COINTEGRATION, CAUSALITY AND INTERNATIONAL PORTFOLIO DIVERSIFICATION: INVESTIGATING POTENTIAL BENEFITS TO A SOUTH AFRICAN INVESTOR

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By

NKULULEKO LWAZI MSIMANGA

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DECLARATION

The work contained in this thesis is original, except as acknowledge in the customary manner, and has not been submitted previously for a degree at any University. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made.

Nkululeko Lwazi Msimanga
Grahamstown
December 2010

ABSTRACT

Research studies on portfolio diversification have tended to focus on developed markets and paid less attention to emerging markets. Traditionally, correlation analysis has been used to determine potential benefits from diversification but current studies have shifted focus from correlation analysis to exploring cointegration analysis and other forms of tests such as the Vector Error Correction Methodology.

The research seeks to find if it is beneficial for a South African investor to diversify their portfolio of emerging market equities over a long-term period. Daily weighted share indices for the period of January 1996 to November 2008 were collected and analysed through the application of the Johansen cointegration technique and Vector Error Correction Methodology. Granger Causality tests were also performed to established whether one variable can be useful in forecasting another variable.

The study found that there was at least one statistically significant long-run relationship between the emerging markets. After testing for unit roots for all the share indices and their first difference using the Augmented Dickey–Fuller test (ADF), Philips-Perron and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests, similar conclusions were made. All the unit root tests and their levels could not be rejected for all the series. However, unit root tests on the first differences were rejected, meaning that all series are of order 1(1) - evidence of cointegration. Simply put, emerging markets tend not to drift apart over time. This suggests that emerging markets offer limited benefits to investors who are looking to add some risk to their portfolios.

In addition, the study also found evidence of both unidirectional and bidirectional causality (Granger-Cause tests) between markets. This implies that the conditions for a particular market are exogenous of the other market. The study

concludes that emerging markets are gradually adopting the same profile as developed markets.

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God bless you all.

DEDICATION

To Simphiwe Teboho Mahlangu

Effort only fully releases its reward after a person refuses to quit.

CHAPTER ONE
ORINTATION OF THE STUDY

1.1 Introduction

Considerable literature on finance has paid a lot of attention to the emerging equity markets [Harvey (1995) Bekaert & Harvey (1997) Bekaert & Harvey (2000)]. Earlier studies such as Levy & Sarnat (1970) and Agmon & Lessard (1977) focused on developed equity markets but emerging equity markets seem to be receiving more attention in later studies. Recent studies, including Constantinou, Kazandjian, Kouretas and Tahmazian (2005) add that there has been a growing interest among portfolio managers in the emerging capital markets as they provide opportunities for higher assert returns compared to developed markets. Correlations of returns in the emerging equity market with returns in the developed equity markets are low. As a result, participation in emerging equity markets may lead to a reduction in the existing portfolio risk. Cointegration analysis among emerging and developed markets also reveals some benefits from diversification to an investor.

This study attempts to examine the magnitude of the benefits from international diversification. The study uses the cointegration analysis in order to reveal whether or not there are benefits from emerging markets over a certain period of time. The analysis includes the testing of the emerging share-market indices.

1.2 Context of the research

Emerging equity markets may narrowly be characterised as having securities traded in a public market, having a reliable source of data and as being of interest to global institutional investors, (Divecha et al. 1992). In addition, these markets are seen as beginning to experience rapid economic growth and liberalisation [Hooker (2004) and Jayasuria (2005)].

Statistical evidence also suggests that the emerging markets are characterised by high rates of return coupled with extreme volatility levels. Low correlations between emerging equity markets and developed equity markets allow investors to spread the risk of their portfolios [Harvey (1995), Bekaert & Harvey (1997) Salman (1999) and Fuss (2002)]. Although such correlations have increased over the years, they are still sufficiently low to provide important portfolio diversification (Bekaert and Harvey, 2002)

Early studies on international diversification such as Grubel (1968), Levy & Sarnat (1970) and Lessard (1973) indicate that international investing is useful in reducing risk compared to holding a portfolio that is domestically diversified. For example, U.S. investors can substantially benefit from international diversification. Solnik (1974) adds that if the primary motivation in holding a portfolio of stocks is to reduce risk, then international diversification can lower the systematic risk in portfolio more than domestic diversification can. Later studies, including Black & Litterman (1991) observe that the efficient frontier is pushed out further when international investments are included in the opportunity set, increasing the opportunity for risk reduction beyond a home country-only portfolio. Odier & Solnik (1993) contribute by noting that regardless of the investors' nationality, investing in different markets offers benefits in terms of risk reduction and enhances returns. Also, Michaud et al. (1996) conclude that international diversification increases return per unit of risk relative to a comparable home country-only portfolio. More recently, studies such as Bekaert & Harvey (2000) and Hanna et al. (2001) have demonstrated the importance of diversification across emerging and developed equity markets and the benefits that come with such diversification. Li et al. (2003) conclude that an important issue in international economics concerns the size of the benefits from diversifying over securities in foreign countries, especially securities in emerging markets. They add that in theory, if foreign securities do not perfectly correlate with other country's securities, domestic investors gain from international diversification.

A vital question is over what period of time the available opportunities in emerging markets may benefit the investor. This question may be answered by addressing the issue of the stability of the correlations between the markets in a portfolio. A number of studies have addressed this issue; Longin & Solnik (1995), and Solnik (1996) have separately found that the correlation between emerging and developed markets appears to increase over time, although there are short term fluctuations. Further, Bekaert & Harvey (1997) demonstrate that the correlations between emerging and developed markets tend to fluctuate quite widely in the short term, but do not increase significantly with time. However, the correlations between emerging and developed markets do increase when world market volatility is high relative to the local market volatility.

Diversification across all markets reduces risk. Harvey (1995) concludes that the inclusion of emerging market assets in a Mean-Variance (MV) efficient portfolio will significantly reduce portfolio volatility and increase expected returns. However, these benefits from diversification may be enjoyed by investors over a short investment horizon.

Recent studies have focused on the use of Cointegration analysis to investigate the extent to which emerging stock markets (especially, the European emerging markets) are integrated with global markets, and the extent to which they are subject to global versus local shocks (see for example, Gelos and Sahay, 2000; Scheicher, 2001 and Gilmore and McManus 2002).

1.3 Statement of the problem

Emerging equity markets are receiving greater attention in academic literature. Recent studies show that these markets offer greater opportunities to the global investor [Bekaert & Harvey (1997), Bekaert et al. (1998) and Mateus (2002)]. However, data on them is limited. This is probably due to the fairly short histories available in standard databases. For instance, Bekaert and Harvey (2002) show that the International Finance Corporation's Emerging Markets Database (EMDB) provides data only starting from only 1976. Most research on emerging markets has relied on data dating from as recently as the early 1990s [see Bekaert et al. (1998), Bekaert and Harvey (2002)]. Because emerging equity markets are small and illiquid relative to developed markets, little is still known about them (Thomas, 2006). This study seeks to add value to the already existing literature on emerging markets and to provide information to the South African investor about opportunities which still remain largely unexplored.

1.4 Objectives of the research

The research seeks to find out if it is beneficial for a South African investor to diversify their portfolio of emerging market equities over a long term period considering the following crises:

(i) The Mexican crisis of 1994-1995,
(ii) The East Asian crisis of 1997-1998,
(iii) The Russian crisis of 1998,
(iv) The Brazilian crisis of 1998-1999 and more recently,
(v) The US credit crunch of 2007-2008.

1.5 Significance of the research

The benefits to the domestic investor from diversifying internationally have been documented widely [Meric and Meric (1989) Izan et al. (1991) Bekaert and Urias (1996)]. This research seeks to look at whether or not it is beneficial for South African investors to diversify their portfolios internationally (portfolio consisting of only emerging markets). The results of the research will provide more evidence on international diversification. This information can be used by South African investors wishing to diversify their equity portfolios internationally.

1.6 Research methods

Daily weighted share indices were collected from Thompson DataStream and analysed for the period of January 1996 through November 2008. All indices were denominated in dollars. The econometric methodology used to analyse the data included the Cointegration under the Johansen (1993) Approach. This approach provided a method to analyse the extent and the dynamics of long-run relationships. The daily returns were calculated by taking the first difference of the logarithms of two consecutive days. To calculate the percentage daily changes in the volume of transactions, the first difference of the logarithms of the two consecutive trading volumes were multiplied by 100. A correlation matrix among these share indices, making up the sample population, was computed and the variances and covariances were used in all subsequent computations. To examine the potential benefits that are available from diversification, cointegration analysis was preferred to correlation analysis. The results were then used to determine the benefits of diversification to a South African investor wishing to invest over a long term period.

1.7 Scope of the research

Segal (2003) suggests that emerging market investments should be on a longer-term basis than in the developed world and advises investors that countries with deep political and social divisions can experience a series of crises. For instance, the 1990s saw five major financial crises; the Mexican crisis of 1994-1995, caused by the devaluation of the peso in December 1994 put an abrupt end to capital inflows and precipitated a financial crisis, the East Asian crisis of 1997-1998 caused financial sector weaknesses, external sector problems, and the contagion that spread from Thailand to other countries (Goldstein, 1998): the

Russian crisis of 1998 was caused by the collapse in the value of the ruble and political instability: and the Brazilian crisis of 1998-1999 was an outcome of a series of currency devaluations resulting from the change of its managed fixed exchange rate system to the floating exchange rate. History of this nature is important in studying these markets. Since data on emerging markets is limited, only the data available in standard databases (such Bloomberg DataStream) were analysed.

1.8 Organisation of the research

- Chapter one is the orientation of the study presenting the statement of the problem and the objectives of the research.
- Chapter two presents the literature on international diversification
- Chapter three describes the data identified as required, and research methods and techniques used to collect such data. It also describes how the data were processed.
- Chapter four discusses the findings that were revealed by the analysis of the data described in chapter four.
- Chapter five draws inferences, generalisations and implications from the data. It also identifies questions that surfaced in the process of this research which needed to be answered through further research.

1.9 Limitations

The study relied mostly on open source data. Changing of jobs also limited the researcher's access to some journal articles as the current job is not subscribed to the journals required.

1.10 Summary

This chapter presented the objectives and set the scope of the study. The significance and the limitations were discussed. The next chapter presents the literature and empirical evidence by other researchers.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

A major development in the field of investment has been the recognition that the creation of an optimum investment portfolio is a matter of combining several unique individual securities that have desirable risk-return characteristics. Therefore, investors should consider both the characteristics of individual securities and the relationship between those securities.

This chapter first describes a theoretical framework of the portfolio theory and diversification as developed by Markowitz (1952). This will give the background on the nature of the portfolio problem and a perspective for some of the portfolio work that followed such as Tobin (1958), Sharpe (1964), Lintner (1965) and Mossin (1966). The chapter then presents empirical evidence on international portfolio diversification. The empirical evidence is intended to demonstrate the benefits available from diversification.

2.2 Portfolio diversification

Markowitz (1952) developed the theory of portfolio selection which became known as the Modern Portfolio Theory (MPT). The theory suggests that portfolio return can be expressed as a weighted average of the returns for each risky asset, while portfolio risk depends on the variance of returns of each asset and the covariance of returns between each asset. A crucial insight of MPT is that even very risky assets can reduce a portfolio's overall risk if there is a low covariance of returns between this risky asset and the other assets in the portfolio. Rational investors will select their optimal portfolio along an efficient frontier depending on their personal risk tolerances and preferences. Some will opt for the best return they can get for a maximum risk level they will tolerate.

Others will target a desired return and attempt to minimise the level of risk in the best portfolio. Markowitz's work established that a mean-variance efficient frontier exists for any collection of risky assets, and rational investors should only select portfolios "on this frontier" at a position that reflects their personal risk preferences and tolerances.

The purpose of the Modern Portfolio Theory (MPT) is to determine the combination of risk and return that allows the investor to achieve the highest return for a given level of risk. Markowitz (1952) formulated the portfolio problem as a choice of the mean and the variance of a portfolio of assets. He showed quantitatively that by holding a portfolio with a constant variance, an investor can maximise expected return or that holding a portfolio with a constant expected return can maximise the risk of that portfolio. The main focus of the theory was that assets could not be selected only on characteristics that were unique to the security. Rather, an investor had to consider how each security co-moved with all other securities. The knowledge of these co-movements resulted in an ability to construct a portfolio that had the same expected return and less risk than the portfolio constructed by ignoring the interactions between securities.

The portfolio theory dictates that given estimates of the returns, volatilities, and correlations of a set of investments and constraints on investments, it is possible to perform an optimisation that results in the risk/return or mean-variance efficient frontier (Fabozzi, Gupta and Markowitz, 2002). Tobin (1958) expanded on Markowitz's work by adding a risk-free asset to the analysis. This made it possible to leverage portfolios on the efficient frontier. The theory led to the notion of a super-efficient portfolio and the capital market line. Through leverage or de-leverage, portfolios on the capital market line are able to outperform portfolio on the efficient frontier.

Harry Markowitz's work revolutionised the practice of investment management in the late 1950s. Before Markowitz's theory, investors focused on assessing the risks and rewards of individual securities. Judgement and experience were the guidelines used by the investors to build portfolios. Markowitz (1952) brought in the idea of diversification, proposing that investors should select portfolios not individual securities. He suggested that the process of selecting a portfolio may be divided into two stages. The first stage starts with observation and experience and ends with beliefs about future performance of available securities. The second stage starts with the relevant beliefs about future performances and ends with the choice of portfolio. Sharpe (1967) divides these stages into three tasks: security analysis, portfolio analysis and portfolio selection.

Studies after Markowitz and Tobin, such as Sharpe (1964) and Lintner (1965) found other ways of quantifying the risk of a portfolio. They developed a model for pricing risky assets. The model was called the Capital Asset Pricing Model (CAPM). CAPM extends MPT (initially developed by Markowitz and Tobin in the late 1950s) and implies that the expected return of an asset must be linearly related to the covariance of its return with the return of the market. MPT and CAPM can be used to explain risk and return relationships between various securities through diversification. Diversification helps spread risk between countries, currencies and markets.

Wallingford (1967) observes that until Markowitz, theoretical models which did exist failed to explain the phenomenon of diversification. Markowitz (1952) invented the mean-variance analysis (MV) of portfolio decisions. He introduced the concept of efficiently diversified portfolios, that is, those that maximise the expected return for a given risk as measured by variance. Further, Markowitz elaborated on this concept and provided algorithms for calculating efficient portfolios, given estimates of the means, variance and covariances of return on available securities. He showed that risk is key to investment return and how investors can deal with uncertainty and risk by constructing a portfolio through asset allocation. The logic behind asset allocation is that different asset classes have different financial characteristics. Stocks, bonds, gold, real estate and cash all behave quite differently when it comes to risk and reward. For instance, stocks may offer the highest returns among various asset classes, but they also carry the highest risk of losses. The way to increase return is to seek a portfolio composition that optimises the risk and return.

The quantitative approach suggested by Markowitz to portfolio analysis begins with the assumption that the only investment objectives are to maximise the expected return and minimise the variance of return from a portfolio of securities. In other words, investors like return and dislike risk. Thus, the investor attempts to find a set of portfolios which provide the maximum return for every possible level of risk and minimise risk for every level of return. To find these efficient sets of portfolios, investors need to calculate the expected return and variance of portfolios of several securities from the knowledge about the distribution of the individual securities. Wallingford (1967) and Evans & Archer (1968) concur with Markowitz. They assert that if the goal of the investor is to select a portfolio from a number of securities, such that, regardless of the shape and the investor's utility function with respect to risk, the investor may rely upon a portfolio analysis model to provide him with a set of efficient portfolios.

A portfolio is defined as efficient if it offers a higher overall expected return than any other portfolio with comparable risk (Sharpe, 1967). The expected return from a portfolio of several securities can be shown to be the weighted sum of the expected returns from each of those securities. This expected return from a portfolio of n securities could be calculated from the equation:

$$E(R) = \sum_{i=1}^{n} x_i e_i \qquad (2.1)$$

Where $E(R)$ is the expected return and $x_i e_i$ is the weighted sum of the expected returns from the ith security in the portfolio. If single-period returns for various securities are treated as random variables, than expected values, standard deviations and correlations can be assigned. Based on these, the expected return and volatility of any portfolio constructed with those securities can be calculated. Volatility and expected return may be treated as proxies for risk and reward. From a number of possible portfolios, some portfolios will optimally balance risk and reward. These comprise what Markowitz (1952) and Wallingford (1967) call an efficient frontier of portfolios. An investor should select a portfolio that lies on the efficient frontier. The efficient frontier was first defined by Markowitz (1952). The theory considers a universe of risky investments and explores what might be an optimal portfolio based upon possible investments. The notion of "optimal" portfolio can be defined in one of two ways: (1) for any level of volatility, consider all the portfolios which have that volatility. From among them all, select the one which has the highest expected return. (2) For any expected return, consider all the portfolios which have that expected return. From among them all, select the one which has the lowest volatility. Each definition produces a set of optimal portfolios. Definition (1) produces an optimal portfolio for each possible level of risk. Definition (2) produces an optimal portfolio for each expected return. Markowitz called this set of optimal portfolios the efficient frontier.

2.2.1 The CAPM and the International CAPM

Tobin (1958) expanded on Markowitz's work by adding a risk-free asset to the analysis. This made it possible to leverage portfolios on the efficient frontier. This led to the notions of capital market line (CML). Capital market line assumes that all portfolios are perfectly positively correlated, which means that all portfolios on the CML are perfectly correlated with the completely diversified market portfolio. This implies a measure of complete diversification (Lorie, 1975). Adding to the CML was the development of the Capital Asset Pricing Model by Sharpe (1964), Lintner (1965) and Mossin (1966) independently, building on the earlier work on diversification and Modern Portfolio Theory by Markowitz. According to CAPM, all investors should hold the market portfolio, leveraged or de-leveraged with positions in the risk-free asset. CAPM also introduced beta and relates an asset's expected return to its beta.

The focus of CAPM is motivated by two considerations. Firstly, the CAPM is a prototype of modern asset pricing theory. Its main pricing prediction is that, in equilibrium, expected returns will be proportional to covariance and with aggregate risk, a prediction shared virtually by all other asset pricing models, [See Merton (1973), Lucas (1978) and Breeden (1979)]. The meaning of aggregate risk differs across models. Portfolio analysis deals with the selection of a set of investments. Earlier studies suggested that the investor should be interested in the probability distribution of his future wealth. Further, the selection process should deal, at the very least, with some measure of dispersion of this distribution as well as with its central tendency [Markowitz (1952), Tobin (1958) and Sharpe (1967)].

The CAPM is also applied in international asset markets. The CAPM as applied to international asset markets implies that the demand for foreign investment depends on real exchange rate risk and real rates of return. International investments inevitably involve exchange rate risk as it requires currency conversion at the beginning and at the end of the investment period. It may be argued that optimal portfolios would be different for investors of different countries because of exchange risk. More recent models on asset pricing have devised an international asset pricing model that modifies the CAPM to incorporate exchange rate risk [see Solnik (1974), Stulz (1981) and Adler & Dumas (1983)].

Early tests on unconditional asset pricing models, such as Hamao (1988) and Jorion (1991), were rather unconvincing and generally found no evidence that exchange risk is priced on the Japanese and US stock markets. Recently, Vassalou (2000) found proof that exchange risk, along with foreign inflation risk, can explain part of the cross-sectional variation in equity returns of 10 developed countries.

The evidence shows that there can be considerable departures from the purchasing power parity (PPP), so exchange rate risk should be priced. More recently, empirical support for the existence of a foreign exchange risk premium has been found by Dumas & Solnik (1995) and De Santis & Gerard (1998). These studies have shown that a CAPM which incorporates foreign exchange risk premium (a so-called International CAPM) is better capable of empirically explaining the structure of worldwide rates of return than is the classic CAPM. The international CAPM involves other risk factors that include covariances with exchange rate changes of different countries. The overall portfolio risk depends not only on the covariances between the local market returns, but also on the covariances between the exchange rate changes and cross-covariances between the local market returns and exchange rate changes. Further, the international CAPM assumes that interest rates stay constant over time, essentially reducing the model to a static one. Recent empirical studies on international CAPM have emphasised the exchange rate risk. For example, De Santis & Gerard (1998) developed tests of a conditional version of the Adler-Dumas model. They found that conditional information is important and foreign exchange risks are priced. Dumas & Solnik (1998) assume that the time-varying world prices of foreign exchange risk depend on the conditional information of the econometrician. Dumas & Solnik also examine the unconditional implications of the conditional model.

Foreign exchange volatility risk is priced because of the priced foreign exchange level risk [Dumas & Solnik (1995) and De Santis & Gerard (1998)]. If the level of foreign exchange is a risk factor, as in the international CAPM, its volatility should forecast stock market returns and should thus reflect investment opportunities. Coval & Shumway (2001) presume that higher foreign exchange volatility indicates poorer investment opportunities because it makes hedging foreign exchange difficult.

Most recent studies, such as in Choi et al., (1998), Doukas et al., (1999) and Carrieri (2001), based on conditional asset pricing models, tend to provide more consistent results. They strongly support the hypothesis that foreign exchange risk is priced in the stock markets of major developed countries. Such evidence is not sufficient to reach more general conclusions on exchange risk pricing in global equity markets. The literature has some limitations that still need to be addressed. Most of the studies that find no evidence of an exchange risk premium use aggregate market data. This could explain ambiguous results because the exchange risk exposures of different firms may offset each other when those firms are grouped into an aggregate market index measure.

2.2.2 Characteristics of emerging markets

Research into emerging market equity returns has focused on the importance of the characteristics of these markets in the asset allocation decisions of investors. Emerging markets are markets of lesser-developed countries, which are beginning to experience rapid economic growth and liberalisation. A market is deemed 'emerging' if its Gross Domestic Product (GDP) per capita is below a certain barrier (according to the World Bank standards) that changes through time. The assumption behind the term is that such markets emerge from less developed status and join the group of developed markets (Bekaert and Harvey, 2002). The International Financial Corporation (IFC) lists 79 countries that are considered emerging markets. A growing population experiencing a substantial increase in living standards, income, economic growth, and a relatively unstable currency describes these countries. Divecha et. al (1992) narrowly define an emerging market as a market that: (1) has securities traded in a public market, (2) is not a developed market (as defined by countries covered within the Morgan Stanley Capital International Indices or Financial Times Indices), (3) is of interest to global institutional investors, and (4) has a reliable source of data. These emerging markets have come into existence only in the last few years.

Since the 1980s investments in emerging markets have become increasingly important in international portfolio management. A number of new equity markets have emerged in Europe, Latin America, Asia, the Middle East and Africa. Fuss (2002) notes that although these markets have an enormous growth potential and generate distinctively higher rates of return on the capital markets, they are, at the same time, characterised by extremely high rates of volatility and little is known about them. These markets experienced high levels of inflation and therefore the return should be higher in order to compensate for the risk involved in the system and to encourage capital inflow to the country (Salman, 1999).

Emerging and developed financial markets are more integrated today than at any time since the First World War. Contributing factors have been found to be the foreign investment in emerging markets that has expanded in recent years. The local operations of foreign financial institutions playing an increasingly important role in the financial system and emerging market residents who are now involved in foreign financial systems, both as issuers and as investors. These factors have broadened the links between emerging and developed financial markets (Wooldridge et al, 2003).

Initially, empirical studies investigating financial integration tended to focus on developed markets. But recently, most researchers have focused on emerging markets, and several studies have documented the high returns and low correlations of these markets with the rest of the world, suggesting significant benefits from adding emerging markets to global portfolios [see Bekaert et al. (1998) and Meric et al. (2001). An additional area of research has focused more on the liberalisation [Bekaert and Harvey (1997), Bekaert et al. (2003), Bekaert and Harvey (2003), and Kim et al. (2005)] and integration of emerging equity markets [Bekaert (1995), Bekaert and Harvey (1997) and Bekaert and Harvey (2003)]. The liberalisation of international financial markets is a relatively recent phenomenon. Financial liberalisation refers to a series of regulatory changes that allow foreign investors to buy domestic assets and domestic citizens to invest in foreign assets. This makes the domestic securities market an integral part of the world capital markets while allowing the introduction of depository receipts, country funds or equity capital flows to the emerging economy (Taskin and Muradoglu, 2003). For example, many barriers were lifted only at the beginning of the 1980s in Japan and in the United Kingdom (UK). The process of liberalisation started even later in many emerging markets. According to De Santis and Imrohoroglu (1997), one of the arguments often used against liberalisation was that investment flows towards emerging markets would be extremely volatile in response to changing economic conditions. Further, one of the consequences of volatile investment flows would be the high volatility in stock prices. But Levine (2001) suggests that liberalisation restrictions on international portfolio flows tend to enhance stock price liquidity, which in turn accelerates economic growth by increasing productivity. In another example, Bekaert et al. (2002) show that after integration, equity markets can be larger, more liquid and more volatile, and that the costs of capital declines, credit ratings improve, real exchange rates appreciate and economic growth increases. One conclusion may be that integration relies not only on liberalisation but also on the establishment of country funds.

Collins and Biekpe (2003) point out that it seems evident that emerging markets are becoming more integrated with each other and with developed markets. They argue that events in emerging financial markets during the 1990s have given rise to a fevered debate about the role of globally integrated capital markets in financial crises. The Mexican peso crisis of 1994, the Asian crisis of 1997 and the subsequent Russian and Brazilian crises of 1998 have provided new data with which to examine the transmission of financial variable movements from one country to another. The successful integration of financial markets has stimulated the minds of many academic researchers in the field of international diversification. Focus has been shifted from integration to the analysis of risk-return profiles of emerging markets as they are characterised by high returns and extreme volatility.

Research by Harvey (1995a) found that emerging market equity indices exhibit higher returns for lower levels of risk than those attainable in developed markets. This work evolved into a body of literature that examines the empirical distributions of emerging market equity returns with particular interest in the risk–return tradeoff within emerging markets [Harvey (1991) and Bekaert and Harvey (1997)]. Efficient investment frontiers within emerging markets and the diversification potential these markets have brought to portfolios combining emerging market participation with developed market investment have also received attention (Barry, Peavy and Rodriquez, 1998). Literature on risk–return profiles, has given particular attention to certain specific risk factors including, among others, political risk (Diamonte, Liew and Stevens, 1996) and country risk [Erb, Harvey and Viskanta., (1996a) and Erb et al., (1996b)]. Studies have constructed efficient frontiers using emerging markets (Barry et al. 1998), and applied asset pricing models to observe emerging market returns [Harvey (1991) and Harvey (1995a)].

Harvey (1995a) studied emerging market returns and suggested that there is no relation between expected returns and betas measured with respect to the world market portfolio. Harvey also investigated the persistence of emerging market returns and found that serial correlation is on average much higher than the level found in developed markets. Also, when correlations increase, the benefits of diversification decrease. However, correlations of emerging markets are sufficiently low to provide portfolio diversification [see, Harvey (1995), Bekaert and Urias (1999) and Errunza et al. (1999)]. As for risk considerations, Harvey (1991) measured the conditional risk of 17 developed countries and provided evidence that the countries' risk exposures helped explain differences in performance. Bekaert, Erb, Harvey and Viskanta (1998) examined departures from normality and detailed that emerging markets displayed significant skewness and kurtosis in their returns. Bae, Lim and Wei (2006) found that stock returns were more positively skewed in emerging markets than in developed markets and that the positive skewed stock markets tended to have lower corporate governance scores.

With respect to legal foundation, La Porta et al. (1997, 1998), examined differences between national capital markets, both debt and equity, as a reflection of the underlying legal environment. The literature developed includes the effect of legal structure on the size of capital markets, the relative shares of differing sources of capital and financial market development (Levine, 1999). Burger and Warnock (2006) found that countries with stronger legal institutions had more developed local bond markets and that US investors tended to avoid local currency bond markets that had high variance, negative skewness that are found in emerging bond markets. La Porta et al. (1997, 1998) demonstrated that the size of a capital market was a function of its legal foundation. The return for any capital investment is a function of the price of that investment today. Since the price of the investment in the next period is mathematically defined as the price in the initial period plus the growth rate, there is a mathematical relationship between the growth of a given financial market and any returns to an index for that market.

2.3 Empirical evidence on international diversification

International equity markets have developed rapidly over the years and seem to provide evidence of favourable conditions for portfolio diversification. Correlation between these markets is sufficiently low and the cost of diversifying is outweighed by the benefits of reduction of risk in a Markowitz sense. According to Modern Portfolio Theory (MPT), the gains from international diversification are inversely related to the correlations of security returns (Gilmore & McManus, 2002). A number of studies on the advantages of international diversification emanating from the low correlations between developed and emerging equity markets have been demonstrated [see Errunza & Padmanabhan (1988), Bailey & Stulz (1990), Divecha et al. (1992) and Michaud et al. (1996)]. These studies have documented that the correlations between equity markets were estimated using relatively short term horizons (weekly, monthly and quarterly). Kasa (1992) points out that the benefits from international diversification indicated by low correlations may be overstated for investors with long term investment horizons if equity markets are trending together. Recent studies have employed cointegration techniques to explore whether there are linkages and long term co-movements between both developed and emerging equity markets. These studies have produced mixed results and conclusions as to the gains from diversification for US investors. For example, Kasa (1992) and Arshanapalli & Doukas (1993) found evidence of bivariate cointegration of the US with those markets; however, the results in Byers & Peel (1993) and Kanas (1998) suggest that there is no such linkage. The divergence of results between these studies may be explained by differences in time periods examined and the research methods applied.

2.3.1 Returns, volatility and exchange rate changes

Van Agtmeal & Errunza (1982) tested two hypotheses for a five-year period. They gathered data on eleven of the major emerging markets in five different continents. In each market, twenty-five actively traded stocks in 1980 were identified and monthly performance (including price change, capitalisation changes and dividend yield) for each of these stocks during the five-year period was calculated. Based on these data, correlations between the U. S. markets and the basket of the most actively traded stocks in various emerging markets were also computed. The findings yielded a low mean correlation of 0.15 showing clearly that emerging markets do not move in tandem with the U.S. markets (Standard & Poors index). In many cases, the correlation coefficients were close to zero or quite low. The researchers concluded that the main attractions of investing in emerging markets were somewhat similar to those that induced major investors to expand their horizons to foreign markets generally: (1) risk is further diversified, and (2) new, unexplored opportunities are tapped, with the expectation of a higher potential rate of return.

Using monthly and weekly stock market indices for a large number of developing countries, De Santis & Imrohoroglu (1997) analyse the dynamics of returns and volatility in emerging markets. They note that one of the primary reasons for studying these dynamics is that in investment, performance is potentially affected by the degree of exposure to market risks. The analysis was on a weekly series from December 1988 to May 1996 for 384 observations. The countries covered were grouped into three geographical regions: Europe/Middle East, Asia and Latin America. De Santis and Imrohoroglu (1997) found that for almost all the countries in their sample, there was evidence of time-varying volatility, which exhibited clustering, high persistence and predictability. Furthermore, the level of volatility in emerging markets was considerably higher than that of more developed markets, both at conditional and unconditional levels. The conditional probabilities of large price changes were higher in emerging markets. However, De Santis and Imrohoroglu concluded that they did not find any relation between expected return and country-specific risk even though the static version of the CAPM assumes a linear function between expected return on any asset and the covariance between the return on an asset and the return on the market portfolio.

Bekaert et al. (1998) note that the behavior of emerging market returns differs sharply from the behavior of developed equity market returns. While forecasts of expected returns and volatilities in emerging markets have extensively been studied, the authors focus primarily on skewness and kurtosis. They conclude that emerging market returns are highly non-normal and highly volatile and the samples are small. In conjunction with empirical evidence collected by Solomons & Grootveld (2003), using standard statistical techniques, they found statistically significant differences that investors should be able to exploit. The downside risk analysis reveals that the higher rewards in emerging markets come with higher risk. However, risk and return are dependent on the sample period taken. They observed time varying behaviour in the emerging market equity risk premium (ERP) data, but could not claim the presence of a structural break in the data.

They concluded that there was no difference in ERP in the period before and after the market liberalisations. Solomons & Grootveld (2003) focused on equity risk premiums, which essentially are brought about by excess returns over the risk free rate.

Meric et al. (2001) considered only the risk-reducing benefits of international portfolio diversification in their analysis. They found that low correlations among national equity markets were often presented as evidence in support of the benefits of international portfolio diversification. Due to high correlations between the developed equity markets, international investors have turned their attention to the emerging markets to obtain greater portfolio diversification benefits. They further found that the correlation between the U.S., Argentine, Brazilian, Chilean, and Mexican equity markets increased and the benefits of portfolio diversification with these equity markets decreased considerably during the February 1984–February 1995 period.

However, returns are also important in international portfolio investment decisions. The implications of the research by Meric et al. (2001) were that U.S. investors should require higher returns from their investments in the Latin American equity markets to be compensated for the decreasing portfolio diversification benefits with these markets over time. It is also possible that the market risk has been reduced in these markets after the opening and liberalisation processes that took place.

2.3.2 Correlation, covariance and the benefits of international diversification

Eun & Resnick (1988) examined seven major (developed) markets for the period 1980 through 1985. They examined the effect of exchange rate changes on the risk of international portfolios, investigated how the negative effects of exchange rate volatility could be mitigated in a portfolio context by the judicious use of forward exchange contracts and developed an ex ante efficient international diversification strategy that could effectively control exchange rates and estimation risk. They found that during the sample period (1980 – 1985), exchange rate volatility was found to account for about fifty percent of the volatility of dollar returns from investment in the stock markets of major countries such as Germany, Japan and, U.K. Further, the exchange rate changes vis-a-vis the U.S dollar were found to be highly correlated across currencies, implying that a large portion of exchange risk would remain nondiversifiable in a multicurrency portfolio.

Using value weighted stock indices for U.S and six developed countries (Canada, France, Germany, Japan, Switzerland and the U.K), a time series of weekly returns was constructed for each index in U.S and local currency. Again using U.S and Local currency returns, a corresponding time series of exchange rate changes versus the dollar was constructed for each country. These weekly stock index returns and exchange rate change dates were used to test the performance of the ex-ante investment strategies. It was found that fluctuating exchange rates made foreign investment more risky, and, aggravated estimation risk, thereby diminishing the gains from international diversification evidence. Also,the correlations were such higher among the exchange rate changes than among the local stock market returns) Eun & Resnick (1988).

Izan et al. (1991) apply the Eun & Resnick methodology to the Australian situation from an Australian investor's position. Initially, the Eun & Resnick study was carried out from the perspective of the U.S investor. Izan et.al (1991) investigated stock market indices for eight different countries over the period 1986 – 1988 (Australia, Canada, France, West Germany, Italy, Japan, the U.K and the US). Exchange rate values were expressed in Australian currency. Both the index values and exchange rate data were (initially) screened to eliminate reporting errors. Using time series to test four ex ante international portfolio (naive portfolio based on equal weighting of each country index, CETP, MVP, and BSTP) they found that the minimum variance portfolio weights were relatively stable over time, due to the relative stability of the variance – covariance matrix of stock returns. Further, the weights of the CETP were, however, relatively unstable due to the instability of the mean- returns vector. Izan et al. (1991) concur with the findings by Jorion (1985) and Eun & Resnick (1988) that the composition of the minimum variance portfolio (MVP) is more stable over time. They concluded that the Australia investor could benefit from international diversification.

In evaluating potential gains from international diversification, Eun & Resnick, (1994) examined these gains from the Japanese and U.S perspectives. Monthly return data (on seven major countries) for national bond and stock market indices from the period of 1978 through 1989 were used. A corresponding time series of exchange rate changes versus the dollar and the yen were constructed for each country. Eun & Resnick (1994) found that both U.S and Japanese investors could benefit from international diversification in the absence of parameter uncertainly. However, the magnitude of the potential gains was much higher for U.S investors than for Japanese investors. They noted that the exchange rate uncertainty was an important component as well as the foreign investment risk for both U.S and Japanese investors; especially for bond investment. Hedging exchange risk was found to generally increase the benefits from international investment for investors in the U.S and not so for Japanese investors.

After 1990, a number of equity markets have emerged in Europe, Latin America, Asia, the Middle East and Africa. These equity markets have become increasingly important in international portfolio management. Fuss (2002) notes that although these markets have an enormous growth potential and generate distinctively higher rates of return on the capital markets, they are at the same time characterised by extremely high rates of volatility. Harvey (1995) explores the unconditional risk of these markets, and tests whether adding emerging market assets to the portfolio problem significantly shifts the investment opportunity set. Data on 800 equities in six Latin American markets, eight Asian markets, three European markets, one Middle East market and two African markets (a total of twenty emerging markets) were collected. Monthly value-weighted index returns were calculated with dividends reinvested. Annualised mean and average returns (usually associated with volatility) were determined,

Harvey (1995) found that the emerging markets composite index exhibited high average return coupled with a high standard deviation, implying the high volatility that emerging markets portray. Also, when emerging markets were denominated in local currency rather that US dollar returns, they exhibited high returns and were extremely volatile as a result of high inflation. Serial correlation coefficients (using the first order) were found to be high in emerging markets. Further, the returns in emerging markets departed from the normal distribution. In terms of diversification, Harvey (1995) found low average correlations between developed and emerging markets, with some emerging markets exhibiting effectively zero average correlation with developed markets. Harvey concluded that the low correlations between emerging and developed markets suggested that the emerging market returns were not spanned by the developed market assets in a mean-variance efficient portfolio.

Errunza et al. (1999) examined whether investors could take advantage of the gains of international diversification by forming a portfolio of securities that trade in the United States. Seven developed markets (DMs) and nine emerging markets (EMs) from 1976 – 1993 were investigated. For each country, a diversified portfolio using U.S market indices; 12 US industry portfolios, 30 multinational corporation (MNC) stocks, closed-end country funds (CFs), and American Depositary Receipts (ADRs) was constructed. Using the new Generalised Dynamic Covariance (GDC), multivariate generalised autoregressive conditional heteroskedasticity (GARCH) model to estimate time variation in the conditional correlation between foreign market indices and their respective mimicking portfolios, Errunza et al. (1999) found that the monthly returns correlations and homemade diversification portfolios with foreign market indices were higher than those with the S&P 500 index. Also, the mean variance spanning test results provide strong evidence of gains beyond those attainable through home-made portfolios.

Goetzman et al (2005) argue that the benefits of diversification depend critically on both the number and the performance of international capital markets. Cross-sectional time series information (over 150 years) about the returns to the world's stock markets was analysed. Groetzman et al. (2005) found that the periods when diversification benefits tended to be potentially highest when correlations between international indices were lowest. Also, these periods presented investors with the greatest difficulty in diversifying. These tended to be periods of war and significant international tension. Also, the periods that had the highest correlations (and thus the lowest diversification benefits) were during the great depression and these tend to be periods when markets are generally bearish in tendency. Thus, diversification benefits are non-constant and may be least available when they are most needed.

Knowledge about covariance and correlation matrices as major inputs for the computation of trading portfolios is important in determining the behaviour, stability and predictability of the portfolio. Ratner (1992) claimed that the international correlations remained constant over the period 1973-1989. Kock and Koch (1991) on the other hand, examined the correlations of eight markets using daily data for three separate years (1972, 1980, and 1987) and concluded from simple Chow tests that international markets had recently grown more interdependently. Von Fursternberg & Jeon (1989) reached a similar conclusion using a VAR approach for four markets and a very short time period (1986 – 1988).

A question often raised is whether the international correlation increases in periods of high turbulence. It may seem that international correlation increases when global factors dominate domestic ones and affect all financial markets. The dominance of global factors tends to be associated with very volatile markets such as the oil crises, the gulf war, and financial crisis. Empirical evidence by King & Wadhwani (1990) and Bertero & Mayer (1990) using high frequency data surrounding the crash of 1987, suggests that international correlation tends to increase during the stock market crisis. A number of studies have documented incidences and events that create high turbulence in financial markets. For example, King & Wadhwani (1990) investigated the impact of the crash of the U.S stock market in 1987 on the correlations between the stock markets in the U.S, the U.K and Japan and Lee & Kim (1993) studied the effects of the same events across 12 major stock markets. Calvo & Reinhart (1996) analysed the impact of the Mexican peso crisis in 1994 on contagion in major financial markets. The general conclusion of these studies was that cross-market correlations during crisis periods increase significantly, indicating contagious effects across markets. Previous studies such as Hamao et al. (1990), Solnik et al (1996), Ramchand & Susmel (1998), show that cross-market correlations rise in periods of high volatility, reducing the benefits of portfolio diversification. Recent studies include Butler & Joaquin (2002). Forbes & Rigobon (2002) note that correlation coefficients are biased measures of dependence when markets become more volatile, and that there is no evidence of contagion in recent financial crises once corrected for these effects.

Longin and Solnick (1995) tested the hypothesis of a constant international conditional correlation for the period 1960-1990. Month end stock market indices for seven major (developed) markets (France, Germany, Switzerland, UK, Japan, Canada, USA) were calculated in local currency. Using a multivariate GARCH model, Longin and Solnick (1995) found that the international covariance and correlation matrices were unstable over time. The volatility of the markets changed over the period (1960-1990) and the proposed GARCH model captured this evolution in variances. Also, an explicit model of the conditional correlation indicates an increase in the international correlation between markets over the past 30 years. Correlation rises in periods when the conditional volatility of markets is large. Login and Solnick (1995) concluded that there is some preliminary evidence that economic variables such as the dividend yield and interest rates contain information about future volatility and correlation that are not confined to past returns.

2.3.3 Cointegration and the benefits of international diversification

Current studies have shifted focus in computing correlation to determine the benefits from diversification to exploring cointegration analysis. Unlike correlation, cointegration refers to co-movements in raw asset prices (or exchange rates or yields) and not to co-movements in returns. Developments in cointegration testing have resulted in the emergence of new methods that are able to account for specific properties of time series data, such as non-normality, heteroscedasticity and exogenous shocks.

Studies that deal with the issue of the multivariate analysis of the relationship among the stock of different stock markets have applied cointegration theory with the purpose of studying the long-run properties of stock prices (see Taylor and Tonks (1989) and Arshanapalli and Doukas (1993)). Most of these studies have reached the conclusion that there is cointegration between two stock prices or between two stock price indices and they have interpreted this finding as evidence that there is a long-run linkage and therefore a long-run relationship [(Byers and Peel (1993), and Georgoutsos and Kouretas (2003)].

Following the results above, it may be argued that the existence of cointegration between two or more stock prices could be seen as evidence of long-run relationships between these series. With respect to portfolio diversification, existence of cointegration between two or more stock prices implies that in the long run these prices are moving together and therefore, the benefits from diversification with the construction of a portfolio that consists of these stocks are limited. In contrast, lack of cointegration implies that there are significant long-run benefits from the reduction of risk without loss in the expected returns.

Arshanapalli and Doukas (1993) focused their analysis on the capital markets of the U.K., France, Germany and U.S.A. They performed statistical tests for the existence of bivariate cointegration between the U.S. stock market with each of the other major markets. For the U.S. investor, their study found that cointegration existed for all potential pairs and therefore there are small benefits from the international portfolio diversification of the American investor. Contrary to these findings, Taylor and Tonks (1989) found no evidence of cointegration between the U.S. and the U.K. stock markets.

Byers and Peel (1993) as well as Kasa (1992) studied three European stock markets and those of Japan and Canada. They reached the conclusion that there was partial evidence of cointegration. Kanas (1998) examined six of the largest stock markets vis-à-vis the NYSE and found no evidence in favour of cointegration leading to the conclusion that there may be substantial benefits from international portfolio diversification.

Other studies such as Gallagher (1995) analysed some of the major European stock markets and also confirmed that there was no evidence of cointegration between the stock markets of Ireland, Germany and the U.K. Serletis and King (1997) after examining the European Union, failed to find a common stochastic trend. They explained this evidence on the low integration of the Athens Stock Exchange with the other European capital markets. More recently, Fraser and Oyefeso (2005) also examined the long-run interrelationships of the European capital markets and concluded that although cointegration existed, the gains from diversification were short-lived since the adjustment to the common trend was very slow.

2.3 Summary

The theory of portfolio selection introduced by Markowitz (1952) suggests that portfolio returns can be maximised even with very risky assets as long as there is a low covariance of returns between the risky assets and other assets in the portfolio. The theory brought in the idea of diversification, proposing that investors should select portfolios and not individual securities as was done in the past. The logic behind portfolio diversification is that different asset classes have different financial characteristics both domestically and internationally.

Investors have been able to combine domestic assets with foreign assets in their portfolios, targeting asset classes with low correlations since financial liberalisation and integration in the 1980s. The MPT strongly argues that for beneficial international diversification, correlations among international markets should be lower than the correlations among stocks within the same market. However, over the years, correlations have increased and therefore giving no reason for these correlations to remain constant over time. For example, correlation is extremely sensitive to short term movements; it has a shorter term connotation compared to cointegration analysis. Cointegration measures common movements during longer periods of time and thus is not affected by short term movements. Additionally, leads or lags in the time series make correlations almost useless. For example, if the time series were to lag by one or two days, the effect on the correlation between the series will be significant; the correlation might even turn from positive to negative. On the other hand, the effect on the long term relationship between the series might be minimal. Therefore, the application of cointegration techniques allows for short term divergence between two different time series, meaning that on a daily basis, the series do not necessarily have to fluctuate at the same time: one might rise while the other falls, thus there is no need for the two series to move in daily synchrony at all. In the long run however, the two price series cannot wander off in opposite directions for very long without coming back to their long term equilibrium.

Initially, correlation techniques were performed to determine the benefits from diversification, but recent studies have shifted focus to cointegration analysis. Cointegration analysis enables investors to investigate the long-run properties of stock prices. Most studies using cointegration have arrived at essentially the same conclusion that there is cointegration between stock prices or stock price indices. This means that there is a long term linkage and therefore a long term relationship between them, meaning that benefits from diversification are limited. While most studies focused on correlation techniques to determine the benefits from diversification underpinned by MPT, this study examines the benefits for a South African investor's perspective by investigating whether superior risk adjusted portfolios can be constructed by combining MPT with cointegration techniques as compared to portfolios created solely by using MPT techniques. This approach should be able to provide useful information about the long term and short term dynamics of emerging markets especially now that these markets are fully integrated into the world markets. Also, the approach begs the question: to what extent are these markets still emerging?

CHAPTER 3
RESEARCH METHODS AND TECHNIQUES

3.1 Introduction

According to Modern Portfolio Theory (MPT), not only is it necessary to have a measure of the mean return, it is also useful to have some measure of how much the outcomes differ from the mean. Once the mean has been determined, the variance and the standard deviation are computed. Standard deviation measures the tendency for the individual returns to cluster around the mean return and the variability of the return. The larger the dispersion around the mean the greater the standard deviation and the larger the risk associated with the particular stock.

The study seeks to find if it is beneficial for an investor to diversify their portfolio of emerging markets over a certain period of time. To achieve this, the nature of both the short and long-run linkages among emerging equity markets are scrutinised. The econometric methodology used includes the Cointegration under the Johansen (1988) approach. This approach provides a method to analyse not only the extent but also the dynamics of the long-run relationships. The concept of Cointegration was first introduced by Engle and Granger (1987) and elaborated further by Stock and Watson (1988) and Johansen (1988 1991). This section presents the data and methods of analysing such data.

3.2 The Data

The data on international financial markets vary greatly in terms of quality and availability. To insure good quality of the data, a restricted time period and a number of selected countries were chosen. Day- to – day closing weighted share indices were collected from the Thompson DataStream. Thomson DataStream is the world's largest and most respected financial, statistical database. It contains more than two million financial instruments, securities and indicators for over 175 countries in 60 markets. Holding up to 50 years of history and over 8,000 different fields, it provides access to over one hundred million time series.

Eight emerging markets share indices are collected and analysed over the period January 1996 through November 2008. Data is limited on emerging markets. One possible reason could be attributed to the fairly short histories available in standard databases. The International Finance Corporation's Emerging Market Database (EMDB) provides data from 1976. Morgan Stanley Capital International data begins ten years later (Bekaert and Harvey, 2002). The study focuses on emerging markets with the longest history (countries with data from at least 1996) and such data is found in Thompson DataStream. Stambaugh (1997) finds that longer histories provide greater information about moments of return not only for the longer history assets, but also for the shorter history assets. Also, during 1996, emerging markets survived a period of international turbulence created by the 1994-95 Mexican peso crisis and its tequila effects which were dissipating as the year began (IFC, 1997).

Therefore, the sample period starting in January 1996 through November 2008 provides data on these financial markets having experienced the financial crises. For instance, the 1990s saw four major financial crises - the Mexican crisis of 1994-1995 caused by the devaluation of the peso in December 1994 put an abrupt end to capital inflows and precipitated the financial crisis, the East Asian crisis of 1997-1998 (caused financial sector weaknesses; external sector problems; and the contagion that spread from Thailand to other countries, Goldstein, 1998), the Russian crisis of 1998 (caused by the collapse in the value of the ruble and political instability), and the Brazilian crisis of 1998-1999 was an outcome of a series of currency devaluations resulting from the change of its managed fixed exchange rate system to the floating exchange rate. More recently, the study also analyses the 2008 credit crisis experienced in the US. The crises of the 1990s were due primarily to a combination of unsustainable current account deficits, excessive short term foreign debt and weak domestic banking systems. Further, over enthusiasm prior to 1994 had made emerging markets vulnerable and the crisis exposed the macroeconomic imbalances (Salomons and Grootveld, 2003).

The emerging markets in the study are: Amman (AM), Athens (AT), Brazil (BR), India (IN), Israel (IS), Korea (KO), Russia (RU) and South Africa (SA). In the tables presented in this study, these countries will be called by the letters indicated in parentheses. Emerging markets are divided into six regions namely: Africa (South Africa), Asia (Korea), Europe (Athens and Russia), Latin America (Mexico and Brazil), Middle East (Israel) and South Asia (India). Although, the study had wanted to explore twenty emerging markets, it fell short of data on the other emerging markets and other markets were left out because their extreme volatility (such as Kenya, Nigeria, Zambia and Zimbabwe). Table 3.1 shows the indices used in the sample.

Table 3.1 Indices used for the countries in sample

No.	**Country**	**Index Name**	**Code**
1	Amman (AM)	Amman SE Financial Markets Price Index	AMMANFM
2	Athens (AT)	Athex Composite	GRAGENL
3	Brazil (BR)	Brazil (IBX)	BRIBXIN
4	India (IN)	India BSE (100) National	IBOMBSE
5	Israel (IS)	Tel Aviv SE General	ISTGNRL
6	Korea (KO)	Korea SE Composite (KOSPI)	KORCOMP
7	Russia (RU)	RSF EE MT (RUR) Index	RSMTIND
8	South Africa(SA)	FTSE/JSE All Share	JSEOVER

The share indices are analysed statistically and the results compared. Most studies analysed the benefits of diversification by determining the mean daily returns and standard deviation. The standard deviation function is often used to determine the degree of volatility (degree of dispersion). Volatility is then used as a risk measure between the values of the indices over the sample period. The reason for using standard deviation function is that the scale of the value is more readily conceptualised to the scale of the data thereby giving a statistical measure of risk. The more a stock's returns vary from the stock's average return, the higher is the standard deviations representing a high level of volatility. However, for the purpose of this study, the cointegration analysis is computed instead in order to determine any benefits from diversification.

The analysis is divided into three groups. The first showing the overall analysis, the second one showing the period of the financial crisis during the 1990s and lastly, the period after the year 2000 which includes the 2008 credit crisis.

Table 3.2. Division of the periods analysed

Nature	**Period**
Overall	01 Jan 1996 – 30 Nov 2008
1990s Crises	01 Jan 1996 – 31 Dec 1999
Period from 2000	01 Jan 2000 – 30 Nov 2008

3.3 The analysis

To examine the potential benefits from international diversification, cointegration analysis is performed. Under this analysis, unit root tests and vector error correction models are also computed for all the eight emerging markets.

3.4 Testing for Cointegration

The study adopts a framework of cointegration theory and statistically examine whether cointegration exists among the eight share indices. Unlike correlation, cointegration refers not to co-movements in returns, but to co-movements in raw asset prices (or exchange rates or yields). If spreads are mean reverting, asset prices are tied together in the long term by some common stochastic trend, and the asset prices are said to be cointegrated The fundamental aim of cointegration analysis is to detect any common stochastic trends in the price data, and to use these common trends for a dynamic analysis of correlation returns. Thus cointegration analysis is an extension of the simple correlation based analysis. Whereas correlation is based only on return data, cointegration analysis is based on the raw price, exchange rate or yield data as well as the return data.

The Johansen's (1988, 1991) methodology takes its starting point in the vector autoregression (VAR) of order p given by

$$y_t = \mu + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_1, \qquad (1)$$

where y_t is an $n \times 1$ vector of variables that are integrated of order one, commonly denoted I(1) and ε_t is an $n \times 1$ vector of innovations. This VAR can be re-written as

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \qquad (2)$$

where

$$\Pi = \sum_{i=1}^{p} \mathrm{A}_i - \mathrm{I} \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} \mathrm{A}_j . \qquad (3)$$

If the coefficient matrix Π has reduced rank $r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the Vector Error Correction model (VEC) and each column of β is a cointegrating vector. It can be shown that for a given r, the maximum likelihood estimator of β defines the combination of y_{t-1} that yields the r largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present (Johansen, 1995). Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in equations (4) and (5) respectively.

$$J_{trace} = -T\sum_{i=r+t}^{n} 1n(1-\lambda_i) \tag{4}$$

$$J_{\max} = -T1n(1-\lambda_{r+1}) \tag{5}$$

Where T is the sample size and λ_i is the ith largest canonical correlation. The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r+1$ cointegrating vectors.

The existence of cointegration between two or more stock prices suggests evidence of long-run relationships between these series. In terms of portfolio diversification, this implies that in the long-run these prices are moving together and therefore, the benefits from diversification for a portfolio containing such stocks are limited. In contrast, lack of cointegration implies that there are significant long-run benefits from the reduction of risk without loss in the expected returns.

3.4.1 Unit root tests

The augmented Dickey-Fuller (ADF) test is a test of unit roots in autoregressive moving average (ARMA) model with unknown order. The ADF test, tests the null hypothesis that a time series y_t is I(1) against the alternative that that is I(0), assuming that the dynamic in the data have an ARMA structure. The ADF test is based on estimating the test regression

$$\Delta y_t = (p-1)y_{t-1} + u_t = \delta y_{t-1} + \varepsilon_t \qquad (6)$$

where $\Delta$is the first difference operator. This model can be estimated and testing for a unit root is equivalent to testing $\delta = 0$ (where $\delta = p-1$). The p lagged difference terms, Δy_{t-1} are used to approximate the ARMA structure of the errors, and the value p is set so that the errors ε_t are serially uncorrelated. The specification of the deterministic terms depends on the assumed behavior of y_t under the alternative hypothesis of trend stationary. Under the null-hypothesis, y_t is I(1) which implies that θ=1. An important practical issue for the implementation of the ADF test is the specification of the lag length p. If p is too small then the remaining serial correlation in the errors will bias the test. If p is too large then the power of the test will suffer (Ibrahim, 2007).

3.4.2 Vector Error Correction Model (VECM)

Cointegration always implies an error-correction model or ECM (Granger representation theorem). The ECM is superior to modeling integrated data in first-differences or in levels (Engle and Granger, 1987). It is quite possible for random walks to be related to each other so that a regression of one random walk on the other has a stationary error term. If the combination of unit root variables is not unit root then some form of relationship is assumed to exist between them. If a relationship exists between the unit root variables (which are equivalent to establishing cointegration) then that relationship is called the cointegration vector. The VEC model of y and x in levels (after rearranging the short and long term models) yield the following:

$$\Delta y_t = y_0 \Delta x_t - (1-\alpha 1)[y_{t-1} - \beta_o - \beta_1 x_{t-1}] + \varepsilon_t \qquad (7)$$

where:

$\Delta y, \Delta x, [y_{t-1} - \beta_0 - \beta_1 x_{t-1}]$ are all stationary variables, clear long-run component $[y - \beta_0 - \beta_1 x]$ if cointegration exists and $(1 - \alpha 1)$measures the speed of adjustment to long-run equilibrium.

The error correction comes from the cointegration relationship. The betas contain the cointegration equation and the alphas the speeds of adjustment. If y and x are far from their equilibrium relationship, either $y$or x or both must change, the alphas let the data choose.

2.1. Granger Causality Test

Traditionally, the Granger (1969) causality was employed to test for the causal relationship between two variables. This test states that, if past values of a variable *y* significantly contribute to forecast the future value of another variable *x* then *y* is said to Granger cause *x* . Conversely, if past values of *x* statistically improve the prediction of *y* , then it can be concluded that *x* Granger causes *y* .

Many tests of Granger-type causality have been derived and implemented, including Granger (1969), Sims (1972), and Geweke, Meese and Dent (1983), to test the direction of causality. The tests are all based upon the estimation of autoregressive or vector autoregressive (VAR), models involving the variables *X* and *Y*, together with significance tests for subsets of the variables.

Engle and Granger (1987), show that if two series are individually *I*(1), and cointegrated, a causal relationship will exist in at least one direction. Furthermore, the Granger Representation Theorem demonstrates how to model cointegrated *I*(1) series in the form of a VAR model. In particular, the VAR can be constructed either in terms of the levels of the data, the *I*(1) variables; or in terms of their first differences, the *I*(0) variables, with the addition of an error correction term (ECM) to capture the short-run dynamics. The test is based on the following regressions:

$$y_t = \sum_{i=1}^{p} \alpha_i \cdot y_{t-i} + \sum_{j=1}^{q} \beta_j \cdot x_{t-j} + u_t$$

$$x_t = \sum_{i=1}^{p} \alpha_i \cdot y_{t-i} + \sum_{j=1}^{q} \beta_j \cdot x_{t-j} + u_t$$

Where *ut* is white noise, *p* is the order of the lag for *y*, and *q* is the order of the lag for *x*. The null hypothesis that *x* does not Granger cause *y* is that for *j=1,2,…,q*. Likewise, the null hypothesis that y does not Granger cause x is that for *i=1,2,…,p*.

3.5 Summary

Cointegration examines whether co-movements exist in raw asset prices (or exchange rates or yields). The definition in the simple case of 2 time series x_t and y_t, that are both integrated of order one (abbreviated I(1) means that the process contains a unit root. Most economic series behave in a certain way and this is often predicted by the theory. When testing for cointegration, one notices that economic series behave like I(1) processes (Sorensen, 2005). That is, they seem to drift all over the place. The second thing to notice is that these series seem to drift in such a way that they do not drift away from each other. Unlike correlation, cointegration refers not to co-movements in returns but rather detects any common stochastic trends in the price data and uses these common trends for a dynamic analysis of correlation returns. Thus cointegration analysis is an extension of the simple correlation based analysis. Whereas correlation is based only on return data, cointegration analysis is based on the raw price, exchange rate or yield data as well as the return data.

Cointegration has emerged as a powerful technique for investigating common trends in multivariate time series, and provides a sound methodology for modeling both long-run and short-run dynamics in a system. A number of features arise from a Johansen analysis over the entire period, the results of which are presented in the next chapter.

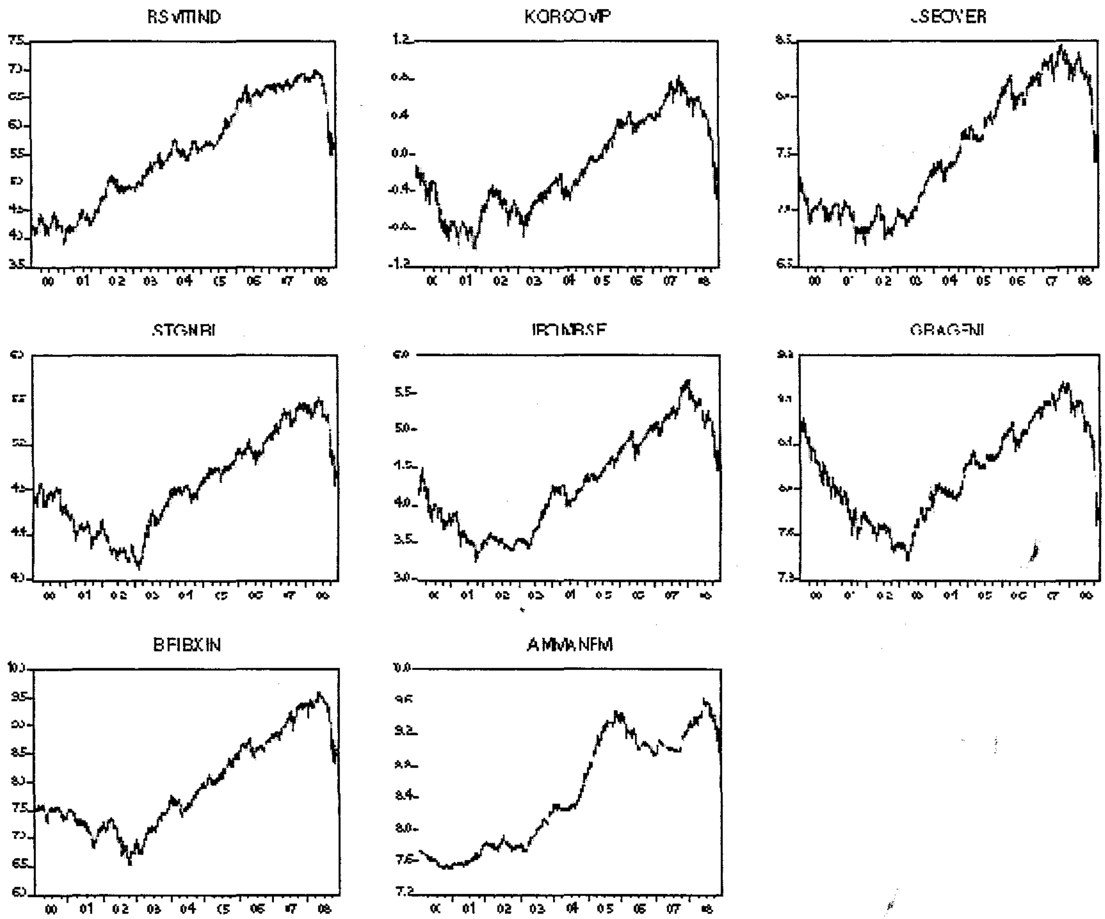
CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

This chapter presents the analysis of the data and the findings in line with the methodology discussed in the previous chapter. The chapter further provides a comprehensive analysis of the potential benefits that may be realised from portfolio diversification.

Figure 4.1 Graphical Analysis



Source: E-views

Figure 4.1 presents the share indices of eight emerging markets for the period under investigation. The data series have been logged. What is mainly evident from figure 4.1 is that the share indices of these markets tended to increase over time although there were a few periods when the prices fell. For instance, all indices exhibit an upward trend between the period 2003 and 2007. From the period 2000 to 2003, these markets tended to take a dip. The fall in the markets could be attributed to the 1999 – 2000 internet bubble. The period 2008 shows the emerging markets' share indices falling from as high as 9.6% (Brazil) to as low as 4.5% for India. Korea was the worst hit by the crisis falling from 0.8% to – 4.5%. Overall, Korea was outperformed by all the markets throughout the sample period. In general, what may be concluded is that all the emerging markets appear to be non stationary and seem to move together.

4.2 Unit root tests

Testing for the presence of a unit root in the level of the series, the study applied a set of unit root tests developed by Elliott *et al.* (1996) and Elliott (1999) as well as by Ng and Perron (2001). These tests modify conventional ADF and Philips-Perron unit root tests in order to derive tests that have better size and power. The ADF test, tests the null hypothesis that a time series y_t is I(1) against the alternative that is I(0), assuming that the dynamic in the data have an ARMA structure.

Table 4.1Results for unit root tests on the levels (ADF)

Method	Statistic	Prob.**
ADF - Fisher Chi-square	4.23126	0.9984
ADF - Choi Z-stat	2.19839	0.9860

** Probabilities for Fisher tests are computed using an asympotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results UNTITLED

Series	Prob.	Lag	Max Lag	Obs
RSMTIND	0.5684	0	12	2318
KORCOMP	0.7391	0	12	2318
JSEOVER	0.8072	0	12	2318
ISTGNRL	0.7993	1	12	2318
IBOMBSE	0.8332	1	12	2318
GRAGENL	0.7298	1	12	2318
BRIBXIN	0.8498	2	12	2318
AMMANFM	0.8607	1	12	2318

Performing the unit root and stationary tests for all the share indices and their first difference order allows the study to obtain a clear picture of the stochastic properties of the series. The ADF test assists in deriving tests that have better size and power. For instance, using the generalized least squares (GLS) de-trending technique proposed by Elliot et al (1996) and extended by Elliot (1999) maximise power and modifies the selection criterion. This criterion selects the lag truncation parameter in order to minimise size distortion. Evidence from this set of tests (see table 4.1) indicates that all share indices as well as the trading volumes are non-stationary while their first differences are a stationery process. Therefore, the unit root tests and their levels could not be rejected for all the series. However, unit root tests on the first differences are rejected, meaning that all series are of order I(1) [see table 4.2].

Table 4.2 Results for unit root tests on the first differences

Method	Statistic	Prob.**
ADF - Fisher Chi-square	237.886	0.0000
ADF - Choi Z-stat	-12.7828	0.0000

** Probabilities for Fisher tests are computed using an asympotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results D(UNTITLED)

Series	Prob.	Lag	Max Lag	Obs
D(RSMTIND)	0.0001	0	12	2318
D(KORCOMP)	0.0001	0	12	2318
D(JSEOVER)	0.0001	0	12	2318
D(ISTGNRL)	0.0001	0	12	2318
D(IBOMBSE)	0.0001	0	12	2318
D(GRAGENL)	0.0001	0	12	2318
D(BRIBXIN)	0.0000	1	12	2318
D(AMMANFM)	0.0001	0	12	2318

The rejection of the unit root tests on the first differences means that the 1st-difference of the share indices is stationary.

The results from the Phillips-Perron tests are shown in table 4.3. The results indicate that the share indices are non-stationary. However, the first differences of these indices are a stationery process (see table 4.4).

Table 4.3 The Phillips-Perron results

Method	Statistic	Prob.**
PP - Fisher Chi-square	4.12209	0.9987
PP - Choi Z-stat	2.25137	0.9878

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results GRP

Series	Prob.	Bandwidth	Obs
RSMTIND	0.5691	10.0	2318
KORCOMP	0.7598	10.0	2318
JSEOVER	0.8062	5.0	2318
ISTGNRL	0.8070	1.0	2318
IBOMBSE	0.8414	2.0	2318
GRAGENL	0.7310	6.0	2318
BRIBXIN	0.8540	14.0	2318
AMMANFM	0.8615	6.0	2318

Table 4.4 *Results for unit root tests on the first differences (Phillips-Perron)*

Method	Statistic	Prob.**
PP - Fisher Chi-square	147.365	0.0000
PP - Choi Z-stat	-10.5190	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(GRP)

Series	Prob.	Bandwidth	Obs
D(RSMTIND)	0.0001	10.0	2318
D(KORCOMP)	0.0001	10.0	2318
D(JSEOVER)	0.0001	4.0	2318
D(ISTGNRL)	0.0001	3.0	2318
D(IBOMBSE)	0.0001	6.0	2318
D(GRAGENL)	0.0001	1.0	2318
D(BRIBXIN)	0.0001	16.0	2318
D(AMMANFM)	0.0001	3.0	2318

Similar conclusions can be made between the two unit root tests, namely that the unit root tests and their levels could not be rejected for all the series. However, unit root tests on the first differences are rejected, meaning that all series are of order I (1).

The third unit root test is the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test by Kwiatkowski *et al.* (1992). The KPSS tests for the null hypothesis of level or trend stationarity against the alternative of non stationarity. The additional results provide robust inference. The overall evidence from this set of tests suggests that all the share indices are non stationary while their first difference is a stationary process. (***See results in appendix A***)

4.3 The Johansen Cointegration Approach

Using a maximum likelihood method, Johansen developed two statistical criteria to test the null hypothesis of no cointegration. The first test is the maximum eigenvalue and the second test is the trace test. Table 4.5 shows that VAR lag length selection while table 4.4 depicts the maximum eigenvalue and the trace tests.

Table 4.5 Results for VAR lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	2832.155	NA	1.51e-12	-1.678451	-1.662075	-1.672595
1	80184.88	154245.6	1.69e-32	-47.61883	-47.45508	-47.56027
2	80638.04	901.1987	1.35e-32	-47.84009	-47.52895*	-47.72883*
3	80717.96	158.5178	1.35e-32	-47.83945	-47.38093	-47.67548
4	80793.92	150.2566	1.36e-32	-47.83646	-47.23056	-47.61978
5	80917.68	244.1308	1.32e-32	-47.86188	-47.10860	-47.59250
6	81008.75	179.1611	1.32e-32*	-47.86787*	-46.96720	-47.54578
7	81047.57	76.16829	1.35e-32	-47.84279	-46.79474	-47.46800
8	81103.39	109.2073*	1.37e-32	-47.82782	-46.63239	-47.40032

* indicates lag order selected by the criterion

The results for various selection criteria are listed in Table 4.5. The LR shows the modified likelihood ratio (LR) tests statistic, each at 5 % significant level. The important aspect to note is the Schwarz information Criterion (SC) column. SC assists in selecting a model among a class of parametric models with different numbers of parameters. As can be observed from the table, SC is closely related to Akaike's information criterion (AIC). Akaike's information criterion on the other hand is a measure of the goodness of fit of an estimated statistical model. AIC is not a test of the model in the sense of hypothesis testing, rather it is a test between models, that is, a tool for selecting a model. The SC, together with the Hannan-Quin (HQ) information criterion selects 2 lags, while the Final prediction error (FPE) and AIC select 6 lags. Table 4.6 shows the cointegration of the nine share indices within a multivariate framework.

Table 4.6 Results for maximum Eigenvalue and trace tests

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	2	2	1	1
Max-Eig	1	1	1	1	1

The trace and max Eigen value denote the likelihood ratio (LR) statistics. After testing for the VAR lag length selection, a structure of 2 Lags was chosen according to the LR tests after correcting for the degrees for freedom (Sims, 1980). The two different tests suggest 1(according to the Max-Eigenvalue test) and 2 (trace test) cointegration relationships. Enders (2004) suggests that in a case where there are two cointegration equations, the maximum tests may be used. This therefore, implies that there is evidence of one significant cointegration relationship between the variables, revealing potential benefits from portfolio diversification. Both statistics reject the null hypothesis of no cointegration among the nine share indices. The results strongly suggest that there is at least one long term relationship between the nine indices. Evidence of long-run relationships between these indices implies that the domestic investor may benefit from diversifying their portfolio.

The findings may be consistent with the intuition that the eight indices are subject to common disturbances such as macroeconomic disturbances (Inflation levels, interest rate levels, tax rates, monetary policy) and political events.

4.4 The Vector error correction model (VECM)

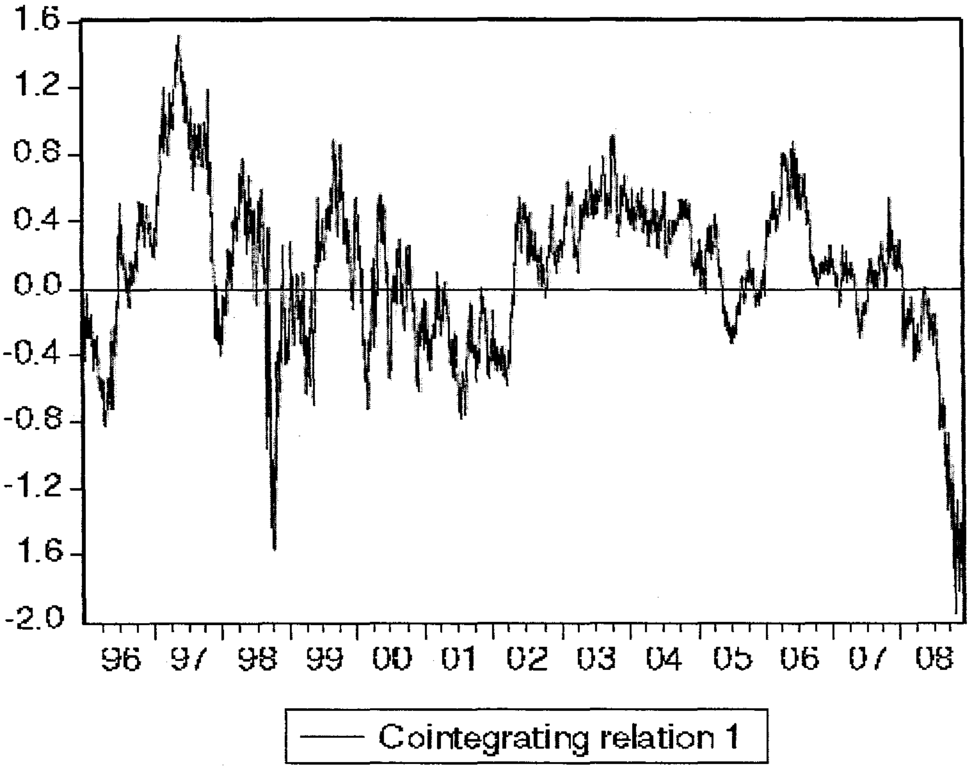
The vector error correction models (VECM) specify the short-run and LR dynamics of each variable in the system, and in a framework that anchors the dynamics to long-run equilibrium relationships suggested by economic theory (see JOHANSEN, 1995 and Lütkepohl, 2005). Given that there is one significant cointegration relationship (determined by the max-eigenvalue), it follows that the maximum eigenvalue test indicates 1 cointegrating equation at 5% significant level. Table 4.7 shows the short run equilibrium coefficients.

Table 4.7 Short run equilibrium adjustment coefficients from the VECM

Error Correction:	D(JSEOVER)	D(KORCOMP)	D(MXIPC35)	D(RSMTIND)	D(ISTGNRL)	D(IBOMBSE)	D(GRAGENL)	D(BRIBXIN)	D(AMMANFM)
CointEq1	-0.000202	-0.001677	0.001411	-0.002474	0.001785	0.001848	0.000881	0.001393	0.001428
	(0.00058)	(0.00092)	(0.00067)	(0.00127)	(0.00047)	(0.00064)	(0.00062)	(0.00087)	(0.00038)
	[-0.34854]	[-1.82188]	[2.10572]	[-1.94991]	[3.81063]	[2.88694]	[1.42728]	[1.59384]	[3.80674]

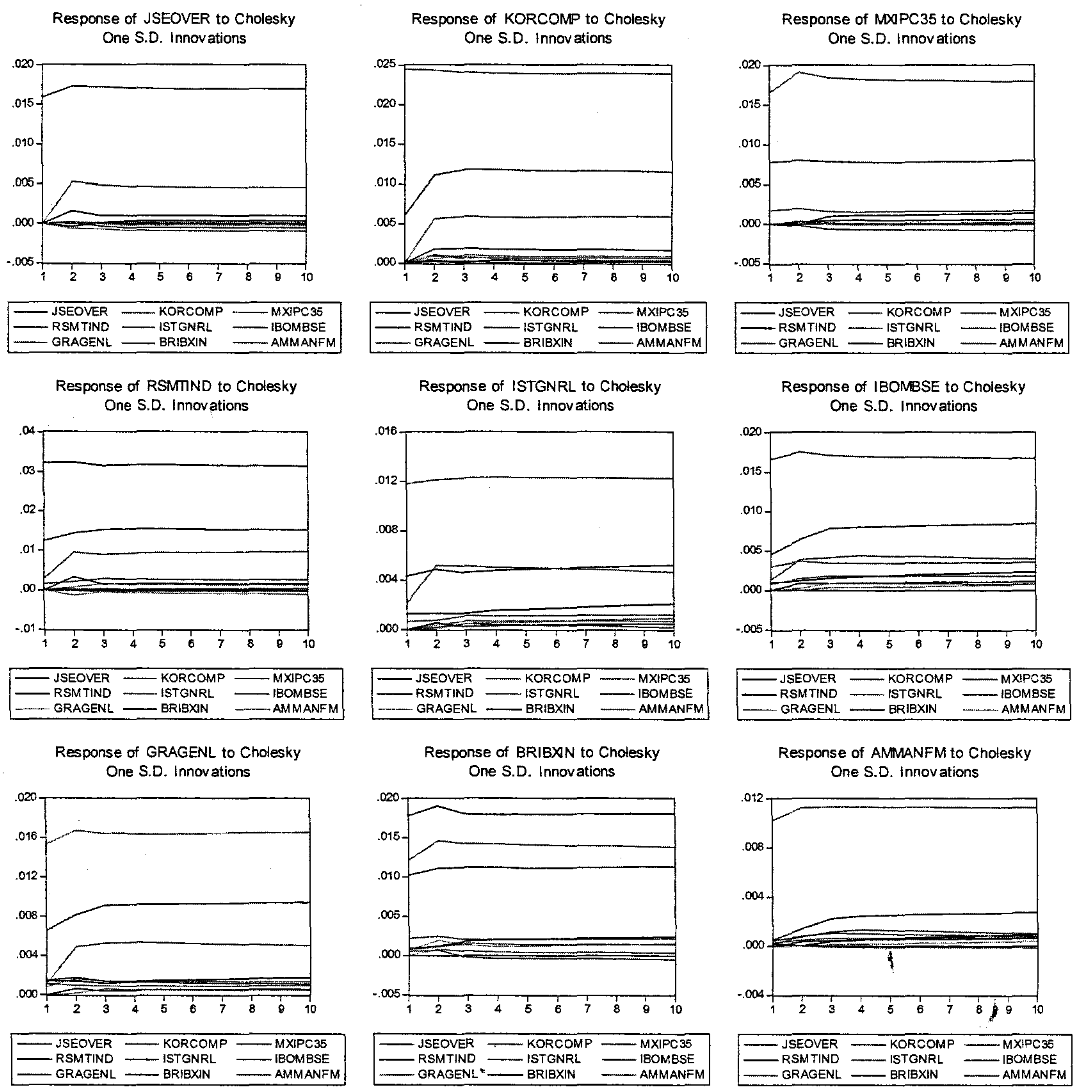
Transforming the VEC into the corresponding VAR model allows for the calculation of the impulse response functions and decomposes the variance.

Figure 4.2 Cointegration graph for equation 1.



The impulse response function illustrated in figure 4.2 describes how the variables react over time to exogenous impulses, usually referred to as shocks. These shocks are often modeled in the context of a vector autoregression (VAR) model. The shocks include five major financial crises experienced by the emerging markets. Figure 4.3 presents the impulse function results

Figure 4.3 Results of the impulse response function



The impulse responses are presented in figure 4.3. The resulting impulse responses were cumulated in order to obtain the impulse responses since the variables were entered in first differences in the VAR. The VECM orthogonalisation is the Cholesky decomposition which is the lower triangular. The variables are ordered as: South Africa, Korea, Russia, Israél, India, Athens, Brazil and Amman. For stationary VARs, the impulse responses should die out to zero and the accumulated responses should asymptote to some (non-zero) constant. The results show that the share indices are not constant. They respond to changes in the variables that affect internal and external balances.

4.5 Granger Causality tests

In order to determine whether changes in one variable are a cause of changes in another, the Granger causality test is used. Granger causality is a term for a specific notion of causality in time-series analysis (Granger, 1969). The theory of Granger causality states that a variable x Granger-causes y if y can be better predicted using the histories of both x and y than it can using the history of y alone. Testing causality, in the Granger sense, involves using *F*-tests to test whether lagged information on a variable y provides any statistically significant information about a variable x in the presence of lagged x. If not, then y does not Granger-cause x. The Granger causality tests are run in order to determine strategies that portfolio investors may use to set up short-run investment in different markets. If one market is found to have an influence over the other, the benefits from diversification become limited. On the contrary, if there is no influence at all, the benefits from diversification increase.

The Granger causality tests are divided into two sets; firstly, the pre 2000 period (that is, from January 1996 to December 1999 and secondly, the post 2000 period (January 2000 to December 2008). Both tests select the lag length $\rho = 2$. The results of the pairwise Granger causality tests are detailed in Appendix A. The null hypothesis (H_0) in each case shows that the variable under consideration does not Granger-cause the other variable.

The results suggest bi-directional causality between South Africa (JSEOVER) and the other emerging markets such as Russia, Israel, India, Athens and Amman at 5 % level of significance. Further the null hypothesis that South Africa does not Granger cause the above-mentioned indices is also rejected.

4.5.1 Pre 2000 tests results (5 observations)

Table 4.5 Pairwise Granger-Causality

Null Hypothesis:	Obs	F-Statistic	Probability
KORCOMP does not Granger Cause JSEOVER	1043	2.70407	0.06740
JSEOVER does not Granger Cause KORCOMP		11.8160	8.4E-06
MXIPC35 does not Granger Cause JSEOVER	1043	53.4422	8.1E-23
JSEOVER does not Granger Cause MXIPC35		3.27015	0.03839
RSMTIND does not Granger Cause JSEOVER	1043	0.48248	0.61739
JSEOVER does not Granger Cause RSMTIND		2.85577	0.05796
ISTGNRL does not Granger Cause JSEOVER	1043	0.13543	0.87336
JSEOVER does not Granger Cause ISTGNRL		0.14518	0.86488
IBOMBSE does not Granger Cause JSEOVER	1043	1.81786	0.16289
JSEOVER does not Granger Cause IBOMBSE		1.77515	0.16997
GRAGENL does not Granger Cause JSEOVER	1043	0.15223	0.85881
JSEOVER does not Granger Cause GRAGENL		7.37644	0.00066
BRIBXIN does not Granger Cause JSEOVER	1043	36.7225	3.9E-16
JSEOVER does not Granger Cause BRIBXIN		2.80039	0.06125
AMMANFM does not Granger Cause JSEOVER	1043	3.19123	0.04153
JSEOVER does not Granger Cause AMMANFM		0.18952	0.82739

The results of pairwise Granger-Causality tests in table 4.5 show that South Africa does not Granger-Cause most of the emerging markets. Of the eight pairs, three are rejected as they reveal a unidirectional (one-way) Granger causality. These are:

- South Africa does not Granger cause Korea
- Mexico does not Granger cause South Africa
- Brazil does not Granger cause South Africa

From a South African perspective, the null hypothesis can be rejected as there is no evidence of Granger-causality with Korea (assuming 2 lags) for the period January 1996 through December 1999. The lack of bi-directional between these two markets means that the conditions for South Africa are exogenous of the Korean market. The rest of the emerging markets reveal bi-directional causality. This means that past share prices of each market statistically improve the prediction of future trends of the other market.

4.5.2 Post 2000 test results (9 observations)

Table 4.6 Pairwise Granger-Causality

Null Hypothesis:	Obs	F-Statistic	Probability
ISTGNRL does not Granger Cause IBOMBSE	2318	18.8129	7.9E-09
IBOMBSE does not Granger Cause ISTGNRL		7.87284	0.00039
JSEOVER does not Granger Cause IBOMBSE	2318	23.8285	5.7E-11
IBOMBSE does not Granger Cause JSEOVER		3.32808	0.03603
JSEOVER does not Granger Cause ISTGNRL	2318	6.24487	0.00197
ISTGNRL does not Granger Cause JSEOVER		7.25020	0.00073
JSEOVER does not Granger Cause KORCOMP		69.8996	3.3E-30
MXIPC35 does not Granger Cause JSEOVER	2318	135.227	2.9E-56
JSEOVER does not Granger Cause MXIPC35		7.16261	0.00079
RSMTIND does not Granger Cause JSEOVER	2318	2.80538	0.06069
JSEOVER does not Granger Cause RSMTIND		4.75501	0.00869
GRAGENL does not Granger Cause JSEOVER	2318	2.99852	0.05005
JSEOVER does not Granger Cause GRAGENL		3.09073	0.04566
BRIBXIN does not Granger Cause JSEOVER	2318	86.4194	6.4E-37
JSEOVER does not Granger Cause BRIBXIN		8.76985	0.00016
AMMANFM does not Granger Cause JSEOVER	2318	1.64369	0.19349
JSEOVER does not Granger Cause AMMANFM		16.3380	9.0E-08

The results of pairwise Granger-Causality tests are shown in table 4.6. Three bi-directional causality are revealed

- South Africa does not Granger cause Israel
- South Africa does not Granger cause Russia
- South Africa does not Granger cause Athens

The bi-directional causality between these markets proves the existence of long-run relationships between them. The lack of bi-directional causality in other markets (India, Korea, Brazil and Amman) implies that over time, the share indices are independent. However, the short-run implications are that the benefits from diversification are limited.

4.6 Summary

This chapter provided a comprehensive analysis of the potential benefits that may be realised from diversification by a South African investor. The data from January 1996 through December 2008 were analysed. The Johansen (1988, 1991) Cointegration methodology was employed to examine whether there were long-run relationships among the nine share indices. The results revealed both unidirectional and bi-directional causality among the indices implying that past values may improve the prediction of future values. Further, the study found that there was at least one statistically significant long-run relationship between the eight emerging markets. These results are consistent with the study by Constantinou, Kazandjian, Kouretas and Tahmazian (2005) on the Cyprus market.

CHAPTER FIVE
SUMMARY AND CONCLUSIONS

5.1 Summary

The study sought to investigate if it is beneficial for a South African investor to diversify their portfolio of emerging market equities. Data collected were used to provide an explanation, running throughout the chapters of the study. This chapter concludes the study by summing up some broad generalisations about the findings, discussing links between this work and broader academic debates, and outlining some issues for further research on the topic.

The volatility of emerging markets is a concern for many investors. Socio-economic and political instabilities give rise to volatility. For these reasons, experts believe that emerging market investments should be on a longer-term basis. Moreover, there are ways to invest in emerging markets that reduce risk. But the bottom line is that investors should recognise that countries with deep political and social divisions and financial weaknesses can experience a series of crises (Segal, 2003). For instance, the 1990s saw five major financial crises - the Mexican crisis of 1994-1995 caused by the devaluation of the peso in December 1994. This put an abrupt end to capital inflows and precipitated the financial crisis. The East Asian crisis of 1997-1998 caused financial sector weaknesses, external sector problems and the contagion that spread from Thailand to other countries (Goldstein, 1998). The Russian crisis of 1998 was caused by the collapse in the value of the ruble and by political instability. Lastly, the Brazilian crisis of 1998-1999 was an outcome of a series of currency devaluations resulting from the change of its managed fixed exchange rate system to the floating exchange rate. The detrimental effect of major emerging market crises can be spotted quite easily and serves to show the extent to which downside risk is revealing. In retrospect, the crises of the 1990s were due primarily to a combination of unsustainable current account deficits, excessive short term foreign debt and weak domestic banking systems. Further, over enthusiasm prior to 1994 had made emerging markets vulnerable and the crises exposed the macroeconomic imbalances (Salomons and Grootveld, 2003).

After employing Johansen's (1988, 1991) cointegration methodology, the study finds that since emerging markets are in transition and hence not stable, they offer an opportunity to investors who are looking to add some risk to their portfolios. The possibility for some economies to fall back into a revolution, sparking a change in government (in the case of Russia), could result in a return to nationalisation, expropriation, and the collapse of the capital market. This further exacerbates the level of risk. Delicate exchange rate fluctuations experienced by markets such as Korea (in the Asian Continent) transformed into extreme devaluations resulting from investors speculating in the possibility of political disorder or losing confidence in the banking/financial system. Because the risk of an emerging market investment is higher than that of a developed market, panic, speculation and knee-jerk reactions are also more common. Harsch (1998) adds that one of the major features of the Asian calamity was the panic that gripped foreign investors, contributing to capital flight and a fall in share prices across the region. Since such portfolio investments are highly mobile, the contagion effect was felt in stock markets far from Asia. The 1997 Asian crisis, during which international portfolio flows into these countries actually began to reverse themselves, is an example of how emerging markets can be high-risk investment opportunities.

Crises in Korea, Russia, and Brazil, were all associated with exchange rate systems that had been more or less fixed. This suggests strong evidence that such systems are prone to crisis. Equally striking is the evidence from other countries, among them Mexico, Athens, and South Africa, that faced strong financial pressures but whose flexible exchange rates allowed them to manage those pressures far better. Given such market characteristics, possibilities of gains from diversifying one's portfolio may be possible.

The financial crises and the need for economic reforms in emerging markets have given rise to the perception that these markets are extremely volatile. Although, over the (sample period), these markets have shown signs of economic growth, have developed sound financial systems and are fully integrated into world markets, the notion that these markets are volatile still remains. Notwithstanding this notion, the study concludes that investors can benefit from diversifying their portfolios. The study also reveals the behaviour and predictability of these markets. That is, past share prices of each market statistically improve the prediction of future trends of the other market. The Granger causality test results revealed both unidirectional and bi-directional causality among the indices, implying that past values may improve the prediction of future values. However, such benefits are limited, more especially in the short-run.

According to the United Nations Conference on Trade and Development (UNCTAD) between 1980 and 1994, institutional investors tended to treat all "emerging markets" (in the developing countries and the former Soviet bloc) as a single category, so that expectations of losses in one market quickly spread to others, regardless of local economic performance. For example, when the Asian crisis occurred, South Africa, which has the largest and most active stock market on the African continent, did not initially fall victim to the panic. The South African economy displayed numerous signs of recovery during the first four months of 1998, and foreign investors poured about R16.3 billion into South African bonds. But, already jittery because of the Asian crisis, investors began to move out of South Africa in May, following rumours about the dismissal of the Reserve Bank governor and an impending devaluation of the rand. While a few of Africa's larger stock markets (such as Egypt, Nigeria and Namibia)) also experienced steep dips (in some cases because of local economic or political factors), a number of the continent's smaller markets (such as Botswana, not part of the analysis) continued to perform well (Harsch, 1998). The general sentiment about emerging markets may make investors more wary about emerging markets. However, Africa's stock markets are likely to be influenced more by local conditions, especially political stability and economic policy performance, than by external capital swings. Evidence of this analysis is shown by the lack of bi-directional (Granger-Cause tests) between two markets. This means that the conditions for a particular market are exogenous of the other market. For example, South Africa is exogenous of the Korean market.

5.2 Conclusion

Modern portfolio theory states that the risk for individual stock returns has two components: systematic risk and unsystematic risk. Systematic risk includes examples such as interest rates, recessions and wars and these cannot be diversified away while unsystematic risk can be diversified away as one increases the number of stocks in their portfolio. The understanding of these components of risks serve as the basis for MPT that it is not enough to look at the expected risk and return of one particular stock. For a well-diversified portfolio, the risk or average deviation from the mean of each stock contributes little to portfolio risk. Instead, it is the difference or covariance between individual stock's levels of risk that determines overall portfolio risk. As a result, investors benefit from holding diversified portfolios instead of individual stocks. The assumptions of MPT have been criticised in recent years by many researchers as they do not reflect accurately the players or the scenario where investment decisions are made. Various disciplines such as behavioural finance that includes emotions and human behaviour into investment decisions and/or the Arbitrage price theory that allows for prices of financial assets to be modelled by influences beyond simple means and variances, such as macroeconomic variables, have challenged the MPT's assumptions of normality in asset prices, constant correlations and rational behaviour. Despite the criticisms, MPT is still extensively used because the new theories have not been able to consistently explain asset prices. Investors, scholars and analysts in capital markets have relied on the foundation of Harry Markowitz's portfolio theory for asset allocation and, as a result, reaped the benefits from diversification. The results of this study, which are consistent with other studies (see Constantinou, Kazandjian, Kouretas and Tahmazian, 2005)

As the size and depth of the US credit crunch became apparent in 2008 and continued into 2009, investors have shifted focus from developed markets to investigating investment opportunities that emerging markets may provide. This is particularly evidenced by the emergence of the BRICS trading bloc (Brazil, Russia, India, China and South Africa). The study investigated these emerging markets with the exception of China. These markets have (post financial crisis), exhibited an unblemished track record for positive returns (higher than the previous crises of the late 1990s) which may illustrate investors' growing interest in emerging markets. The presence of long term relationship and short term dynamics confirms that these markets have successfully opened up their stock market towards the outside world and hence their stock markets are influenced by other markets.

A number of studies have documented incidences and events that create high turbulence in financial markets (see King and Wadhwani (1990); Lee and Kim (1993); Calvo and Reinhart (1996); and Butler and Joaquin (2002). However, these studies have tended to focus on developed markets and post-Asian crisis. The results of this study show that the share indices are not constant contrary to the MPT's assumption that correlation remains constant over time. They respond to changes in the variables that affect internal and external balances and therefore will tend to move simultaneously if there is a problem shock that affects one of them. This means that the benefits of international diversification to the investor will disappear when all markets come down together. Additionally, the results of the study reflect the growing interest by investors in emerging markets, particularly in the BRICS bloc. One of the contributions of this study is that emerging markets are gradually adopting the same profile as developed markets and this necessitates the need to relook at the classification of emerging markets.

5.3 Implications for global investors

Emerging markets have been characterised to exhibit high risks, high return, low correlations, predictability and non-normal distributions [De Santis (1993), Harvey (1995) and Bekaert and Harvey (2002)]. The results of the study are important for the investor. Investors need to assess whether it makes sense to invest in a certain market or geographical group and then establish their level of comfort with these characteristics and decide in advance what conditions need to exist in a market before entry.

In the case of a free market economy, it is important for investors to understand, in advance, whether a country has a traditional rule of law. A crucial indicator is a history of property rights, particularly for minority equity shareholders. Further, fair treatment of foreign investors need also be noted, which of course ranges widely from one emerging market to the next. Aggregate liquidity, aggregate market capitalisation and concentration are important factors in determining the size of assets that can be realistically invested and traded in a country. These measures are important in getting a sense of the true costs of investing. Agency risk (the degree to which agents have been delegated responsibility) and trading mechanism, that is, the type of exchange and trading conventions also matter. For example in Thailand, there are two classes of trading. Identical stocks trade on Main (for domestic investors) and Alien Boards (for foreign investors). Foreigners are restricted to a certain proportion of the capitalisation, which depends on the industry (Bailey and Jagtiani, 1993). Trading mechanisms such as the electronic settlement versus physical settlement often result in failed trades. Some markets do not have a mechanism to ensure delivery versus payment, thereby increasing intraday risk of broker failure (Umland, 2003).

Although, emerging markets are risky individually, the presence of long-run relationship among markets can lead to risk reduction and increased benefits for modest investments. As these markets develop greater links (financial and trade) with other markets, they will undoubtedly become more highly cointegrated (as this is the case to an extent with some of the developed markets). The implication for global investors is that there are diversification opportunities currently available – one should indulge while the opportunity exists.

5.3 Recommendations for further research

Much of the research in the literature of finance has focused on developed markets in the world such as Australia, Japan, United Kingdom and United States of America. Different methods and techniques, for example the widely used generalised auto-regressive conditional hetoredasticity (GARCH) models and Cointegration analysis have generated rich empirical evidence on these markets. However, this luxury seems not to exist in emerging markets. Emerging equity markets provide a challenge to existing models and beg the creation of new models. While the data are not nearly as extensive, it is better for the empiricist to use what is available than to use nothing. Such work demands extensive robustness tests, given the limited nature of the data.

Given the relation between finance and the real economy, the research done in emerging markets has a chance to make an impact beyond the particular equity markets that have been examined. More research on emerging markets is clearly needed to clarify their underlying characteristics, with emphasis on opportunities for prolonged diversification benefits.

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APPENDICES

APPENDIX A – 1

PHILLIPS PERRON TABLES

Null Hypothesis: Unit root (individual unit root process)
Series: RSMTIND, KORCOMP, JSEOVER, ISTGNRL, IBOMBSE, GRAGENL, BRIBXIN, AMMANFM

Sample: 1/14/2000 12/02/2008
Exogenous variables: Individual effects
Newey-West bandwidth selection using Bartlett kernel
Total (balanced) observations: 18544
Cross-sections included: 8

Method	Statistic	Prob.**
PP - Fisher Chi-square	4.12209	0.9987
PP - Choi Z-stat	2.25137	0.9878

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results GRP

Series	Prob.	Bandwidth	Obs
RSMTIND	0.5691	10.0	2318
KORCOMP	0.7598	10.0	2318
JSEOVER	0.8062	5.0	2318
ISTGNRL	0.8070	1.0	2318
IBOMBSE	0.8414	2.0	2318
GRAGENL	0.7310	6.0	2318
BRIBXIN	0.8540	14.0	2318
AMMANFM	0.8615	6.0	2318

Null Hypothesis: Unit root (individual unit root process)
Series: RSMTIND, KORCOMP, JSEOVER, ISTGNRL,
IBOMBSE, GRAGENL, BRIBXIN, AMMANFM

Sample: 1/14/2000 12/02/2008
Exogenous variables: None
Newey-West bandwidth selection using Bartlett kernel
Total (balanced) observations: 18544
Cross-sections included: 8

Method	Statistic	Prob.**
PP - Fisher Chi-square	147.365	0.0000
PP - Choi Z-stat	-10.5190	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(GRP)

Series	Prob.	Bandwidth	Obs
D(RSMTIND)	0.0001	10.0	2318
D(KORCOMP)	0.0001	10.0	2318
D(JSEOVER)	0.0001	4.0	2318
D(ISTGNRL)	0.0001	3.0	2318
D(IBOMBSE)	0.0001	6.0	2318
D(GRAGENL)	0.0001	1.0	2318
D(BRIBXIN)	0.0001	16.0	2318
D(AMMANFM)	0.0001	3.0	2318

APPENDIX A – 2

KPSS TABLES

Null Hypothesis: AMMANFM is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		5.458999
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.489322
HAC corrected variance (Bartlett kernel)	19.41082

Null Hypothesis: D(BRIBXIN) is stationary
Exogenous: Constant
Bandwidth: 15 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.265640
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000558
HAC corrected variance (Bartlett kernel)	0.000576

Null Hypothesis: BRIBXIN is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		5.006277
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.686942
HAC corrected variance (Bartlett kernel)	27.25280

Null Hypothesis: D(GRAGENL) is stationary
Exogenous: Constant
Bandwidth: 6 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.500185
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000256
HAC corrected variance (Bartlett kernel)	0.000319

Null Hypothesis: GRAGENL is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		3.423397
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.176085
HAC corrected variance (Bartlett kernel)	6.916588

Null Hypothesis: D(IBOMBSE) is stationary
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.365295
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000344
HAC corrected variance (Bartlett kernel)	0.000397

Null Hypothesis: IBOMBSE is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		4.951570
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.438741
HAC corrected variance (Bartlett kernel)	17.41383

Null Hypothesis: D(ISTGNRL) is stationary
Exogenous: Constant
Bandwidth: 0 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.319612
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000175
HAC corrected variance (Bartlett kernel)	0.000175

Null Hypothesis: ISTGNRL is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		4.678089
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.172341
HAC corrected variance (Bartlett kernel)	6.832636

Null Hypothesis: D(JSEOVER) is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.316957
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000305
HAC corrected variance (Bartlett kernel)	0.000308

Null Hypothesis: JSEOVER is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		5.326500
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.289213
HAC corrected variance (Bartlett kernel)	11.47640

Null Hypothesis: D(KORCOMP) is stationary
Exogenous: Constant
Bandwidth: 10 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.296388
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000498
HAC corrected variance (Bartlett kernel)	0.000445

Null Hypothesis: KORCOMP is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		4.854914
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.244984
HAC corrected variance (Bartlett kernel)	9.679849

Null Hypothesis: D(KORCOMP) is stationary
Exogenous: Constant
Bandwidth: 10 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.296388
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000498
HAC corrected variance (Bartlett kernel)	0.000445

Null Hypothesis: RSMTIND is stationary
Exogenous: Constant
Bandwidth: 39 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		5.608681
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.861176
HAC corrected variance (Bartlett kernel)	34.05321

Null Hypothesis: D(RSMTIND) is stationary
Exogenous: Constant
Bandwidth: 10 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.476921
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000617
HAC corrected variance (Bartlett kernel)	0.000632

APPENDIX A – 3

Vector Error Correction Model (VECM) (Cointegrating relationship)

Vector Error Correction Estimates

Sample (adjusted): 1/04/1996 12/02/2008
Included observations: 3369 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
JSEOVER(-1)	1.000000
KORCOMP(-1)	0.509270 (0.27597) [1.84539]
MXIPC35(-1)	-3.267242 (0.63331) [-5.15897]
RSMTIND(-1)	1.335783 (0.19234) [6.94487]
ISTGNRL(-1)	-0.345865 (0.62309) [-0.55508]
IBOMBSE(-1)	-1.211109 (0.57670) [-2.10005]
GRAGENL(-1)	1.773310 (0.32242) [5.50005]
BRIBXIN(-1)	0.501954 (0.36470) [1.37633]
AMMANFM(-1)	-0.402454 (0.21902) [-1.83750]

Short run equilibrium adjustment coefficients from the VECM

Error Correction:	D(JSEOVER)	D(KORCOMP)	D(MXIPC35)	D(RSMTIND)	D(ISTGNRL)	D(IBOMBSE)	D(GRAGENL)	D(BRIBXIN)	D(AMMANFM)
CointE q1	-0.000202	-0.001677	0.001411	-0.002474	0.001785	0.001848	0.000881	0.001393	0.001428
	(0.00058)	(0.00092)	(0.00067)	(0.00127)	(0.00047)	(0.0064)	(0.00062)	(0.00087)	(0.00038)
	[-0.34854]	[-0.34854]	[2.10572]	[-1.94991]	[3.81063]	[2.88694]	[1.42728]	[1.59384]	[3.80674]