 (-1.0489)	-.56546 (-.11498)
EGIN	-.60754 (-1.3048)	-.83861 (-1.1707)	.54917 (1.0121)	-.81503 (-.73811)
UGIN	2.5246 (2.3020)*	-1.0916 (-.69207)	.82528 (.70306)	1.8955 (1.1904)
R^2	.39159	.36387	.40489	.68201
F(16, 59)	2.1320*	.78652	2.2537*	2.9491*
DW	2.4055	2.0925	2.2555	2.1261
Serial correlation	12.8925*	7.6378*	4.8489*	10.0548*
Heteroscedast.	.31523	.17519	1.2898	1.4333

t-statistics appear in parentheses, critical value at 5% 1.99, critical value at 10% 1.66, (two tail t-test). Critical value for F test: 1.99. * denotes significance in 5%, ** denotes significance in 10%.

The implementation of the SUR estimation proccedure requires that we have more than one regression equation in the system, so two groups are formed, according to the geographical position of the markets: the first group consisted of the 4 Latin America markets and the second group of the 4 Asian markets.

Two problems arise at this stage: first, for the second group we have missing and/or insufficient observations for the estimation of the system. Recall, that in this chapter quarterly data are employed, and that for 2 of the 4 Asian markets the data start in 1985. A second problem is that in the right hand side only factors that are common to all the markets must be included.

This presents us with the problem of accounting for the domestic factors that are different to each market. To overcome the problem of estimating the risk prices the following proccedure is adopted: first, factor regressions are estimated *with domestic factors only*. The insignificant factors are removed and the models are reduced until only significant factors remain (Tables 6.3 and 6.4). The residuals from this model can be interpreted as the returns with the domestic factors removed, i.e. the returns *adjusted* for the domestic factors. In the second stage[34] these adjusted returns are used in a *global factor* APT [35], as the left hand variables.

The reduced models (domestic factors only) suggest that interest rates (either expected or unexpected) become significant in 60% of the countries, Savings (either expected or unexpected) in 80% of the countries, inflation in 50%, Trade Balance in only 3 countries, and exchange rates in only 2 countries. The diagnistic statistics are all very good, except the serial correlation test for Brazil, Argentina and Thailand.

[34] I used TSP (386 version) to estimate the models in the present chapter; for the cointegration analysis (chapter 5) I used MFit3 and PCFilm; for the seasonality tests and the RW tests (chapter 4) I used MFit3 and Excel; while for the E-Garch tets (chapter 7) I used RATS.

[35] The cointegrating vectors from the previous chapter were included at this stage of the estimation.

Table 6.3
Factor regression results for models with significant domestic factors only.
Latin America markets, (1977Q1-1994Q4)

Variable	DLBR (Brazil)	DLAR (Argent.)	DLCH (Chile)	DLME (Mexico)
C	-.038628 (-.47118)	-1.3292 (-2.2165)	-.019077 (-.37498)	.47375 (1.6998)
EXXRIR			-.56090 (-1.9214)	
UXXRIR	.0018859 (2.0066)	-.016084 (-1.9871)	-1.0134 (-3.5518)	
EXXS	3.0830 (2.9112)	7.1035 (2.2779)		-2.7986 (-1.5617)
UXXS	.11546 (2.6513)			
EXXTB				
UXXTB				
EXXE	13.7534 (2.7244)			
UXXE	12356 (2.6992)			
EXXIN			.47552 (3.3675)	
UXXIN		-.016684 (-1.5809)	-1.1454 (-3.1528)	
R^2	.25933	.13627	.35556	.034622
F(8,53)	4.4816*	3.4710*	9.1036*	2.4388*
DW	2.3097	2.1061	1.7195	2.2330
Serial correlation	5.0854*	5.1864*	1.1027	1.4648
Heteroscedas.	1.1007	.12736	.14092	.087017

t-statistics appear in parentheses, critical value at 5% 1.99, critical value at 10% 1.66, (two tail t-test). Critical value for F-test 1.99.

Table 6.4
Factor regression results for models with significant domestic factors only.
Asian markets, (1977Q1-1994Q4)

Variable	DLTH (Thailand)	DLMA (Malays.)	DLKO (Korea)	DLPH (Phillipin.)
C	.43681 (3.7619)	.02516 (1.0999)	2.7098 (1.6702)	-.26940 (-1.2101)
EXXRIR	-2.4884 (-2.3433)			
UXXRIR				-2.9338 (-3.4944)
EXXS				
UXXS		.78193 (2.0509)	-1.1371 (-1.7329)	-.92701 (-2.2589)
EXXTB	-.31911 (-2.3019)		6.7314 (1.6601)	
UXXTB				
EXXE				27.8217 (2.1187)
UXXE			-3.0990 (-4.0726)	
EXXIN	-3.1905 (-3.2623)			-1.2320 (-3.0693)
UXXIN				-4.1011 (-3.5057)
R^2	.21744	.10208	.27922	.49904
F(8, 39)	6.1128*	4.2063*	8.5223*	5.3128*
DW	2.2187	2.0656	2.0606	1.8981
Serial correlation	8.8196*	2.4303	1.5681	3.8937
Heteroscedas.	.24092	.90063	.051355	1.9133

t-statistics appear in parentheses, critical value at 5% 1.99, critical value at 10% 1.66, (two tail t-test). Critical value for F-test 2.18.

The next step is to run the factor regressions of the the global factors and the cointegrating vectors on the *adjusted* returns. The variable ULA refers to the cointegrating vector of the 4 Latin America markets and the variable UAS refers to the cointegrating vector in Asia. The results are reported in tables 6.5 and 6.6.

We can easily observe the significance of the cointegrating vectors for most markets. The rest of the global factors do not appear to explain much of the adjusted returns. also, most models suffer from both serial correlation and heteroscedasticity.

Table 6.5
Factor regression of adjusted returns on global factors
1977Q1-1994Q4

Variable	Brazil	Argentina	Chile	Mexico
C	-.2067E-3 (-.0064)	.012138 (.40301)	-.002896 (-.15981)	.8570E-3 (.02729)
UDLWO	.044630 (.09324)	.019501 (.04330)	.39970 (1.4747)	1.0602 (2.2706)*
UGIR	-.55837 (-.2894)	3.8025 (.78220)	5.3910 (1.8427)**	2.2918 (.44711)
UGIN	7.5106 (1.4294)	.75353 (.41492)	.97770 (.89454)	.31557 (.16766)
ULA	.011822 (.70583)	-.13666 (-9.0185)*	.042553 (4.6660)*	-.047188 (-2.887)*
R^2	.037951	.55933	.28456	.18749
F	.64102	20.9428*	6.5627*	3.7498*
DW	2.3483	1.9169	1.6187	2.3072
Serial correlation	6.9547*	4.0771*	3.4846	6.8016*
Heteroscedas.	1.0424	15.1391*	.042292	14.3231*

t-statistics appear in parentheses, * denotes significance in 5%, ** denotes significance in 10%, ULA: the residuals of the Johansen cointegrating vector.

Table 6.6
Factor regression of adjusted returns on global factors
1977Q1-1994Q4

Variable	Thailand	Malaysia	Philippines	Korea
C	-.02789 (-5.6533)*	-.04163 (-2.6123)*	-.01515 (-.69186)	.002400 (.16191)
UDLWO	.053772 (.93913)	.071772 (.38813)	.35345 (1.3912)	.51530 (2.9955)*
UGIR	.17271 (.21076)	-2.7956 (-1.0564)	-2.8651 (-.78797)	-1.9110 (-.77625)
UGIN	-.19877 (-.87664)	-1.7742 (-2.4229)*	.70893 (.70465)	.42050 (.61731)
UAS	-.3006 (-11.832)*	.14735 (1.7960)**	-.20299 (-1.800)**	.33832 (4.4326)*
R^2	.97019	.63578	.20201	.51069
F	214.7952*	11.5208*	1.6708*	6.8883*
DW	1.8079	2.1164	1.9173	1.8648
Serial correlation	2.8700	4.0289*	.84230	4.1802*
Heteroscedas.	3.7420*	19.0655*	.053394	.0052500

t-statistics appear in parentheses, * denotes significance in 5%, ** denotes significance in 10%.
UAS1, UAS2: the residuals of the Johansen cointegrating vectors.

The final step in the analysis is to estimate the APT as SUR. Formally the model is:

$$\begin{aligned}\rho_i(t) = {} & c + b_{UDLWO}\,\lambda_{UDLWO}(t) + b_{UGIR}\,\lambda_{UGIR}(t) \\ & + b_{UGIN}\,\lambda_{UGIN}(t) + b_{ULA}\lambda_{ULA}(t) + \\ & + b_{UDLWO}\,UDLWO + b_{UGIR}\,UGIR \\ & + b_{UGIN}\,UGIN + b_{ULA}\,ULA + e_i \qquad (6.5)\end{aligned}$$

where, $\rho_i(t)$ the adjusted returns, b_{UDLWO} the sensitivity of the adjusted returns of country i to the unexpected changes of the global portfolio, $\lambda_{UDLWO}(t)$ the price of risk for the unexpected changes of the global portfolio, b_{UGIR} the sensitivity of the adjusted returns of country i to the unexpected shocks in the global interest rates, $\lambda_{UGIR}(t)$ the price of risk for the unexpected shocks in the global interest rates, b_{UGIN} the sensitivity of the adjusted returns of country i to the unexpected shocks in global inflation, $\lambda_{UGIN}(t)$ the price of risk for the unexpected shocks in global inflation, b_{ULA} the sensitivity of the adjusted returns of country i to the residuals of the cointegrating vector, $\lambda_{ULA}(t)$ the price of risk for the residuals of the cointegrating vector.

At this stage the estimation took place only for the Latin American countries due to the fact of the few observations for the Asian countries, and the results appear in the following Table 6.7.

Table 6.7

APT as a SUR estimation, Latin America markets

	Brazil	**Argentina**	**Chile**	**Mexico**
b_{UDLWO}	.045424 (.099217)	.019387 (.04465)	.39954 (1.5288)**	1.0713 (2.38620)*
b_{UGIR}	7.4255 (1.5026)**	3.80018 (.81081)	5.3865 (1.90956)*	1.50462 (.310473)
b_{UGIN}	-.55909 (-.30290)	.754584 (.43104)	.977388 (.927660)	.33002 (.182322)
b_{ULA}	.012153 (.788950)	-.136669 (-9.3545)*	.04254 (4.8384)*	-.04341 (-2.8739)*
R^2	.037768	.559327	.284489	.178760
DW	2.34916	1.91691	1.61828	2.27392
λ_{UDLWO}	-.59166 (-.757168)			
λ_{UGIR}	-.14327 (1.6405)**			
λ_{UGIN}	-.10655 (-.19517)			
λ_{ULA}	2.57194 (.71353)			
t-statistics appear in parenthesis.				

According to the results in the above table, only one of the international factors is carrying a risk premium; i.e. only unexcpected shocks in international interest rates are priced in this model. For the rest of the factors the risk premium is statistically insignificant, eventhough their sensitivities are not. For example, returns in Chile, Argentina and Mexico, appear sensitive to the long run trends, or unexpected changes in the global portfolio (Chile, Mexico) or global interest rates (Brazil, Chile). This indicates a sort of inefficiency in these markets, since factors with significant sensitivities are not priced in the model.

6.4. CONCLUSION.

In this chapter, the sources of risks in the emerging equity markets are investigated. I argued that the price of equity in a country should be affected by the same factors that affect a country's GNP i e a combination of domestic and international real interest rates, domestic and international prices, a global equity portfolio, the level of Savings in a country, the exchange rates, the Trade Balance, and for the specific sample the long-run undiversifiable cointegrating relationships among the markets.

Preliminary tests, suggest that in the Latin America markets, when all factors domestic and international are included, the trade balance, savings, exchange rates, global inflation, and global interest rates (with the exception of Chile) are not significant. Only for Brazil savings and exchange rates are significant The changes in the global portfolio are significant only for Brazil (expected changes) and Mexico (unexpected). For the Asian countries the results suggest that the domestic and global interest rates, trade balances, and global inflation are insignificant for all countries Only for Thailand domestic interest rates (expected), trade balance (expected), inflation (expected), the changes in the global portfolio (expected), and the global interest rates (unexpected) are significant. Further, the cointegrating vectors identified in the previous chapter are reported as a significant factor, in a regression model of returns adjusted for domestic risks on international factors.

The next step was an attempt to estimate a multifactor asset pricing model, similar to the International version of the APT, with a methodology proposed by McElroy and Burmeister this methodology writes the APT as a multivariate nonlinear regression model and estimates it as a Non Linear Seemingly Unrelated Regression, (NLSUR). The empirical results from this model suggest that eventhough factors such us the returns on a world portfolio, global interest rates, global inflation and the cointegrating vector, play a role in the determination of the security returns in the emerging markets, only the risk from global interest rates is priced

This seem to suggest that the pricing mechanism operates inefficiently in the emerging markets, since factors to which returns appear sensitive do not carry a risk premium.

Another important result of this chapter is that emerging market returns are sensitive to a factor that represents a long run common trend, and is an undiversifiable kind of risk. It is interesting to note that in the previous chapter we discovered that this common trend is most significant in Chile and Mexico, as is also the case here.

CHAPTER VII.

METEOR SHOWERS AND VOLATILITY SPILL-OVERS IN THE EMERGING EQUITY MARKETS.

7.1. INTRODUCTION.

The dynamics of many financial variables, like stock price indices, tend to be characterized by clusters of volatility. Turbulent periods, with large and frequent changes in stock prices tend to be followed by tranquil periods with small and infrequent price changes. In addition, we know that for some financial variables (exchange rates) volatility is often not contained in one market location, i.e. it persists across markets (Engle (1990)). In efficient markets, with rational traders, there is no reason why volatility should persist across markets. However, we have seen in chapter 4 that the emerging markets are not efficient and, furthermore, the evidence in chapter 5 (the existence of cointegrating vectors among the markets) suggests that the markets, in the long run, tend to move together, i.e. that there exists some sort of interdependency among them.

This gives rise to an important question: since the prices exhibit such interrelations, can we expect a similar behavior for the volatility? In other words can we expect a change in the volatility in one market due to the arrival of information in another market, i.e. a volatility spill-over?

Volatility spill overs, as Ito et.al.(1992), note, may either: " ...represent a failure of the market to fully process its information and may signal a violation of market efficiency since it is unlikely that the sources of volatility are so geographically mobile", or be interpreted as evidence of potential international policy coordination, that implies cross country news autocorrelation (Engle et.al (1990)).

The existence of volatility spill-overs may have important implications not only for the international institutional investor, but also for the emerging market policy-makers and Governments, multilateral institutions, and the macroeconomic growth prospects of the emerging markets.

Engle, Ito and Lin (1990), dubbed the phenomenon of volatility spill-overs a "meteor shower" because of its similarity to the pattern of meteor showers as the globe turns (Engle, et.al. (1990), p227):

"Using meteorological analogies, we suppose that news follows a process like a heat wave so that a hot day in New York is likely to be followed by another hot day in New York but not typically by a hot day in Tokyo. The alternative analogy is a meteor shower which rains down on earth as it turns. A meteor shower in New York will almost surely be followed by one in Tokyo."

The heat wave hypothesis is that the volatility has only country specific autocorelation. It is consistent with the view that the main factors that affect the prices are changes in country specific fundamentals. The meteor shower hypothesis is that of volatility spill-overs from one market to the other. Note here, that in chapter 6 we reported that prices are sensitive to international factors as well as domestic factors.

Empirical evidence on exchange rate dynamics suggests the existence of the meteor shower phenomenon. For example, Engle et. al *(1990) used the daily yen/dollar exchange* rate and reports evidence against the heat wave hypothesis. Ito et. al (1992), examine the intra-daily volatility of the yen/dollar exchange rate over 3 different regimes from 1979 to 1988, which correspond to different degrees of international policy coordination. Their results reject the heat wave hypothesis. In a more recent study, Hogan and Melvin (1994), examine the role that news and heterogeneous expectations play in the persistence of exchange rate volatility, (the meteor shower effect). Their results indicate that exchange rate volatility persists from one market location to another. However, no evidence exists on volatility spill overs for the emerging equity markets, despite the obvious importance of the issue. The analytic framework we employ here is that of the meteor shower hypothesis versus the heat wave hypothesis.

A second issue examined in the chapter is that of the relationship between Financial Liberalization (FL) and equity market volatility. Many economists in the 1970s, among them the early architects of the neoclassical theory of Financial Liberalization, McKinnon and Shaw (1973)[37] , argued that Financial Liberalization in the Less Developed Countries will initiate a circle of increased Savings, Investment, and Economic Growth. The Keynsian argument (Samuels and Yacout, 1981); Calamanti, 1983), held that the expansion of the LDC equity markets could attract speculators, induce short-term speculative investment strategies, introduce financial crises and macroeconomic instability in the LDC emerging capital markets, and inevitably result in a missalocation of Savings and Investment. While the neoclassical approach predicts a decrease in capital market volatility following a Financial Liberalization program and asserts that volatility will not affect long-term economic growth, the Keynsian approach asserts that there is a relation between capital market volatility and economic growth, and that increased volatility can induce macroeconomic instability; unexpected changes in the price levels, dramatic increases in interest and exchange rates, huge trade deficits.

Earlier research presents evidence that financial market volatility increased in selected LDCs, following Financial Liberalization programs. For example, Grabel (1995), utilizes both Neoclassical and Keynsian indices that measure volatility; the former are based on the assumption that assets yield a rate of return based on fundamental values (dividends) and that the deviation from the asset fundamentals-based return is the asset's volatility, the later make no such assumption: volatility is simply the magnitude of the asset fluctuations. The results from both measures, supported the notion of increased volatility, in selected LDCs, following Financial Liberalization.

However, when there are no arbitrage opportunities, return volatility is related proportionally to the rate of information flow (Ross, 1989). This leads Antoniou and

[37] For example see: McKinnon P., "Money and Capital in Economic Development", 1973, Washinghton DC: Brookings Institution.

Holmes (1995) to argue that higher volatility *per se* is not a bad thing; what should be of interest is *persistence of shocks* to volatility.

Therefore a different approach, than that of Grabel, is employed; volatility is modeled with E-GARCH in order to measure the change in the *nature* of the volatility. We use E-GARCH here because as Nelson (1991) suggested a conditional variance that is symmetric to the ε_t's is somewhat at odds with the empirical evidence available on stock prices when the leverage effect is present (see below). This approach is often used by researchers to investigate the effects of the derivative markets on spot price volatility: the introduction of the derivative markets had, as a primary aim, the hedging of risks by traders, and as a result it was argued that the introduction of this market would stabilize prices and reduce spot market volatility. However, it has been claimed that derivative markets have destabilized spot markets and resulted in an increase in volatility. Researchers addressing this issue have used GARCH techniques to investigate whether derivative markets have increased or decreased spot price volatility. For example, Antoniou and Foster (1992), utilized GARCH analysis to investigate volatility in oil spot prices both before and after the introduction of futures trading. They estimated a number of GARCH-M (p,q) equations for both before and after the introduction of futures trading, and reported a decrease on the coefficient of the lagged conditional variance, which indicated a decrease in the volatility.

This chapter is organized as follows: section 2 discusses the data and the methodology. Section 3 presents the results whilst section 4 concludes the chapter.

7.2. DATA AND METHODOLOGY.

The data used in this section are the IFC monthly stock price indexes for the 10 emerging markets, the S&P500 for the USA, and the Nikei 225 for Japan. The last two indices are included in the sample to examine the additional issue of whether volatility effects are initiated in the big industrialized equity markets and spill over to the thinly traded emerging markets. From the logarithmic price levels of these indexes returns are computed as described in Chapter IV.

The methodology employed in this chapter to model the emerging equity market volatility was introduced by Engle (1982). Prior to the introduction of the ARCH modeling researchers used only informal procedures to account for the changes in the variance. For example, Mandelbot (1963a) used recursive estimates of the variances over time. The ARCH model not only captures the changes in the variance but also is applicable in numerous and diverse areas. For example, it has been used to test asset pricing models, to test the EMH, to measure the term structure of the interest rates. An extensive literature of empirical studies has documented significant ARCH effects not only for individual stock returns but also for equity index returns, for derivative markets such as futures markets, etc.

The most prominent explanation of the existence of *serial correlation in conditional* second moments was proposed by Diebold and Nerlove (1989), and Gallant, Hsieh and Tauchen (1989). They argued that the source of the ARCH effects is the presence of serial correlation in the news arrival process, in the markets. This theory is supported by the results of an empirical study by Engle, Ito and Lin (1990a,b). However, the question of why there is a systematic dependence in the news arrival process has not been adequately answered. Further, Lamoureux and Lastrapes (1990b), argue that the ARCH effects are a manifestation of clustering in trading volumes. However, the use of lagged volume as an instrument for the contemporaneous volume did not "remove" the ARCH effects.

Other researchers, such as Campell (1987), Glosten et al. (1991) found that interest rates are significant determinants of volatility, and that adding an interest rate ratio into the GARCH formulation decreased the persistence as measured by conventional GARCH parameters. Attanasio (1991), presented results that suggested that dividend yields were an important part of the process that drives stock volatilities. Engle and Rodriques (1989), report money supply and oil prices as factors that affect the variance of stock returns.

7.2.1. The definition of the ARCH process. [38]

Consider a dynamic linear regression model of the form:

$$y_t = \phi X_t + e_t, t = 1, \ldots, T \tag{7.1}$$

where X_t is a K x 1 vector of exogenous variables, which may include lagged values of the dependent variable, and ϕ is a K x 1 vector of regression parameters. The ARCH model characterize the distribution of the stochastic error ε_t conditional on the realized values of the set of variables $\psi_{t-1} = \{ y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2}, \ldots \}$.

Engle (1982)[39] , reparametrized the conditional mean and the conditional variance as functions of the available information set so that the conditional mean could be used for forecasting rather than the unconditional mean. His model assumes:

$$\varepsilon_t \mid \psi_{t-1} \sim N(0, \sigma_t^2) \tag{7.2}$$

[38] An excellent review of the ARCH models and relevant empirical studies can be found in Bollerslev T., Chou R., Kroner K., "ARCH modelling in finance", *Journal of Econometrics*, Vol 52, 1992, pp5-59.
[39] For a detailed review and discussion see Engle R., Bollerslev T., "Modelling the persistance of Conditional Variances", *Econometric reviews*, Vol 5, No1, 1986, pp1-50.

where $$\sigma_t^2 = \alpha_0 + \alpha_t(L)\varepsilon_t^2 \qquad (7.3)$$

where $\alpha_0 > 0$, $\alpha_i \geq 0$, to ensure that the conditional variance is positive, and L denotes the lag operator.

The distinguishing feature of the model in (7.2) and (7.3) is that it does not only state the conditional variance h_t as a function of the conditioning set ψ_{t-1}, but also that the conditional variance function is formulated so as to capture the clustering of large shocks to the dependent variable. It is the order of the lag q that determines the length of time for which a shock persists in conditioning the variance of subsequent errors. The larger the value of q the longer the episodes of volatility will tend to be. A linear function of lagged squared errors is not the only conditional variance function that will produce clustering of large deviations. Any monotonically increasing function of the absolute values of the lagged errors will lead to such clustering. However, since variance is expected squared deviation, a linear combination of lagged squared errors is a natural measure of the recent trend in variance to translate to the current conditional variance h_t [40].

Maximum likelihood inference procedures for the ARCH family of models under this distributional assumption are discussed in Engle (1982) and Pantula (1985).

[40] See Bera and Higgins (1993) for a discussion.

7.2.2. The Generalized ARCH, GARCH(p,g), model.

Bollerslev (1986), and Taylor (1986), suggested a generalized ARCH model which introduced an alternative and more flexible lag structure than the initial ARCH.
A random variable ε_t is said to follow a GARCH(p,q) process if:

$$E_{t-1}(\varepsilon_t) = 0$$

$$\begin{aligned} h_t &= \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} \\ &= \alpha_0 + \alpha(L)\varepsilon_t^2 + \beta(L) h_t \end{aligned} \tag{7.4}$$

where the restrictions $\alpha_0 > 0$, $\alpha_i \geq 0$ (i=1,....,q), $\beta_i \geq 0$ (i=1,...,p), are imposed to ensure that the conditional variance is strictly positive, $\alpha(L)$, $\beta(L)$ are polynomials in the backshift operator L. It can be shown that a GARCH(p,q) process is an infinite order ARCH process with a rational lag structure imposed on the coefficients. The generalization from ARCH to GARCH is similar to the generalization from an MA process to an ARMA process. Empirical evidence (see Bolerslev, 1985a) suggests the GARCH model will fit as well or even better than the ARCH model. Furthermore, in most empirical applications an order of p=q=1 will sufficiently characterize the data, (Bollerslev et al., 1992).

7.2.3. The exponential GARCH, EGARCH(p,q) model.

In the above model the variance only depends on the magnitude and not the sign of ε_t. However, as Nelson (1991) suggested a conditional variance this is symmetric to the ε_t's is somewhat at odds with the empirical evidence available on stock prices when the leverage effect is present.[41] Therefore, Nelson suggested the exponential GARCH, EGARCH(p,q), model in which volatility is an asymmetric function of past ε_t's. Formally the model is:

Let $\varepsilon_t = z_t \sqrt{h_t}$, where $E(z_t) = 0$, $Var(z_t) = 1$,

Then,

$$\log h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \left(\phi z_{t-i} + \gamma \left[|z_{t-i}| - E|z_{t-i}| \right] \right) + \sum_{i=1}^{p} \beta_i \log h_{t-i} \qquad (7.5)$$

Unlike the linear GARCH(p,q) model where the restrictions $\alpha_0 > 0$, $\alpha_i \geq 0$ (i=1,....,q), $\beta_i \geq 0$ (i=1,...,p), are imposed to ensure that the conditional variance is strictly positive, in the EGARCH(p,q) there are no restrictions on the parameters α_0, α_i, β_i, to ensure nonegativity of the conditional variances. Thus, (7.5) represents an unrestricted ARMA(p,q) for log h_t. If the term $\alpha_i \phi < 0$ the variance tends to rise (fall) when ε_{t-i} is negative (positive). This is in accordance with the empirical evidence on stock market prices

[41] For example, Black (1976) has reported a negative correlation between current returns and future volatility. Balck (1976) and Cristie (1982) suggested that this might be due to the leverage-effect. According to this effect a reduction in the equity value would raise the Debt-to-Equity ratio and therefore the riskiness of the firm, and this would appear as an increase in the future volatility.

In the present study we model the dynamic process of monthly volatility using the E-GARCH framework, where $z_{j,t}$ and $z_{j,t-1}$ as defined in model (7.5) but *for market j. Significant coefficients associated with the* $z_{j,t}$ *and* $z_{j,t-1}$ *in the conditional variance model will indicate meteor shower effects.*

For the investigation of whether Financial Liberalization increased or decreased the equity market volatility we estimate a number of E-GARCH(1,1)[42] models for the periods before and after FL. From the comparison of these final models we can get an indication for the behavior of the persistence of shocks of volatility following FL. Financial liberalization began in the late 1970s in the Latin America region, and in the beginning of the 1980s in the Asian region. Due to the complicated nature of liberalization programs, and the long period they take to completion, it is difficult to assess with accuracy the beginning and end date for a program, in order to estimate the volatility before and after the implementation of the program. Therefore, we have to make an important assumption in order to find a "cutoff" date. Based on the discussion in chapter 3, and relevant publications[43] , we assume that for the Latin America region the major financial liberalization programs were in effect by the end of 1982, and for the Asian region by the end of 1984. Three of the sample countries (Malaysia, Philippines, Taiwan) do not have available stock market data for the period before FL and therefore have to be dropped from the sample.

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[42] We use this lag structure since empirical evidence (Bollerslev, et.al., 1992) has shown that models with q=1, p=1are sufficient for most stock market data.
[43] Grabel I.," Assesing the impact of Financial Liberalisation on Stock Market Volatility in Selected Developing Countries", *The Journal of Development Studies*, Vol.31,No.6,1995,pp903-917.

7.3. RESULTS.

The meteor shower effect.

Tables 7.1-7.12 report the results for the E-Garch model, for all the emerging markets and the two industrialized markets. In every table country's i volatility $\log(h_{i,t})$ is modeled with every other country's $z_{j,t}$ and $z_{j,t-1}$, and its own $\log(h_{i,t-1})$. *Significant coefficients associated with the $z_{j,t}$ and $z_{j,t-1}$ suggest a volatility spill-over from country j towards country i.*

The results indicate that there is not a pattern of a meteor showers within the emerging markets. In many cases, however, we were able to detect significant coefficients, indicating volatility spill-overs. The markets most affected by the volatility in other markets are Brazil and Philippines.

Brazil is affected by India, Thailand, Taiwan, the US and Japan. Philippines by Mexico, India, Taiwan, the US and Japan. The markets least affected are Chile (no spill-overs), Thailand, Japan (affected only by Taiwan) and Korea (affected by Japan). The market from which the most spill-overs are initiated is Taiwan. It affects Brazil, Mexico, Thailand, Philippines and Japan. This is an interesting result since one would reasonably expect that spill-overs are initiated from the big industrialized markets, and not from small emerging markets like Taiwan. Perhaps, further, more detailed, research with daily data is needed to shed light to this phenomenon.

Tables 7.13 to 7.15 report some diagnostic statistics for the above models; specifically a χ^2 statistic for testing the normality and the heteroscedasticity assumptions of the model residuals. We can see that very few models suffer from heteroscedasticity (where the hypothesis of homoscedasticity is rejected at the at the 10%), with the exception of all the models for Mexico which all suffer from heteroscedasticity (also rejected at the 10%). The most severe problem of the models is the nonnormality of the residuals from which all but few models suffer, i.e. except for the models of Argentina, Mexico, Korea, and Taiwan (note, however, that for Brazil and Chile the null of homoscedasticity is rejected at the 10%). Similar tests for serial correlation (not reported) reveal that only the models for Brazil, Chile, Korea and the USA suffer from serial correlation.

Overall, eventhough meteor shower effects are present in the emerging markets there is not a pattern to suggest a dominant market from which volatility spills over to the other markets (with the exception, perhaps, of Taiwan which affects 5 out of 11 markets).

FL and volatility.

The results of the estimation of E-GARCH (1,1) models for the volatility of the emerging markets, for the periods before and after FL, appear in Table 7.16. Philippines, Malaysia and Taiwan are dropped from the sample since not enough observations are available. The coefficients of the models, suggest that volatility has been reduced in the emerging markets for the period after Financial Liberalisation. This is especially true for all a_2's and b_1's coefficients (z_{t-1} and log ($h_{i,t-1}$), respectively) and less so for the a_2's (z_{t-1}). The diagnostic tests (not reported) suggest that the models are well specified with respect to serial correlation and heteroscedasticity; the only problem is that in some models (i.e. India Brazil and Thailand) the normality assumption is violated. Thus, the evidence seems to support the Neoclassical argument for the financial volatility.

Table 7.1

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Brazil)

	Coefficients		
j =	$b_{i,1}$	$a_{j,2}$	$a_{j,2}$
Argentina	0.38324	-0.01449	0.000185
	(0.0656)*	(0.03559)	(0.03562)
Chile	0.38399	-0.029803	0.059534
	(0.065751)*	(0.064149)	(0.064093)
Mexico	0.38842	-0.055013	-0.0051835
	(0.065833)*	(0.060489)	(0.060234)
India	0.37899	0.11195	0.0096787
	(0.065622)*	(0.063637)**	(0.064110)
Thailand	0.37031	0.14761	0.057259
	(0.065565)*	(0.069267)*	(0.070033)
Taiwan	0.28928	0.066735	0.088252
	(0.097007)*	(0.042809)**	(0.043370)*
Philippines	0.35048	-0.019107	-0.028397
	(0.098216)*	(0.091735)	(0.091855)
Korea	0.38317	-0.048879	-0.032015
	(0.065574)*	(0.057777)	(0.057804)
Malaysia	0.35395	-0.083579	0.066245
	(0.097914)*	(0.11268)	(0.11084)
Japan	0.35817	-0.030852	0.16677
	(0.097179)*	(0.11291)	(0.11308)**
USA	0.33353	0.25616	0.22129
	(0.096966)*	(0.15491)**	(0.15631)**

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.2

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,...,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Argentina)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.19653	0.021694	-0.015429
	(0.070756)*	(0.052578)	(0.052607)
Chile	0.19899	0.025068	-0.069926
	(0.070912)*	(0.075609)	(0.075159)
Mexico	0.19411	-0.034394	0.0016178
	(0.070998)	(0.071111)	(0.070943)
India	0.19938	0.00037699	0.094392
	(0.071107)*	(0.075779)	(0.075032)
Thailand	0.17274	-0.15701	-0.044092
	(0.071579)*	(0.082323)*	(0.082692)
Taiwan	0.23985	-0.0044740	0.069565
	(0.10643)*	(0.055125)	(0.053905)
Philippines	0.24489	-0.17803	0.021954
	(0.10532)*	(0.11106)**	(0.11318)
Korea	0.19672	0.0091243	-0.089723
	(0.070529)*	(0.067850)	(0.067700)
Malaysia	0.23236	-0.14330	-0.17974
	(0.10399)*	(0.13693)	(0.13521)
Japan	0.19944	0.044572	0.0081665
	(0.070841)*	(0.10414)	(0.10382)
USA	0.19538	0.057461	0.047715
	(0.070652)*	(0.12017)	(0.12016)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.3

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Chile)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	-0.056250	-0.023231	0.050307
	(0.070629)	(0.041273)	(0.041239)
Argentina	-0.048772	0.039926	-0.025619
	(0.070711)	(0.032766)	(0.032895)
Mexico	-0.049296	0.034057	-0.056569
	(0.070731)	(0.055654)	(0.055647)
India	-0.051706	0.050505	-0.028604
	(0.070797)	(0.059219)	(0.059273)
Thailand	-0.059034	-0.022503	-0.047971
	(0.070890)	(0.064947)	(0.064747)
Taiwan	-0.020860	0.0051429	-0.050137
	(0.10463)	(0.038875)	(0.038682)
Philippines	-0.017345	-0.028196	-0.015898
	(0.10495)	(0.080711)	(0.080863)
Korea	-0.056344	-0.0069573	0.00096813
	(0.070796)	(0.053531)	(0.053528)
Malaysia	-0.011773	-0.039987	0.037545
	(0.10519)	(0.099838)	(0.097750)
Japan	-0.053862	0.041807	-0.042636
	(0.070733)	(0.081677)	(0.081695)
USA	-0.055583	-0.038511	0.054838
	(0.070776)	(0.094575)	(0.094580)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.4

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Mexico)

		Coefficients	
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.20275	-0.0073529	-0.021727
	(0.069753)*	(0.047670)	(0.047706)
Argentina	0.20540	0.020795	0.0033929
	(0.069925)*	(0.038010)	(0.037953)
Chile	0.20351	0.010838	-0.070956
	(0.069794)*	(0.068366)	(0.068195)
India	0.18687	-0.086613	-0.047183
	(0.070292)*	(0.068389)	(0.068383)
Thailand	0.20570	-0.046602	0.030954
	(0.069798)*	(0.074719)	(0.074708)
Taiwan	0.19834	0.069694	-0.0012952
	(0.10351)*	(0.047028)*	(0.047518)
Philippines	0.20756	0.011355	-0.088665
	(0.10304)*	(0.098075)	(0.098203)
Korea	0.20069	0.018659	0.0013442
	(0.070166)*	(0.061980)	(0.061740)
Malaysia	0.20814	0.077029	0.029965
	(0.10353)*	(0.12142)	(0.11927)
Japan	0.20255	0.012323	-0.031930
	(0.070156)*	(0.094729)	(0.094278)
USA	0.20602	0.21031	-0.026392
	(0.069696)*	(0.10801)*	(0.10895)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.5

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =India)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.080571	0.080928	0.024818
	(0.072475)	(0.073316)	(0.071729)
Argentina	0.063730	-0.0052910	-0.10666
	(0.070117)	(0.056543)	(0.056540)**
Chile	0.062929	0.090692	-0.015533
	(0.070716)	(0.10257)	(0.10270)
Mexico	0.059641	-0.050087	-0.14928
	(0.070351)	(0.096090)	(0.096073)**
Thailand	0.065098	0.022852	-0.013287
	(0.070721)	(0.11236)	(0.11231)
Taiwan	0.045687	-0.022159	0.040652
	(0.10660)	(0.079630)	(0.078372)
Philippines	0.072269	0.23354	0.026445
	(0.10621)	(0.16276)**	(0.16224)
Korea	0.058703	0.054081	0.089569
	(0.070670)	(0.092552)	(0.092516)
Malaysia	0.050195	0.0060975	-0.11384
	(0.10499)	(0.20047)	(0.19664)
Japan	0.064738	0.0065539	0.00027659
	(0.070862)	(0.14197)	(0.14162)
USA	0.074597	0.12490	0.020907
	(0.071931)	(0.16668)	(0.16368)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.6

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\dots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Thailand)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.23801	0.013639	0.010320
	(0.069346)*	(0.052423)	(0.052437)
Argentina	0.23766	0.015072	-0.038530
	(0.069643)*	(0.041845)	(0.041654)
Chile	0.23592	0.071397	0.021082
	(0.069270)*	(0.074932)	(0.075076)
Mexico	0.24634	0.097114	-0.079497
	(0.069080)*	(0.070015)	(0.070436)
India	0.23642	-0.015670	-0.055506
	(0.069217)*	(0.074986)	(0.075005)
Taiwan	0.22424	-0.079292	0.037235
	(0.10453)*	(0.056063)*	(0.056305)
Philippines	0.20579	-0.032384	0.084759
	(0.10410)*	(0.11654)	(0.11646)
Korea	0.24174	0.047907	-0.066705
	(0.069142)*	(0.067568)	(0.067599)
Malaysia	0.19797	-0.14853	0.066187
	(0.10479)**	(0.14359)	(0.14163)
Japan	0.23892	-0.016843	0.12280
	(0.069113)*	(0.10327)	(0.10319)
USA	0.23795	-0.10683	-0.011882
	(0.069314)*	(0.11962)	(0.11986)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.7

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\dots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Taiwan)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.065747	0.13765	-0.068981
	(0.10646)	(0.12986)	(0.12912)
Argentina	0.016074	0.19360	-0.068591
	(0.10852)	(0.11393)**	(0.11313)
Chile	0.035855	-0.43407	0.17711
	(0.10607)	(0.21767)*	(0.22036)
Mexico	0.049194	-0.12005	-0.074857
	(0.10636)	(0.20117)	(0.19847)
India	0.057562	0.16198	0.016260
	(0.10699)	(0.17970)	(0.17877)
Thailand	0.042413	0.025676	0.050082
	(0.10679)	(0.19392)	(0.19229)
Philippines	0.044025	0.039379	-0.066489
	(0.10642)	(0.19385)	(0.19317)
Korea	0.044469	-0.076999	-0.070566
	(0.10574)	(0.21173)	(0.21181)
Malaysia	0.044022	-0.14378	-0.17237
	(0.10556)	(0.23710)	(0.23291)
Japan	0.044080	-0.026247	0.14425
	(0.10733)	(0.24369)	(0.23995)
USA	0.059603	0.35583	-0.10202
	(0.10605)	(0.33050)	(0.33223)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.8

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Philippines)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	-0.0033629	0.17638	0.11177
	(0.10525)	(0.12712)	(0.12819)
Argentina	0.0062868	-0.040123	-0.0086086
	(0.10569)	(0.11233)	(0.11256)
Chile	0.0078812	-0.026748	0.11657
	(0.10552)	(0.21986)	(0.21989)
Mexico	-0.028291	-0.25841	-0.38491
	(0.10346)	(0.19354)	(0.19285)*
India	0.0088843	-0.052488	0.28261
	(0.10424)	(0.17497)	(0.17495)**
Thailand	0.0047745	-0.038772	0.033644
	(0.10662)	(0.19264)	(0.19117)
Taiwan	0.025417	-0.089078	0.10832
	(0.10534)	(0.091910)	(0.092078)**
Korea	-0.0021155	-0.20427	-0.47264
	(0.10422)	(0.20652)	(0.20487)
Malaysia	0.018987	0.14581	-0.30551
	(0.10474)	(0.23390)	(0.23008)
Japan	0.028527	-0.36823	0.10544
	(0.10595)	(0.23578)**	(0.23864)
USA	0.0064664	0.049095	0.11051
	(0.10564)	(0.33029)**	(0.33061)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.9

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Korea)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	-0.20366	-0.013725	0.014626
	(0.069490)*	(0.043230)	(0.043276)
Argentina	-0.20480	0.017144	-0.040205
	(0.069358)*	(0.034329)	(0.034302)
Chile	-0.20587	-0.034072	-0.010461
	(0.069507)*	(0.061969)	(0.061983)
Mexico	-0.20660	-0.031292	-0.036022
	(0.069448)*	(0.058232)	(0.058266)
India	-0.20178	0.049037	0.0068634
	(0.069679)*	(0.062006)	(0.062044)
Thailand	-0.20619	0.061559	0.050366
	(0.069479)*	(0.067589)	(0.067735)
Taiwan	-0.21278	-0.030543	-0.028077
	(0.10243)*	(0.040663)	(0.040735)
Philippines	-0.20276	0.045649	-0.064534
	(0.10266)*	(0.084552)	(0.084493)
Malaysia	-0.20163	-0.033230	0.056141
	(0.10244)*	(0.10424)	(0.10239)
Japan	-0.21691	-0.17981	0.035716
	(0.069702)*	(0.085050)*	(0.085204)
USA	-0.20229	-0.074323	-0.062199
	(0.069810)*	(0.099129)	(0.098882)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.10

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\dots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Malaysia)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	-0.058858	-0.016478	0.034656
	(0.10459)	(0.10316)	(0.10302)
Argentina	-0.062303	-0.033960	0.040655
	(0.10500)	(0.090298)	(0.089964)
Chile	-0.062283	0.055514	0.044812
	(0.10477)	(0.17650)	(0.17617)
Mexico	-0.054003	-0.085812	0.13736
	(0.10417)	(0.15876)	(0.15726)
India	-0.056087	0.048570	-0.0043180
	(0.10513)	(0.14260)	(0.14217)
Thailand	-0.066383	0.11305	0.017733
	(0.10491)	(0.15305)	(0.15289)
Taiwan	-0.076062	0.079707	0.0085230
	(0.10519)	(0.074175)	(0.073849)
Philippines	-0.035351	-0.16967	0.089770
	(0.10540)	(0.15346)	(0.15322)
Korea	-0.043351	0.30648	-0.014097
	(0.10484)	(0.16606)**	(0.16853)
Japan	-0.065209	0.060533	0.27508
	(0.10485)	(0.19161)	(0.18900)**
USA	-0.065904	0.25882	0.18010
	(0.10433)	(0.26282)	(0.26410)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.11

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

(i =Japan)

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	0.29076	0.016791	0.066479
	(0.068465)*	(0.079382)	(0.078892)
Argentina	0.29476	0.089120	-0.028622
	(0.068063)*	(0.062489)	(0.062859)
Chile	0.28837	0.13854	0.10402
	(0.067841)*	(0.11246)	(0.11292)
Mexico	0.29593	- 0.0024271	0.0019522
	(0.068044)*	(0.10651)	(0.10644)
India	0.28480	0.091116	0.058934
	(0.068712)*	(0.11382)	(0.11327)
Thailand	0.28650	0.15952	0.056150
	(0.068198)*	(0.12338)	(0.12385)
Taiwan	0.32265	0.043982	-0.11608
	(0.098669)*	(0.062941)	(0.062821)**
Philippines	0.31997	0.042223	-0.14584
	(0.099850)*	(0.13196)	(0.13193)
Korea	0.29795	0.032452	-0.12742
	(0.067728)*	(0.10168)	(0.10172)
Malaysia	0.32456	-0.18973	0.089342
	(0.099672)*	(0.16184)	(0.15999)
USA	-0.082023	0.016603	0.065105
	(0.070879)	(0.11474)	(0.11472)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.12

$$e_{i,t} \mid \psi_{i,t} \rightarrow N(0,h_{i,t}), \text{ for } i=1,2,\ldots,n$$

$$\log(h_{i,t}) = \omega_i + a_{1j} z_{j,t} + a_{2j} z_{j,t-1} + b_{i1} \log(h_{i,t-1}),$$

$$(i = USA)$$

	Coefficients		
j =	$b_{i,1}$	$a_{j,1}$	$a_{j,2}$
Brazil	-0.081216	0.0047597	-0.025885
	(0.070946)	(0.058107)	(0.058116)
Argentina	-0.080839	-0.080205	0.019207
	(0.070909)	(0.04585)**	(0.046228)
Chile	-0.079671	0.081601	-0.069872
	(0.070798)	(0.082961)	(0.083101)
Mexico	-0.081734	0.0036113	0.041686
	(0.070891)	(0.078269)	(0.078293)
India	-0.080376	-0.052370	0.014238
	(0.070945)	(0.083193)	(0.083273)
Thailand	-0.081853	0.031738	-0.045678
	(0.070917)	(0.091029)	(0.090991)
Taiwan	-0.038741	-0.012125	-0.042084
	(0.10623)	(0.063795)	(0.063176)
Philippines	-0.034080	0.10953	0.052967
	(0.10533)	(0.13064)	(0.13081)
Korea	-0.086227	0.12164	0.064603
	(0.070811)	(0.07451)**	(0.075024)
Malaysia	-0.040931	-0.018809	0.25991
	(0.10473)	(0.16089)	(0.15612)**
Japan	-0.082023	0.016603	0.065105
	(0.070879)	(0.11474)	(0.11472)

standard errors appear in parenthesis.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.13

Diagnostic Statistics for models of Tables 7.1 - 7.4

Table 7.1 (Brazil)		Table 7.2 (Argentina)		Table 7.3 (Chile)		Table 7.4 (Mexico)	
Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.
9.9569**	0.7665	2.9091	1.2448	8.4058**	1.3848	0.4693	2.6762**
9.1007**	1.1071	4.6644	0.6914	10.834**	1.2248	1.3289	2.3497**
10.522**	0.9306	3.1315	0.5013	7.1255**	1.9568	0.4956	2.7618**
7.6849**	0.9821	2.9502	1.3044	10.188**	1.1436	0.8349	2.5249**
8.4869**	1.0469	2.8486	1.6679	11.065**	1.1765	0.8176	2.6236**
1.3266	1.5320	3.0115	0.5766	8.6613**	1.8372	0.8731	3.1163**
4.9685	0.8483	1.9631	1.4964	10.327**	1.0310	0.7462	2.7668**
10.178**	3.5082*	3.1310	0.5640	9.3589**	1.9187	1.6706	2.4140**
4.4612	1.0035	2.3422**	1.6441	9.6095**	1.3986	1.1807	2.5226**
8.2184**	0.3063	1.9396	1.9829	11.071**	1.0396	1.6419	2.5959**
8.5484**	0.5847	2.4139	0.3388	9.0986**	1.5645	2.5777	3.1040*

The tests are all the χ^2 -tetsts for normality and heteroscedasticity of the residuals and appear in the same order as in Tables 7.1-7.4.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.14

Diagnostic Statistics for models of Tables 7.5 - 7.8

Table 7.5 (India)		Table 7.6 (Thailand)		Table 7.7 (Taiwan)		Table 7.8 (Philippines)	
Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.
50 452*	0.5665	83.062*	0.7488	1.7886	0.9951	70.871*	0.6987
35.994*	2.4814**	72.081*	0.3326	1.2662	1.1923	83.891*	0.2275
51 913*	0.4707	67.264*	0.3326	0.8113	1.1102	82.007*	3.1658**
38.837*	1.9215	77.027*	0.9421	1.5745	2.0777	56.625*	0.9469
53.306*	0.5078	74.189*	0.3223	1.5898	2.8822**	80.503*	0.5630
51.285*	0.5390	70.921*	0.4802	1.7628	1.4531	84.028*	0.1932
54.566*	0.5884	77.193*	0.8245	1.4148	1.4890	77.781*	0.2496
48.465*	0.7742	74.984*	0.5289	1.6429	2.8834**	53.568*	0.7835
52.488*	0.8835	77.146*	0.8012	1.7296	1.3557	65.480*	0.7252
50.638*	0.7122	69.976*	0.6066	1.1145	2.9573**	69.308*	0.7760
48.954*	0.6990	64.578*	0.3669	1.5941	1.4744	87.666*	0.6384

The tests are all the χ^2 -tetsts for normality and heteroscedasticity of the residuals and appear in the same order as in Tables 7.5-7.8.
* indicates that the t-statistic is significant at the 5%.
** indicates that the t-statistic is significant at the 10%.

Table 7.15

Diagnostic Statistics for models of Tables 7.9 - 7.12

Table 7.9 (Korea)		Table 7.10 (Malaysia)		Table 7.11 (Japan)		Table 7.12 (USA)	
Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.	Normality	Heterosc.
5.5072	1.2329	28.412*	0.3969	22.971*	0.5054	22.840*	0.5146
4.6874	1.3779	31.217*	1.4453	19.888*	1.1102	11.129*	6.5586*
5.7921	1.7375	28.699*	0.3183	21.540*	0.5787	22.227*	0.3737
5.1772	0.9343	31.036*	0.2148	23.106*	0.6964	21.004*	1.3815
5.6196	1.5889	27.691*	0.5057	22.496*	0.9798	22.242*	0.7489
3.4965	1.3504	27.459*	0.7497	23.368*	1.1753	22.047*	0.3200
6.3677**	1.1136	25.614*	0.4223	18.369*	4.1092*	22.539*	0.8489
4.9830	1.2381	27.004*	0.2931	21.560*	0.3086	21.049*	0.7818
5.0784	1.3237	26.766*	0.3066	22.205*	1.0218	20.493*	0.4380
2.5710	2.9566**	26.049*	0.6129	18.934*	1.4042	20.703*	0.4663
4.1159	1.3482	26.098*	0.5413	22.278*	0.9125	22.160*	0.3557

The tests are all the χ^2 -tetsts for normality and heteroscedasticity of the residuals and appear in the same order as in Tables 7.9-7.12.

* indicates that the t-statistic is significant at the 5%.

** indicates that the t-statistic is significant at the 10%.

Table 7.16

$\log(h_{i,t}) = a_1 z_t + a_2 z_{t-1} + b_1 \log(h_{i,t-1})$, before and after FL.

	Mexico		Argentina	
	Before FL	**After FL**	**Before FL**	**After FL**
a_1	-0.28086	0.034195	-0.01500	0.000873
	(0.14907)*	(0.095904)	(0.09852)	(0.065605)
a_2	0.29110	0.24646	0.053802	0.10813
	(0.14961)*	(0.09576)*	(0.098721)	(0.06568)**
b_1	0.98624	0.98753	0.98900	0.96943
	(0.02144)*	(0.01517)*	(0.03503)*	(0.02191)*
	Brazil		**Chile**	
	Before FL	**After FL**	**Before FL**	**After FL**
a_1	-0.072290	0.30952	0.021684	0.24183
	(0.23873)	(0.14096)*	(0.12539)	(0.11217)*
a_2	-0.20498	0.11020	-0.17734	-0.068114
	(0.23772)	(0.14042)	(0.12540)	(0.11219)
b_1	0.98858	0.98174	0.99258	0.98687
	(0.02197)*	(0.01622)*	(0.02059)*	(0.01393)*
	Korea		**India**	
	Before FL	**After FL**	**Before FL**	**After FL**
a_1	0.15815	0.16987	0.10035	0.14921
	(0.11560)	(0.12866)	(0.26324)	(0.17297)
a_2	-0.13549	-0.10849	0.65313	0.089482
	(0.11585)	(0.12862)	(0.26389)*	(0.17255)
b_1	0.98637	0.98267	0.96971	0.96338
	(0.01910)*	(0.017395)*	(0.02174)*	(0.02479)*
	Thailand			
	Before FL	**After FL**		
a_1	-0.032135	0.030731		
	(0.21442)	(0.12879)		
a_2	0.10251	0.054236		
	(0.21165)	(0.12892)		
b_1	0.98876	0.98794		
	(0.01913)*	(0.01680)*		

7.4. CONCLUSION.

This chapter concentrated on the behavior of the volatility of the emerging markets. This issue has attracted a lot of attention recently, and is of paramaount interest not only for the international institutional investors and fund managers, but also for macroeconomic policy-makers, governments and international banks that hold emerging market debts.

Capital markets are vital for the efficient operation of modern, competative economies, since it is through the capital markets that scarce resources will be allocated in an economy. Thus, a volatility spill-over from a foreign market into a domestic market may destabilize domestic economic planning and fiscal and monetary policies. The problem is particularly acute for emerging economies which are in the early stages of development and often have limited resources; efficient allocation of capital is important.

Here, we model volatility with Exponential GARCH and examine some important questions that relate to emerging market volatility. The first question is whether there are volatility spill-over effects from the two developed markets of the USA and Japan toward the emerging markets; the second whether there are such effects within the emerging markets.

Engle et.al. dubbed this phenomenon as a meteor shower because of its similarity to the pattern of meteor showers as the globe turns (Engle, et.al. (1990), p227): "Using meteorological analogies, we suppose that news follows a process like a heat wave so that a hot day in New York is likely to be followed by another hot day in New York but not typically by a hot day in Tokyo. The alternative analogy is a meteor shower which rains down on earth as it turns. A meteor shower in New York will almost surely be followed by one in Tokyo." The heat wave hypothesis is that the volatility has only country specific autocorelation. It is consistent with the view that the main factors that affect the prices are changes in country specific fundamentals. The meteor shower hypothesis is that of volatility spill-overs from one market to the other.

Volatility spill overs, as Ito et.al.(1992) note, may represent a failure of the market to fully process its information and may signal a violation of market efficiency since it is unlikely that the sources of volatility are so geographically mobile. Alternatively, they can be interpreted as evidence of potential international policy coordination, that implies cross country news autocorrelation (Engle et.al (1990)). Earlier empirical evidence suggests that the meteor shower phenomenon exists for the currency markets.

A third question that we examine here is whether after the financial liberalisation of these markets stock market volatility has increased or decreased. The Keynsean argument held that FL will increase volatility in LDCs, while the Neoclassical argument predicts that financial market volatility will be reduced following FL.

The results suggest that there are volatility spill-over effects within the emerging markets; the markets most affected by the volatility of other markets are Brazil and Philippines. Brazil is affected by India, Thailand, Taiwan, the US and Japan. Philippines by Mexico, India, Taiwan, the US and Japan. The markets least affected are Chile (no spill-overs), Thailand, Japan (affected only by Taiwan) and Korea (affected by Japan). The market from which the most spill-overs are initiated is Taiwan. It affects Brazil, Mexico, Thailand, Philippines and Japan. Overall, even though meteor shower effects are present in the emerging markets there is not a pattern to suggest a dominant market from which volatility spills over to the other markets (with the exception, perhaps, of Taiwan which affects 5 out of 11 markets).

The results of the estimation of E-GARCH (1,1) models for the volatility of the emerging markets, for the periods before and after FL suggest that volatility has been reduced in the emerging markets for the period after Financial Liberalisation. Thus, the evidence seems to support the Neoclassical argument for the financial volatility.

CHAPTER VIII

CONCLUSION

During the last decade many of the countries that were previously known as Less Developed Countries grew at impressive rates, achieved a high level of industrialisation, and in effect became centres of international financial activity in their own right. The gap between these countries and the rich industrialised countries started to narrow and now the World Bank now predicts that six of the ten biggest economies in 2020 will be today's' emerging markets. To illustrate further the dynamics of these economies, note that they cover approximately 77% of the world's land area and have nearly 85% of the world's population.

Historically, as the discussion in Chapter 2 has shown, these markets have followed common trends in the handling of their economies, even though they exhibit different characteristics. The reforms that took place at approximately the same time (end of the 1970s beginning of 1980s) soon paid their dividends, mostly for the Asian countries which avoided many of the policy mistakes of the Latin America countries during the two oil crises As a result, many of these markets attracted the attention of global banks, international investors, multinational corporations, business organisations, money and fund managers. The belief among the financial community is that the emerging markets offer high average returns, low correlation with developed markets, predictable returns, high volatility, and significant investment opportunities. For example, the western emerging market equity funds that invest in emerging markets grew from 94 (and US$ 5,977 million) in 1988, to 557 (and US$ 72,778 million) in 1993. The effect of this foreign indirect investment on the emerging equity markets was substantial: equity markets like Thailand had a market capitalisation of US$ 1,206 million in 1982; by 1992 market capitalisation had increased to US$ 58,259 million, a change of 4,731%.

However, given the emerging markets' growing economic significance in the global economy and their increasingly important role in the international financial markets and the stability of the system, relatively little empirical research has taken place concerning these financial markets; many issues concerning the functioning and the efficiency of these markets have remained unreshearced. The vast majority of academic research in financial economics is concerned with the industrialized markets.

The aim of this thesis is to investigate some of the issues relating to the *Functioning and the Efficiency of the Emerging Markets.* This thesis contributes to the existing literature in many ways, since most of the theoretical issues that are addressed here are examined for the first time for the emerging markets (to the best of my knowledge).

More specifically, the issue of the *integration of the emerging equity markets* and the possibility of common long-run trends and the implications for *international portfolio diversification* has been examined mainly for industrialized markets. Very few studies have previously addressed this issue, for a small sample of emerging markets. Furthermore, it is the first study that examines the relationship between the cointegration structure of equity prices in the emerging markets with the cointegration structure of their dividend payments, as an explanation of the behaviour of the prices, following Kasa (1994), who investigated this issue in a sample of developed markets.

The integration of the equity markets has important implications for international portfolio diversification, for *if markets share a common trend and investors have long horizons, calculations based on simple cross-country correlations may be misleading* (since short-term correlations will ignore the long run-trend). Our results suggest that there exists a single cointegrating relationship among the 4 Latin American equity markets. The situation is similar (one long-run relationship) among the 6 Asian equity markets. In addition, the cointegration structure of the emerging market dividend payments, unlike in previous studies, does not mirror that of the prices, thus suggesting that the international present value model of asset pricing may not valid in the emerging markets of the sample. The evidence of cointegration suggests limited gains for international portfolio diversification. However, and here lies another innovation of this study, further tests that examine more closely the nature of the cointegration reveal that for the Latin American markets the relationship is most significant for Chile and Mexico, and that for the Asian markets the relationship is most significant for South Korea and Taiwan. The rest of the markets do not belong in the common equity region. This seems to indicate that not all markets belong in that common equity region or adjust to equilibrium, thus suggesting that a carefully diversified portfolio, in the emerging markets of the sample, will be beneficial.

Another issue that is examined for the first time in the emerging markets (to the best of my knowledge) is that of the behavior of the volatility, or the *volatility spill-overs.* Empirical research on volatility spill-overs exists mainly for the currency markets and the developed equity markets. Equity market volatility is important not only for financial practitioners but also for emerging market governments, macroeconomic policy makers, etc. The question of whether volatility is contained in one market location, or it can spill-over to other markets is also very important for the *stability of fiscal and monetary policies.* For example, in December 1994, the Mexican government of Ernesto Zedillo decided to devalue the Mexican peso; a move that resulted in the collapse of Mexico's bond markets and in a world-wide financial market crisis: during the next fourteen days after the "peso-crisis" the stock market in Argentina fell by 11%, in dollar terms, and the stock market in Brazil by 17%. Argentina's Brady Bonds fell by 17% and Brazil's Brady Bonds by 9%. In Asia, during the first weeks of January 1995 equity and bond markets in Hong-Kong, Thailand, Singapore and the rest of Asia, Asia-Pacific region fell sharply and many governments had to defend their currencies.

Here we ask three questions: whether there are volatility spill-over effects from two developed markets (USA and Japan) to the emerging markets, whether we have volatility spill-over effects within the emerging markets, and whether Financial Liberalization increased or decreased the equity market volatility in the emerging markets. The results of the tests suggest that *there is a meteor shower phenomenon* within the emerging equity markets, however, we are not able to detect a pattern of spill-overs from some dominant markets to the rest, with the exception perhaps of Taiwan. On the financial liberalization issue the results suggest that volatility was reduced after financial liberalization, therefore, support is found for the Neoclassical argument.

A third important issue that is examined for the first time in the emerging markets is that of whether the long-run trends among the markets are systematic, *undiversifiable, sources of risk* that are priced in an Asset Pricing Model. This is done by defining these trends as the cointegrating vectors from a Johansen system of equations and then using them as a factor in an international multifactor model. The econometric framework is that of a multivariate regression model such as the Seemingly Unrelated Regressions (SURs). This framework was developed recently (late 1980s, early 1990s) and avoids many of the methodological problems inherent in earlier Asset Pricing tests. Further, this framework is utilized for the first time to study the return behavior in emerging markets. Also, the sources of risks in the emerging equity markets are examined within the same framework. A Keynsean model of national income determination is employed to help us identify the macroeconomic shocks that might affect the return generation process in the emerging markets. Preliminary tests, stressed the importance of domestic factors over international factors, suggesting segmentation rather than integration of the markets.

Further, the long-run trends are reported to be significant in a regression model of returns adjusted for domestic risks on international factors. A multifactor asset pricing model, similar to the International version of the APT, suggests that even though factors such as the returns on a world portfolio, global interest rates, global inflation and the cointegrating vector, play a role in the determination of the security returns in the emerging markets, only the risk from global interest rates is priced. This suggests, once again, that the markets operate inefficiently.

Finally, the Efficiency of the emerging equity markets is also examined by testing whether the equity prices in the emerging markets follow a Random Walk process with a test that that is based on the variance of the series and avoids many of the methodological problems of the procedures used in the past. In addition, tests for seasonal effects such as the well known January and Monday effects are employed. The results reject the null hypothesis of a Random Walk, *a violation of the weak form of the Efficient Market Hypothesis*. In addition, mean daily returns in the emerging markets exhibit a strong seasonal pattern which manifestates in a different from all other weekdays and negative Monday return, (90% of the sample). Also, other earlier empirical findings, such as the positive returns of the last three weekdays (Wednesday, Thursday, and Friday) were found to be the case for the emerging markets as well. This evidence contradicts both the *calendar time hypothesis* and the *trading time hypothesis,* and suggests inefficiency and predictable patterns in daily returns. The first theory predicts Monday returns higher the rest of the weekdays, and the second theory predicts equal returns for all weekdays.

For the monthly data the results indicate the existence of a January effect in the mean returns of *only* Chile and India. To interpret this result I argue that it could be the case that the markets are efficient relative to that anomaly, a fact predicted by Finance theory. Recall that in this study I use fresh data, that have not been used in other studies (to the best of my knowledge); the IFC indices.

Another contribution of this study is that it employs a large sample of emerging markets; and furthermore, markets from two different geographical regions are examined and compared. The entire *population* of the emerging markets to which this thesis is refereed is markets with low or middle per capita GNP, with low or middle levels of industrialization (as compared to the industrialized countries such as US, UK, Germany, etc.) and relatively free financial markets, i.e. markets that do not impose major restrictions to the flow of funds. By 1994 there were 25 such markets: Hong-Kong, Mexico, Korea, Taiwan, Malaysia, India, Thailand, Singapore, Brazil, Chile, Argentina, Philippines, Indonesia, Turkey, Greece, Portugal, Pakistan, Venezuela, Colombia, Jordan, Peru, Sri-Lanka and Bangladesh. The *sample* of the study consists of 10 countries from two different geographical regions: Latin America (Brazil, Argentina, Chile, Mexico) and Asia, Asia-Pacific (India, Thailand, Malaysia, South Korea, Philippines, Taiwan) In other words the sample is nearly 40% of the population

To summarize, the main results of this study suggest that the emerging equity markets can not be described by a weak-form efficient markets model, and exhibit seasonal patterns, such as the Monday-effect These results are not surprising given that most of these equity markets are in the early stages of development, in contrast to the mature developed western markets, and exhibit characteristics such as infrequent or/and thin trading, etc. Also, prices in these markets react more significantly to domestic shocks rather than international, suggesting that the emerging markets are more segmented than the developed markets. Even though the markets are reported to be driven by a common trend, not all markets react significantly to this trend, indicating that benefits to international portfolio diversification are possible, for investors with long horizons.

Research projects such as this, that is, research dealing with the emerging financial markets, are often limited by one important factor: availability of reliable data. For very few emerging markets there exists (at least at the time of writing of this thesis) reliable time-series or cross-section data that cover a long period of time. This is even more the case for high frequency data (daily, etc.). That is the main reason why professionals in the financial community rely mainly on data compiled by three international organizations, when it comes to the emerging markets; Morgan Stanley Capital Group, Barings Securities, and the International Finance Corporation (IFC-World Bank).

As now more and more reliable databases became available, especially high frequency and cross-section databases, or derivative markets databases, it is essential that more research is undertaken regarding the emerging markets. I strongly believe that the examination of the behavior of these markets will enhance our understanding of Finance and offer new ways of dealing with many of the important questions.

BIBLIOGRAPHY.

Alexander, S., S., "Price Movements in Speculative Markets: Trends or Random Walks?", *Industrial Management Review*, 2, May 1961, 7-26.

Agrawal, R., Tandon, K., "Anomalies or Illusions? Evidence from Stock Markets in 18 Countries", *Journal of International Money and Finance*, 13, 1994, 83-106.

Alonso, A., Rubio, G., Tusell, F., "Asset Pricing and Risk Aversion in the Spanish Stock Market", *Journal of Banking and Finance*, 14, 1990, 351-369.

Antoniou, A., Garret, I., Prietsley, R., "Common Factors and the Empirical Validity of the APT", *Discussion Paper*, 95-03, 1995, Brunel University, Centre for Empirical Research in Finance, UK.

Antoniou, A., Holmes, P., "The Relationship Between Futures Trading and Spot Price Volatility", *Discussion Paper*, 92-02, 1992, Brunel University, Centre for Empirical Research in Finance, UK.

Antoniou, A., Foster, A., "Futures Trading and Spot Market Volatility: Evidence for Brent Crude Oil using garch", *Discussion Paper*, 91-02, 1991, Brunel University, Centre for Empirical Research in Finance, UK.

Ariel, R. A., "A Monthly Effect in Stock Returns", *Journal of Financial Economics*, 18, 1987, 161-174.

Ariel, R. A., "High Stock Returns Before Holidays: Existence and Evidence on Possible Causes", *Journal of Finance*, 45, 1990, 1611-1625.

Arshanapalli, B., Ducas, J., "Common Stochastic Trends in a System of Eurocurrency Rates", *Journal of Banking and Finance*, 18, 1994, 1047-1061.

Attanasio, O. P., "Risk, Time Varying Second Moments and Market efficiency", *Review of Economic Studies*, 58, 1991, 479-494.

Ayadi, F., Pyun, C., "An application of the variance ratio test to the Korean securities market", *Journal of Banking and Finance*, 18, 1994, 643-658.

Baile, R., Bollerslev, A., "A Multivariate Generalized ARCH Approach to Modelling Risk Premia in Forward Foreign Exchange Rate Markets", *Journal of International Money and Finance*, 9, 1990, 309-324.

Ball, B., Brown, P., "An Empirical Evaluation of Accounting income Numbers", *Journal of Accounting Research*, 6, 1968, 159-178.

Banz, R. W., "The Relationships Between Return and Market Value of Common Stocks", *Journal of Financial Economics*, 7, 1981, 3-18.

Barnes, P., "Thin trading and stock market efficiency: The case of the Kuala Lambour stock exchange", *Journal of Business Finance and Accounting* 13, 1986, 609-616.

Basu, S., "Investment Performance of Common Stocks in Relation to their P/E ratios:A test of EMH", *Journal of Finance*, 32, 1977, 663-681.

Bekaert, G., Harvey, C. R., "Emerging Equity Market Volatility", *Journal of Financial Economics*, 43, 1997, 29-77.

Black, F., "Capital Market Equilibrium with Restricted Borrowing", *Journal of Business*, 45, 1972, 444-455.

Black, F., Jensen, M. C., Scholes, M., "The CAPM: Some Empirical Tests", in Jensen, ed., *Studies in the Theory of Capital Markets*. Praeger, NY, 1972, 79-124.

Bollerlev, T., Chou, R. Y., Kroner, K. F., "ARCH Modeling in Finance", *Journal of Econometrics*, 52, 1992, 5-59.

Bollerslev, T., "Generalized Autoregressive Conditional Heteroscedasticity", *Journal of Econometrices*, 31, 1986, 307-327.

Bossard, A., "Consumption and the capital market", *Economic and Financial Perspects*, 1, 1990, 1-4.

Branch, B., "A Tax Loss Trading Rule", *Journal of Business*, 50, 1977, 198-207.

Brealy, R. A., Myers, S. C., "Principles of Corporate Finance", *New York McGrow-Hill*, 3rd edition, 1988.

Breeden, D. T., "An intertemporal asset pricing model with stochastic consumption and investment opportunities", *Journal of Financial Economics*, 7, 1979, 265-296.

Breeden, D. T., Litzenberg, R. H., "Prices of State-Contigent Claims Implicit in Option Prices", *Journal of Business*, 51, 1978.

Breeden, D. T., Gibbons, M. R., Litzenberger, R. H., "Empirical Tests of the Consumption-Oriented CAPM", *Journal of Finance*, 44, 1989, 231-263.

Brennan, M. J., "Taxes, Market Valuation and Corporation Financial Policy", *National Tax Journal*, 1970, 417-427.

Brown, S. J., Weinstein, M. I., "A New Approach to Testing APT: The Bilinear Paradigm", Journal of Finance, 38, 1983, 711-743.

Buckberg, E., "Emerging Stock Markets and International asset Pricing", *World Bank Economic Review*, 9, 1995, 51-74.

Cadsby, B. C., "The CAPM and the Calendar: Empirical Anomalies and the Risk-Return Relationship", *Management Science*, 38, 1992, 1543-1560.

Cadsby, C. B., Ratner, M., "Turn-of-Month and Pre-Holiday Effects on Stock Returns: Some International Evidence", *Journal of Banking and Finance*, 16, 1992, 497-509.

Campell, J. Y., Shiller, R., "The Dividend-Price Ratio and Expectations about Future Dividends and Discount Factors", *Review of Financial Studies*, 1, 1988a, 195-228.

Campell, J. Y., "Stock Returns and the Term Structure", *Journal of Financial Economics*, 18, 373-399.

Campell, J. Y., "A Variance Decomposition for Stock Returns", *The Economic Journal*, 101, 1991,157-179.

Campell, J. Y., Mankiw, N., "Are Output Flctuations Stationary?", *Quarterly Journal of Economics*, 102, 1987, 858-879.

Ceccheti, S. G., Mark, N. C., "Evaluating Empirical Tests of Asset Pricing Models: Alternative Interpretations", *American Economic Review*, 80, 1991, 48-51.

Chan, K. C., "Can Tax Loss Selling Explain the January Seasonal in Stock Returns ?", *Journal of Finance*, 41, 1986, 1115-1128.

Chan, E. C., Pinegar, M. J., Ravichandren, R., "International Evidence of the Day-of-the-Week Effect", *Journal of Financial and Quantitive Analysis*, 28, 1993, 497-513.

Chaudhuri, K., "Stock Returns in Emerging Markets: A Common Trend Analysis", Applied Economics Letters, 4, 1997, 105-108.

Choudhry, T., "Stock Market Volatility and the Crash of 1987: Evidence from six emerging markets", *Journal of International Money and Finance*, 15, 1996, 969-981.

Charemza, W., Deadman, D., "Econometric Practice", *Edward Elgar Publishing Limited*, UK, 1992.

Chen, N. F., "Some Empirical Tests of the Theory of Arbitrage Pricing", *Journal of Finance*, 38, 1983, 1393-1414.

Chen, N. F., Roll, R., Ross, S., "Economic forces and the Stock Market", *Journal of Business*, 56, 1986, 383-403.

Cho, D. C., Elton, E. J., Cruber, M. I., "On the Robustness of the Roll and Ross APT Methodology", Journal of Financial and Quantitative Analysis, 19, 1984, 1-10.

Chowdury, K., "A Structural Analysis of External Debt and Economic Growth-Some Evidence from Selected Countries in Asia and the Pacific", *Applied Economics*, 26, 1994, 1121-1131.

Chung, P. J., Liu, D. J., "Common Stochastic Trends in the Pacific Rim Stock Markets", *Quarterly Review of Economics and Finance*, 34, 1994, 241-259.

Claessens, S., Dasgupta, S., Glen, J., "Return Behavior in the Emerging Stock Markets", *World Bank Economic Review*, 9, 1995, 131-151.

Clare, A., O'Brien, R., Smith, P., Thomas, S., "A Note on: Global Macroeconomic Shocks, Time-Varying Covariances and Tests of the CAPM", *Discussion paper* 93-06, Brunel University, Centre for Empirical Research in Finance, UK, 1994.

Clare, A., Psaradakis, Z., Thomas, S., "An Analysis of Seasonality in the UK Equity Market", *Discussion Paper*, 93/367, University of Bristol, UK, 1993.

Cochrane, J., "How Big is the Random walk in GNP?", *Journal of Political Economy*, 96, 1988, 893-919.

Cochrane, J., "Volatility Tests and Efficient Markets", *Journal of Monetary Economics 27*, 1991, 463-485.

Condoyianni, L., O'Hanlon, J, Ward, W., "Day-of-the-Week Effects in Stock Returns: International Evidence", *Journal of Business Finance and Accounting*, 14, 1987, 157-174.

Constandinides, G., "Optimal stock trading with personal taxes", *Journal of Financial Economics* 13, 1984, 65-89.

Copeland, T. E., Weston, F. J., "Financial Theory and Corporate policy", *3rd edition, Addison Wesley*, 1988.

DeBont, W. F. M., Thaler, R. H., "Does the Stock Market Overreact ?", *Journal of Finance*, 40, 1985, 793-807.

Dhrymes, P., Friend, I., Gultekin, B., "A Critical Reexamination of the Empirical Evidence on the APT", *Journal of Finance*, 39,1984, 323-346.

Dickey, D. A., Fuller, W. A., "Likelihood Ratio Statistics for Autoregressive Time series with a Unit Root", *Econometrica*, 49, 1981, 1057-1072.

Diebold, F. X., Nerlove, M., "The Dynamics of Exchange Rate Volatility: A Multivariate Latent Factor ARCH Model", *Journal of Applied Econometrics*", 28, 1989, 315-332.

Dinenis, E., Staikouras, S., "Interest rate changes and common stock returns of Financial Institutions: Evidence from the UK", Paper presented at *BAA National Conference*, March 1996, Gardiff Business School, Gardiff.

Douglas, M., "Risk in the Equity Markets: an Empirical Approach of Market Efficiency", *Yale Economic Essays*, 1969.

Dowson, S., "The trend toward efficiency for less developed stock exchanges: Hong-Kong", *Journal of Business Finance and Acounting*, 11, 1984, 151-159.

Dyl, E., "Capital Gains, Taxation and Year-End Stock Market Behaviour", *Journal of Finance*, 12, 1977, 165-175.

Engle, R. F., "Statistical Models for Financial Volatility", *Financial Analusts Journal*, Jan 1993, 72-78.

Engle, R. F, Bollerslev, T., "Modelling the Persistence of Conditional Variances", *Economic Reviews*, 5, 1986, 1-50.

Engle, R. F., Granger, C. W. J., "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 1987, 251-276.

Engle, R. F, Ito, T., Lin, W-L., "Meteor Showers or Heat Waves? Heteroscedastic Intra-Daily Volatility in the Foreign Exchange Market", *Econometrica*, 58, 1990, 525-542.

Errunza, V., Losq, E., "International Asset Pricing Under Mild Segmentation: Theory and Test", *Journal of Finance*, 40, 1985, 105-122.

Fama, E. F., " The Behaviour of Stock market prices", *Journal of Business*, 38, 1965a, 34-105.

Fama, E. F., "Efficient Capital Markets: A Review of Theory and Empirical Work", *Journal of Finance*, 25, 1970b, 383-416.

Fama, E. F., "Efficient Capital Markets II", *Journal of Finance*, 48, 1993, 65-92.

Fama, E. F., MacBeth, J., "Risk, Return and equilibrium: Some empirical tests", *Journal of Political Economy*, 81, 1973, 607-635.

Fama, E. F., French, K. R., "Size and Book-to-Market Factors in Earnings and Returns", *Journal of Finance*, 50, 1995, 131-155..

Fama, E. F., French, K. R., "Common risk factors in the returns on stocks and bonds", *Journal of Financial Economics*, 33, 1993, 3-56.

Fama, E. F., French, K. R., "The Cross-section of Expected Stock Returns", *Journal of Finance*, 47, 1992, 428-470.

Fama, E. F., French, K. R., "Permanent and Temporary Components of Stock prices", *Journal of Political Economy*, 96, 1988a, 246-273.

Fama, E. F., Fisher, L., Jensen, M., Roll, R, "the adjustment of Stock Prices to new Information", International Economic Review, X, 1969, 1-21.

Fama, E. F., Blume, M., "Filter Rules and Stock Market trading Profits", *Journal of Business*, 39, 1966, 226-241.

Fase, M. M. G., "The Interaction Between Trading Volume of Stocks and Options- Some Statistical Evidence", *Journal of International Money and Finance*, 13, 1994, 587-601.

Ferson, W., Harvey, C., "Sources of risk and expected returns in global equity markets", *Journal of Banking and Finance*, 18, 1994, 775-803.

Ferson, W., Harvey, C., "The risk and predictability of International Equity returns", *The Review of Financial Studies*, 6, 1993, .

Finnerty, J. E., "Insiders and Market efficiency", *Journal of Finance*, 31, 1976, 1141-1148.

Fletcher J: " The mean-variance efficiency of benchmark portfolios: UK evidence", *The Journal of Banking and Finance 18*, 1994, p673-685.

Fraser, P., Power, D. M., "Conditional Heteroscedasticity in the Equity Returns from the Emerging Markets", Advances in Pacific Basin Financial Markets, 2B, 1996, 331-347.

French, K. R., "Stock Returns and the Weekend Effect", *Journal of Financial Economics*, 8, 1980, 55-69.

Gallant, R. A., "Nonlinear Statistical Models", NY: John Willey, 1987.

Gallant, R. A., Holly, A., "Statistical Inference in an Implicit, Nonlinear, Simultaneous Equations Model in the Context of Maximum Likelihood Estimation", *Econemetrica*, 48, 1980, 697-720.

Gallant, R. A., Jorgensen, D. W., "Statistical Inference for a System of Simultaneous, Nonlinear, Implicit Equations", *Journal of Econometrics*, 11, 1979, 275-302.

Gallinger, G. W., "Causality tests of the real stock return real activity hypothesis", *Journal of Financial Research*, 17, 1994, 271-288.

Gibbons, M. R., "Multivariate Tests of Financial Models: A New Approach", *Journal of Financial Economics* 10, 1982, 3-27.

Gibbons, M., Hess, P., "Day of the Week Effects and Asset Returns", *Journal of Business*, 54, 1981, 579-596.

Grabel, I., "Assesing the Impact of Financial Liberalization on Stock Market Volatility in Selected Developing Markets", *Journal of Development Studies*, 31, 1995, 903-817.

Granger, C. W. J., "Investigating Casual Relationships by Econometric Models and Cross Spectral Methods", Econometrica, 37, 1996, 425-435.

Gross, F., "The Behaviour of Stock Prices on Fridays and Mondays", *Financial Analysts Journal*, 29, 1973, 67-69.

Gultekin, M., Gultekin, N. B., "Stock Market Seasonality: International Evidence", *Journal of Financial Economics*, 12, 1983, 469-481.

Gultekin, M., Gultekin, B., "Stock Return Anomalies and Tests of the APT", *The Journal of Finance*, 42, 1987, 1213-1225.

Harvey, C. R., "Predictable Risk and Returns in the Emerging Markets", *Review of Financial Studies*, 8, 1995, 773-816.

Hawawini, G., " Equity Price Behavior: Some Evidence from Markets Around the World", *Journal of Banking and Finance*, 18, 1994, 603-620.

Hawawini, G., Keim, D., "On the Predictability of Common Stock Returns: World-Wide Evidence", *Finance, Handbook Series*, 1992.

Haugen, R, Lakonishok, J., "The Incredible January Effect", *Homewood, IL: Dow Jones-Irwin*, Illinois 1987.

He K, Ng L: "Economic Forces, Fundamental Variables, and equity returns", *The Journal of Business*, vol.67, No.4, 1994.

Hogan, K. C. Jr., Melvin, M. T., "Sources of Meteor Showers and Heat Waves in the Foreign Exchange Market", *Journal of International Economics*, 37, 1994, 239-247.

Ho, Y. K., Cheung, Y. L., Draper, P., Pope, P., "Return Volatilities and Trading Activities on an Emerging Market", *Economic Letters*, 39, 1992, 91-94.

Hong, H., Kaplan, R., S., Mandelker, G., "Pooling vs. Purchase: the Effects of Accounting for Mergers and Stock Prices", *Accounting Review*, 1978, 31-47.

Herrera, M., Lockwood, L., "The size effect in the Mexican stock market", *Journal of Banking and Finance*, 18, 1994, 621-631.

Hung, B. W-S., Cheung, Y-L., "Interdependence of Asian Equity Markets", Journal of Business Finance and Accounting, 22, 1995, 281-287.

Jaffe, F., J., "Special Information and Insider trading", *Journal of Business*, 47, 410-428.

Jaffe, J., Wersterfield, R., "The Weekend Effect in Common Stock Returns: the International Evidence", *Journal of Finance*, 40, 1985, 433-454.

Jensen, M. C., "The Performance of Mutual Funds in the period 1945-1964", *Journal of Finance*, 23, 1968, 389-416.

Jensen, M. C., "Capital Markets: Theory and Evidence", *Bell Journal of Economic and Management Studies*, 1972.

Johansen, S., "Statistical Analysis of Cointegrating Vectors", *Journal of Dynamics and Control*, 12, 1988, 231-254.

Johansen, S., Juselius, K., "Maximum Likelihood Estimation and Inference on Cointegration-with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52, 1990, 169-210.

Jorion, P., Schwartz, E., "Integration vs Segmentation in the Canadian Stock Market", *Journal of Finance*, 42, 1986, 603-614.

Ito, T., Engle, R. F, Lin, W-L., "Where Does the Meteor Shower Come From?", *Journal of International Economics*, 32, 1992, 221-240.

Kasa, K., "Common Stohastic Trends in International Stock Markets", *Journal of Monetary Economics*, 29, 1992, 95-124.

Keim, D. B., "Size-related Anomalies and Stock Return Seasonality", *Journal of Financial Economics*, 12, 1983, 13-32.

Kendall, M., G., "The Analysis of Economic Time-Series, part I: Prices", *Journal of the Royal Statistical Society*, 96, 1953, 11-25.

Koch, P. D., Koch, T. W., "Evolution in Dynamic Linkages Across Daily National Stock Indexes", *Journal of International Money and Finance*, 10, 1991, 231-251.

Korajczyk, R. A., "A Measure of the Stock-Market Integration for the Developed and emerging Markets", *World Bank Economic Review*, 10, 1996, 267-289.

Lakonishok, J., Smidt, S., "Are Seasonal Anomalies Real? A Ninety Years Perspective", *Review of Financial Studies*, 1, 1988, 433-455.

Lakonishok, J., Levi M: "Weekend Effects on Stock Returns", *Journal of Finance*, 37, 1982, 883-889.

Lam, K., Mok, H., Cheung, I., Yam, H., "Family Groupings on Performance of Portfolio Selection in the Hong-Kong Stock Market", *Journal of Banking and Finance*, 18, 1994, 725-742.

Lamoureux, C. G., Lastrapes, W. D., "Heteroscedasticity in Stock Return Data: Volume vs Garch Effects", *The Journal of Finance*, 45, 1990, 221-229.

Lau, S., Diltz, D., Apilado, V., "Valuation effects of international stock exchange listings", *Journal of Banking and Finance*, 18, 1994, 743-755.

Lee, I., Richardson Pettit, R., Swankoski, M. V., "Daily Return Relationships Among asian Stock Markets", Journal of Business Finance and Acounting, 17, 1990, 265-284.

LeRoy, S. F., Porter, R. D., "The Present Value Relation: Tests based on Implied Variance Bounds", *Econometrica*, 49, 1981, 555-574.

Lo, A. W., MacKinlay, C. A., "The size and power of the variance ratio test in finite samples", *Journal of Econometrics*, 40, 1989, 203-238.

Linter, J., "The valuation of Risky Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets", *Review of Economics and Statistics*, 47, 1965, 13-37.

Linter, J., "The Aggregation of Investor's Diverse Judgments and Preferences in Purely Competitive Security Markets", *Journal of Financial and Quantitative Analysis*, 1969, 347-400.

Mains, N. E., "Risk, the Pricing of Capital assets, and the Evaluation of Investment Portfolios: A Comment", *Journal of Business*, 50, 1977, 371-384.

Mandelbort, B., "The Variation of Certain Speculative prices", Journal of Business, 36, 1963, 394-419.

Marsh, T. A., Merton R. C., "Dividend Variability and Variance Bounds tests for the Rationality of Stock Market Prices", *American Economic Review*, 76, 1986, 1429-1445.

Malliaris, A., Urruttia, J., "The international crash of October 1987-Causality tests", *Journal of Financial and Quantitive analysis*, 27, 1992, 353-364.

Mankiw, G. N., Romer, D., Shapiro, M. D., "An Unbiased Reexamination of Stock Market Volatility", *Journal of Finance*, 40, 1985, 677-689.

Mankiw, G. N., Shapiro, M. D., "Risk and return:consumption beta vs market beta", *Review of Economics and Statistics*, 47, 1986, 452-459.

Mayers, D., "Non-Marketable Assets and the Capital Market Equilibrium under Uncertainty", in Jensen, ed., *Studies in the Theory of Capital Markets*. Praeger, NY, 1972, 223-248.

Merton, R., "An Intertemporal Capital Asset Pricing Model", *Econometrica*, 41, 1973, 867-888.

Miller, M., Scholes, M., "Rates of rteurn in relation to Risk: A Reexamination of Some recent Findings", in Jensen, ed., *Studies in the Theory of Capital Markets.* Praeger, NY, 1972, 47-78.

McElroy, M. B, Burmeister, E., "APT as a Restricted Nonlinear Multivariate Regression Model", *Journal of Business & Economic Statistics*, 6, 1988, 29-42.

McKinnon, P., "Money and Capital in Economic Development", Washington DC: Brookings Institution, 1973.

Newton da Costa, Jr., "Overeaction in the Brazilian stock exchange", *Journal of Banking and Finance*, 18, 1994, 633-642.

Nelson, D. B., "Conditional Heteroscedasticity in Asset Returns: A New Approach", *Econometrica*, 59, 1990c, 347-370.

Officer, R. R., "Seasonality in Australian Capital Markets: Market Efficiency and Empirical Issues", *Journal of Financial Economics*, 2, 1975, 29-51.

Ostermark, R., "Empirical Evidence on the CAPM in Two Scandinavian Stock Exchanges", *Omega International Journal of Management Science*, 19, 1991, 223-234.

Pantula, S. G., "Moddeling the Persistence of Contitional Variances: A Comment", *Econometric Reviews*, 5, 1986, 71-74.

Poterba, J. M., Summers, L. H., "Mean Reversion in Stock Prices: evidence and Implications", *Journal of Financial Economics*, 22, 1988.

Reinganum, M., "A New Empirical Perspective on the CAPM", *Journal of Financial and Quantitive Analysis*, 16, 1981, 439-460.

Reinganumn, M., "Mispecification of the CAPM", *Journal of Financial Economics*, 9, 1981, 19-46.

Reinganumn, M., "The Anomalious Stock Market Behavior of Small Firms in January", *Journal of Financial Economics*, 12, 1983, 89-104.

Richards, A. J., "Volatility and Predictability in National Stock Markets - How do Emerging Markets and Mature Markets Differ?", *International Monetary Fund Staff Papers*, 43, 1996, 461-501.

Ritter, J. R., Chopra, N., "Portfolio Rebalanching and the Turn of the Year Effect", *Journal of Finance*, 44, 1989, 149-166.

Roberts, H., V., "Stock Market 'Patterns' and Financial Analysis: Methodological Suggestions", *Journal of Finance*, 14, 1959, 1-10.

Roll, R., Ross, S. A., "An Empirical Investigtion of the APT", *Journal of Finance*, 35, 1980, 1073-1103.

Roll, R., Ross, S. A., "A critical Reexamination of the Empirical Evidence on the APT: A Reply", *The Journal of Finance*, 39, 1984, 347-350.

Roll, R., "A Critique of the Asset Pricing Theory's Tests", *Journal of Financial Economics*, 4, 1977, 129-176.

Roll, R., "Ambiguity When Performance is Measured by the Securities Market Line", *Journal of Finance* 4, 1978, 1051-1069.

Roll, R., "Performance Evaluation and Bencmark Errors I", *Journal of Portfolio Management*, Winter 1980, 5-14.

Roll, R., "Vas ist Das ? The Turn-of-the-Year Effect and the Return Premia of Small Firms", *The Journal of Portfolio Management*, 9, 1983, 18-28.

Ross, S. A., "The Arbitrage Theory of Capital Asset Pricing", *Journal of Economic Theory*, 13, 1976, 341-360.

Rogalski, R. J., "New Findings Regarding the Day-of-the-Week Returns Over Trading and Non-trading Periods: A Note", *Journal of Finance*, 39, 1984, 1603-1614.

Rogalski, R. J., Tinic, S. M., "The January Effect: Anomaly or Risk Mismeasurement?", Financial Analysts Journal, Nov-Dec 1986, 63-70.

Rozeff, M. S., KinneyW. R., "Capital Market Seasonality: The Case of Stock Returns", *Journal of Financial Economics* 3, 1976, 379-402.

Rubinstein, M., "The Valuation of Uncertain Income Streams and the Pricing of Options", *Bell Journal of Economics and Management Science*, 7, 1976, 407-425.

Rubio, G., "Further International Evidence on the Asset Pricing", *Journal of Banking and Finance*, 12, 1988, 221-242.

Sauer, A., Murphy, A., "An empirical comparison of alternative models of capital asset pricing in Germany", *Journal of Business Finance*, 16, 1992, 183-196..
Scott, L., "Financial Market Volatility", *IMF Staff Papers*, 38, 1991, 582-617.

Shanken, J., "Multivariate tests of the Multi-beta CAPM", *Journal of Financial Economics*, 14, 1985b, 327-348.

Shanken, J., "The APT: Is it testable?", *The Journal of Finance*, 37, 1982, 1129-1140.

Shanken, J.,"Multi-Beta CAPM or Equilibrium APT?: A Reply", *Journal of Finance*, 40, 1985, 1189-1196.

Shapiro, A., "Multinational Financial Management", *2nd edition, Alley and Bacon* 1992.

Sharpe, W. F., "Capital asset Prices: A Theory of Market Equilibrium Under Conditions of Risk", *Journal of Finance*, 19, 1963, 425-442.

Shiller, R. J., "The Volatility Debate", *American Journal of Agricultural Economics*, 7, 1988, 1057-1063.

Shiller, R. J., "Speculative Prices and Popular Models", *Journal of Economic Perspectives*, 4, 1990, 55-65.

Shiller, R. J., "Do Stock Market Prices Move Too Much to be Justified by Subsequent Changes in Dividends?", *The American Economic Review*, 71, 1981, 421-436.

Solnik, B., "International Investments", *2nd edition, Allison Wesley*, 1991.

Solnik, B., "Why Not Diversify Internationally Rather than Domestically?", *Financial Analysts Journal*, July 1974, 48-54.

Spiegel, M., "Theory and Problems of statistics", *2nd edition, McGraw Hill Inc.*, 1989.

Stonehill, E., "Multinational Business Finance 2", *5th edition, Addison Wesley*, 1989.

Stewart, J., "Econometrics", *Philip Allan* UK, 1991.

Taylor, S. J., "Modelling Financial Time Series", NY, Willey, 1986.

Taylor, M. P., Tonks, I., "The Internalisation of Stock Markets and the Abolition of the UK Exchange Control", *The Review of Economics and Statistics*, 1989, 332-336.

Thaler, R., "Anomalies", *Economic Perspectives*, 1, 1987, 169-177.

Treynor, J. L., "How to Rate Mutual Fund Performance", *Harvard Business Review*, 1965, 63-75.

West, K. D., "Bubbles, Fads and Stock Price Volatility Tests: A Partial Evaluation", *Journal of Finance*, 43, 1988, 639-660.

Young, K. G., Chung, K. H., Pyun, C. S., "Size, Price-Earnings Ratio, and Seasonal anomalies in the Korean Stock Market", Pacific-Basin Capital Markets Research, 3, 1992, 303-319.