MARKET INTEGRATION AND INTERNATIONAL PORTFOLIO DIVERSIFICATION FROM MALAYSIAN PERSPECTIVE

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MARKET INTEGRATION AND INTERNATIONAL PORTFOLIO DIVERSIFICATION FROM MALAYSIAN PERSPECTIVE

ABSTRACT

The purpose of this thesis is to investigate a comprehensive, concurrent comparison of the potential benefits of international diversification between Malaysian markets and developed and developing countries from the viewpoint of a Malaysian investor. Specifically, it bridges the theory between the cointegration methodology and international benefits of diversification by linking market integration, cointegration and portfolio diversification. This study takes a two-fold approach to investigate the issue of market integration from the perspective of a Malaysian investor who would diversify internationally with world global markets. First, the short and long run co-movements with the Malaysian market of twenty-one of the most developed and developing equity markets in the world are examined by employing econometric methodology and utilizing standard cointegration analysis. Second, mean variance analysis and the construction of a portfolio are employed to form efficient frontiers, providing the basis for recommending the degree of diversification into the Malaysian equity market. To facilitate a more comprehensive investigation, this study is divided into four sub periods to capture the effects on the Malaysian market of various stages. In addition, closing daily MSCI indices are used and the influence of financial crisis are also analysed by contrasting different periods from 1996-2007. In general, the research findings of the study are mixed in relation to the issues discussed in this study. Taking into account entire periods, pre crisis, crisis and post crisis period, some findings of the short-run and long-run causal influences and the portfolio constructions, which can be summarized. Our findings suggest, that between Malaysia and the developed markets, there were long-run relations between the developed and Malaysian market during the pre crisis and post crisis period, which indicates that obtaining abnormal profits through portfolio diversification is limited in the long-run. However, there are substantial short-run dynamic interactions between the developed and the Malaysian market for all sub periods. Moreover, the results suggest that long-run relationships among all the markets under consideration were altered by the crisis and were actually strengthened. In addition, the Malaysian market has either unidirectional or bidirectional Granger causality with the US, Japan and Hong Kong in all sub periods. There is less bidirectional relationships between the developed markets and the Malaysian market during the pre crisis and crisis period, as compared to the post crisis period. We also found that the developed countries (larger economies) are higher degree Granger cause developing (smaller economies) countries. In contrast, the variations in the Malaysian market respond more to shocks in the US, Japan and Hong Kong during the overall period, crisis period and post crisis period. In contrast, between the Malaysian and developing markets, one general conclusion that can be drawn from this long run relationship is that the developing stock markets were moving towards a greater integration either among themselves or with the Malaysian market during the crisis period and were weakened after the crisis. Our findings further imply that there was room to gain benefit from the international investment diversification to be earned by investors across developing stock markets in the post financial crisis period as the markets tended to be weaker. There appear to be extensive short-run dynamic interactions between the developing and Malaysian market in the short-run. In addition, relatively, the Argentinean market was found to have no causalities with the Malaysian market for all periods. Therefore, Malaysian investors would have much scope to include the stock of Argentina as it has maximal benefits of diversification. Whereas, the Indian market, for example, significantly Granger caused the Malaysian market during all the sub periods except the crisis period. Furthermore, the investment proportion of optimal portfolios for various interest rates between Malaysia with the developed and developing markets under consideration are different for all sub periods. In addition, it can be clearly seen that the efficient frontiers of the Malaysian and developing countries for the pre crisis and post crisis are generally superior than those for during the overall period and crisis period. An important implication of our findings is that the degree of integration among developed and developing countries tends to change over time, especially around periods marked by financial crisis. Furthermore, for policymaking, any disturbances in the markets of the US, Japan, Hong Kong or India should be taken into consideration by the Malaysian authorities in designing policies that has repercussions on the Malaysian market.

KOINTEGRASI PASARAN DAN PEMPELBAGAIAN PORTFOLIO ANTARABANGSA DARI PERSPEKTIF MALAYSIA

ABSTRAK (BAHASA MALAYSIA)

Tujuan tesis ini adalah untuk menyelidik perbandingan faedah pempelbagaian antarabangsa berpotensi yang komprehensif dan serentak antara pasaran Malaysia dengan negara maju dan negara membangun dari sudut pandangan pelabur Malaysia. Tujuan tesis ini khususnya adalah untuk menghubungkan teori metodologi kointegrasi dengan faedah pempelbagaian antarabangsa dengan menghubungkan integrasi, kointegrasi dan pempelbagaian portfolio pasaran. Kajian ini menggunakan dua pendekatan untuk menyelidik isu integrasi pasaran dari perspektif pelabur Malaysia yang mungkin mempelbagaikan pasaran global dunia di peringkat antarabangsa. Pertama, pergerakan bersama jangka pendek dan jangka panjang bagi pasaran ekuiti di dua puluh satu buah negara paling maju dan membangun di dunia dengan pasaran Malaysia diselidik dengan menggunakan metodologi ekonometrik dan analis kointegrasi yang standard. Kedua, analisis min varian dan pembentukan portfolio digunakan untuk membentuk sempadan yang berkesan, yang menyediakan asas untuk mencadangkan tahap pempelbagaian dalam pasaran ekuiti Malaysia dan negara lain. Untuk memantapkan penyelidikan yang lebih komprehensif, kajian ini dibahagikan kepada empat tempoh pendek untuk memperoleh kesan terhadap pasaran Malaysia pada pelbagai peringkat. Sebagai tambahan, indeks harian MSCI digunakan dan pengaruh krisis kewangan turut dianalisis dengan membezakan tempoh berlainan daripada tahun 1996 hingga 2007. Secara umumnya, hasil penemuan penyelidikan kajian ini bercampur dengan isu yang dibincangkan dalam kajian ini. Dengan mengambil kira seluruh tempoh, tempoh prakrisis, krisis dan pascakrisis, sesetengah hasil penyelidikan bagi jangka masa pendek dan jangka masa panjang penyebab pengaruh, dan juga pembentukan portfolio yang boleh dirumuskan. Hasil kajian kami mencadangkan, terdapat hubungan jangka panjang antara pasaran negara maju dengan Malaysia semasa tempoh prakrisis dan pascakrisis yang menunjukkan bahawa pemerolehan untung abnormal melalui pempelbagaian portfolio adalah terhad dalam jangka masa panjang. Walau bagaimanapun, terdapat interaksi dinamik jangka pendek yang besar antara pasaran negara maju dengan Malaysia bagi semua tempoh pendek. Di samping itu, hasil kajian mencadangkan bahawa hubungan jangka panjang antara pasaran ini telah diubah oleh krisis dan sebenarnya telah diperkukuhkan. Selain itu, pasaran Malaysia mempunyai sebab-akibat Granger sama ada searah atau dwiarah dengan Amerika Syarikat, Jepun dan Hong Kong pada semua tempoh kecil. Wujud kurang hubungan dwiarah antara pasaran negara maju dengan Malaysia pada tempoh prakrisis dan krisis jika dibandingkan dengan tempoh pascakrisis. Kami turut mendapati bahawa negara maju (ekonomi lebih besar) mempunyai tahap sebab-akibat Granger yang lebih tinggi berbanding negara membangun (ekonomi lebih kecil). Berbeza pula, variasi dalam pasaran Malaysia bertindak balas lebih kepada kejutan dari Amerika Syarikat, Jepun dan Hong Kong semasa tempoh keseluruhan, tempoh krisis dan tempoh prakrisis. Bagi pasaran Malaysia dengan negara membangun pula, satu kesimpulan umum yang boleh dibuat daripada hubungan jangka panjang ini adalah pasaran saham negara membangun sedang menuju ke arah integrasi yang lebih kuat sama ada dalam kalangan mereka atau dengan pasaran Malaysia semasa tempoh krisis dan akan menjadi lebih lemah selepas tempoh krisis. Selain itu, hasil penyelidikan kami menunjukkan bahawa terdapat ruang bagi pelabur untuk meningkatkan faedah daripada pempelbagaian pelaburan antarabangsa merentasi pasaran saham negara membangun pada tempoh pasca krisis kewangan kerana hubungan pasaran cenderung menjadi lemah selepas krisis. Bagi hubungan jangka pendek pula, hubungan pasaran antara negara membangun dengan Malaysia terdapat interaksi dinamik jangka masa pendek yang banyak. Pasaran Argentina didapati hampir tiada hubungan dengan pasaran Malaysia dalam semua tempoh. Oleh itu, pelabur Malaysia mempunyai banyak skop untuk memasukkan saham Argentina kerana faedah pempelbagaiannya yang maksimum. Pasaran India pula mempunyai sebab-akibat Granger yang penting dengan pasaran Malaysia pada semua tempoh kecuali tempoh krisis. Tambahan pula, kadar pelaburan bagi membentuk portfolio optimum untuk pelbagai kadar faedah antara pasaran Malaysia dengan negara maju dan negara membangun adalah berbeza bagi semua tempoh pendek. Tambahan lagi, sempadan berkesan (*"efficient frontiers"*) Malaysia dengan negara membangun yang untuk tempoh prakrisis dan pascakrisis jelas dapat dilihat lebih baik daripada negara lain semasa tempoh keseluruhan dan tempoh krisis. Implikasi penting dalam penemuan kajian kami adalah tahap integrasi antara negara maju dan membangun cenderung untuk berubah mengikut masa, terutamanya sekitar tempoh berlakunya krisis kewangan. Selain itu, untuk penggubal dasar, sebarang gangguan daripada AS, Jepun, Hong Kong dan India perlu ditangani secara berbeza dalam membentuk dasar polisi, dan pelaksanaan dasar polisi perlu dilakukan secara berhati-hati kerana ia mempunyai kesan dalam pasaran Malaysia.

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LIST OF ABBREVIATIONS

ADCC	Asymmetric Dynamic Condition Correlation Model
ADF	Augmented Dickey -Fuller
AIC	Akaike Information Criteria
APEC	The Asia-Pacific Economic Cooperation
APT	Arbitrage Pricing Model
ARDL	Autoregressive Distributive Lag
ARIMA	Univariate Autoregressive Integrated Moving Average
ARMA	Autoregressive moving-average
ASEAN	The Association of Southeast Asian Nations
BIC	Bayes Information Criterion
BNM	Bank Negara Malaysia
CAPM	Capital Asset Pricing Model
CEEC	Central and Eastern European Countries
DW	Durbin Watson
ECM	Error Correlation Model
ECT	Error Correction Term
EU	European Union
G7	A group of seven industrialized nations
GARCH	Generalized Autoregressive conditional Heteroscedasticity
GCC	Gulf Coorporation Council
GDP	Gross Domestic Product
GED	Generalized Error Distribution
GMM	Generalized method of Moments
GNP	Gross National Product

ICAPM	International Capital Asset Pricing Theory
IFC	International Finance Corporation
IRFs	Impulse Response Functions
IRS	Impulse Response Functions
KLSE	Kuala Lumpur Stock Exchange
MENA	Middle East and North Africa
MES	Max – Eigen Statistic
MPT	Modern Portfolio Theory
MSCI	Morgan Stanley Composite Index
NAFTA	North American Free Trade Agreement
OLS	Ordinary Least Square
OPEC	The Organization of the Petroleum Exporting Countries
PP	Phillips - Perron
R^2	R squared
SARS	Severe Acute Respiratory Syndrom
SC	Schwarz Information Criterion
STR	Smooth Transition Regression
SWARCH	Switching Autoregressive Conditional Heteroscedasticity
TS	Trace Statistic
UAE	United Arab Emirates
VAR	Vector Autoregressive
VDC	Variance Decomposition
VECM	Cointegration and Vector Error Correction Model

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Although a considerable amount has been written about the Malaysian market, limited research has been found in the Journal of Economics and Finance on the topic of capital market integration and portfolio diversification . The inspiration behind this study is that although extensive research has focused on capital market integration, the majority have been mostly on developed markets. Stock market between the Malaysian stock market and other countries integration has not been investigated deeply enough. Nevertheless, they are equally important in understanding the relationship of stock market integration between Malaysia and other countries.

In addition, the issue of global markets financial integration of the world's stock markets has received enormous interest from practitioners and academic researchers. The integration among the financial markets of the world has encouraged investors and academics to study the relationship among different financial markets. The globalization, financial deregulation and the liberalization of money and capital markets, as well as an improvement and development in communications technology, is expected to improve the international relationship between the capital markets throughout the world. In recent years, the bulk of the research has been concerned with the integration of the world's major stock markets.

This study intends to fill the research gap by investigating the integration using more recent data, and including almost all major markets in both developed and developing countries. In contrast to the existing literature, a number of aspects of our data have some merits. The literature is obviously insufficient in providing up to date insight into the linkages of Malaysia with other global markets. Moreover, for investors in emerging economic country like Malaysia, worldwide diversification may be vital and have significant impact on its equity market. Therefore, it is worth investigating the benefits of international diversification from a Malaysian standpoint. Moreover, the literature reviews have shown that there are divergent conclusions for potential global stock market linkages and portfolio diversification. The empirical results differ, depending on the option of equity markets, the sample time selected, the occurrence of observations – whether it is daily, weekly or monthly – and the diverse methodologies used to examine the relationship of stock markets and the benefits of international diversification. Hence, this subject matter needs further analysis.

Therefore, the emphasis on this thesis is to study the international linkage in one of the emerging markets, namely, Malaysia. This study adds to our understanding of the linkages of the Malaysian equity market with global markets, which has received little attention. Furthermore, given the conflicting evidence of the research in this field, empirical study is required. Moreover, having knowledge and understanding on market integration is crucial for individual investors, and other institutional investors, at both the local and global levels, who are seeking to branch out their investment and make potential benefits of going international. It will also provide important knowledge on signals of wealth and risk in the equity markets of the countries.

Specifically, the intention of this thesis is to examine the diversification potential benefits of the Malaysian equity market from the viewpoint of a Malaysian investor. This study takes a two-step approach to investigate this issue. First, the short-run and long-run co-movements of twenty countries consisting of developed and developing equity markets with the Malaysian market are examined by using cointegration analysis. Second, mean variance analysis and construction of a portfolio are employed to form efficient frontiers, providing the basis for recommending the degree of diversification into the Malaysian equity market. Particularly, as there are signs to show that Malaysia stock market will be the central attention for China companies to be listed in Malaysia and being a base (head quarter) to venture into Middle East, Africa, other Asian countries. Also seeing the fall of EU and USA capital market, there are trends fund manager is moving its resources to be invested in Malaysian equity market.

1.2 BACKGROUND OF THE STUDY

The seminal work of Markowitz (1952, 1959), and Tobin (1958) provide the basis for modern portfolio theory. One of the major subject matters of modern portfolio theory concerns the merits of international diversification. Early studies on the benefit of international portfolio diversification of investment has been well documented by Grubel (1968), Lessard (1973), Levy and Sarnat (1970), and Solnik (1974). Accordingly, the authors claim that low relationships among national stock markets can represent possible opportunities from worldwide diversification.

Traditionally, early figures on potential risk decrease were obtained through the examination of uncomplicated correlation formations. Diversification ideally considers the correlation coefficient of the degree to which risk is reduced by portfolio diversification. However, it depends on how highly the securities included in the portfolio are correlated. If the correlation coefficient is highly positively correlated meaning they move up and down together, the possibility of risk decline by holding these stocks will be minimal.

However, investigation of the query on equity market integration that typically estimates the correlation coefficient between market returns may have difficulties. Recent research has suggested that since such correlation may be temporally unbalanced the signal on proper combinations of assets to join the portfolio may be difficult to deduce. For instance, Forbes and Rigobon (2002) found that correlation coefficients are conditional on market volatility. Therefore, problems have been identified with using the cointegration framework.

The cointegration framework is another means by which preliminary information on asset combinations can be obtained. If assets in identical groups, but held in two or more different places are cointegrated, this would indicate that the markets are trending together over the long run. Similarly, if assets in dissimilar groups were cointegrated this would suggest that there are one or more common stochastic trends in the assets. Under such conditions, there would only be restricted chances in increasing risk reduction benefits through investing in the markets of both groups and or asset classes. There are several approaches that can be taken to analyse the presence of cointegration. Two or more commonly cited methods are the Johansen (1991) and Engle-Granger (1987) cointegration technique. In this study the Johansen (1991) methodology is applied due the fact that it suits the current volatile market and able to analyze more variables with better accuracy.

Besides holding an ideal number of stocks in the portfolio,[1] many investors also believe that a great advantage in risk discount and potential gain could be obtained through portfolio diversification in foreign securities in numerous stock exchange overseas. Consequently, this motivated many studies on diversification across nations to lessen portfolio risk. Thus, various recent studies have utilized econometric methods. For example, cointegration methods, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, Granger-causality, Vector Autoregressive (VAR) model and variance decomposition to discover whether there is integration in both developed and developing stock markets. Among forefront researchers are Morana and Beltratti (2002), Bae Karolyi and Stulz (2003), Westermann (2004), Kim et al. (2005), Ibrahim (2006), Hatemi-J and Morgan (2007), Bredin and Hyde (2008) and Majid et al. (2009).

[1] Solnik, B. H. (July/August 1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, 48-54.

Moreover, year after year, the world stock markets are being bombarded by negative events – the meltdown in October 1987, the Asian financial crisis of 1997 and 1998, the technology bubble of 2000, and September terrorist attack in 2001, SARS of 2002 and currently in 2007, the subprime crisis– which have caused increasing volatility and a panic attack on major world market share indices. However, in the past it has been complicated for investors to conveniently achieve international equity diversification benefits. The Asian financial crisis in 1997 revealed that those investors who only had investment in the local market were badly hit. In addition, with the dreadful worldwide financial crisis of the 1990s and with rising volatility in equity markets, this is an appropriate point in time for Malaysian investors and fund managers to take an optimistic look at international diversification.

The question is, what can a fund manager do to navigate through volatility? A managed established portfolio that considers integrated investment and diversification could reduce this problem. Diversifying investment across diverse asset classes such as stocks, bonds, properties and liquid cash and investing abroad in markets could reduce portfolio risk. Research has shown that diversifying across various countries across the globe would lower the portfolio risk and reflect some diversification benefits (e.g. Bekaert and Urias, 1996; Chatrath et al., 1996; DeFusco et al., 1996; Kanas 1998a; Girard and Ferreira, 2004; Brooks and Negro, 2004; Gilmore et al., 2005; Rezayat and Yavas, 2006; Driessen and Laeven, 2007; Janor et al., 2007; Lagoarde-Segot and Lucey 2007; Bley, 2007). Hence, the worldwide stock market's volatility is the main reason for international investing. Investing in different countries reduces the impact of downturn on the portfolio by means of diversification. It is important that portfolio risk be reduced through diversification.

Therefore, diversification is one of the most important ideas related to investing. In line with this, Markowitz (1952), recognizes the power of diversification and explains mathematically that by combining different stocks in a portfolio the level of risk can be reduced. The concepts laid by Markowitz on portfolio diversification confirm the golden metaphor of "do not put all your eggs into one basket". This means investing in different asset securities that do not move perfectly together. Hence, what is more important is that the fund manager is able to choose funds that perform independently or move in opposite directions.

In recent decades, the emerging stock markets in some developing countries have achieved substantial improvement. One of the major reasons for this study focusing on an emerging market, namely, Malaysia, is because there is an increase in funds flowing from developed markets towards developing markets (Bekaert and Harvey, 2000; Lagoarde-Segot and Lucey, 2007).

Lately, substantial awareness has been given to potential relations in emerging capital markets. The evidence of emerging capital markets among others are Huang and Yang (2000), Bae Karolyi and Stulz (2003), Bae et al. (2006), Li and Rose (2008), Gupta and

Molik (2008) and Mun (2008). With respect to emerging capital markets, Girard and Ferreira (2004) report that most MENA markets are segmented. The authors propose that MENA equity markets offer diversification potential for the worldwide investor. Driessen and Laeven (2007) found that the payback of investing abroad is established for investors in developing countries, including when controlling for currency effects.

1.3 PROBLEM STATEMENT

The main purpose of this study is to investigate the market integration and international portfolio diversification from Malaysian perspective. International portfolio diversifications have the potential to generate profit for different markets, with different growth performance. Despite numerous articles over a few decades exposing the benefits international diversification, many Malaysian investors are still reluctant to invest internationally. Some fund managers are skeptical investing abroad due to unfamiliar with foreign equity markets, regulations and laws of capital controls and obviously the exchange rate risk.

However, against these backdrops, and in concert with the ongoing globalization of the world’s economies, investors worldwide are finding it increasingly simple and convenient to engage in cross boarder portfolio investment. Cross boarder portfolio investment is an aspect of globalization, enabling knowledge, technology, ideas, services and capital to move more easily and quickly from country to country. As part of the continuous efforts by Bank Negara Malaysia (BNM) to reduce the cost of doing business in Malaysia, BNM are pleased to announce further liberalization of foreign exchange administration rules with effect from 1 October 2007. As Malaysian governments in recently are increasingly adopting more flexible exchange rate regimes, capital is flowing more freely throughout the world's financial markets. Non regulatory barriers to capital movement are diminishing as well. Political risk is declining as governments worldwide become more fiscally careful and responsive to increase demand for greater transparency. Information technology is also enhancing the ability of individual investor to make well researched international investment decisions.

Below is the discussion of the problem statement and is based on several aspects.

1. Developed and Developing equity markets with mixed empirical results.

The inspiration behind this thesis is that although much research has been centred on equity market integration, the emphasis has been mostly on developed markets. Integration between the Malaysian stock market and those of other countries has not been investigated nor explore through empirical evidence. In addition, judging by the huge amount of research on the developed countries in this area of study (see Choudhry (1996), Freimann (1998), Bodart and Reding (1999), Billio and Pelizzon (2003), Baele (2005), Li (2007), Bredin and Hyde (2008)) the documentation of stock market integration between Malaysia and other developed and developing countries are never be done.

Furthermore, although numerous studies have been done on the developed markets of the US, Europe and Japan (see e.g. Bodart and Reding 1999, Ibrahim 2006) studies on the integration of markets in Malaysia with other countries are still considered rare. The study of the integration of markets is important to identify the benefits of diversification to reduce portfolio risk. This study sheds some light on the linkages between Malaysia and other developed and developing countries. Although a previous study by Ibrahim (2006) focused on Indonesia, the Philippines, Singapore, Thailand and a few developed markets, namely, the US and Japan, our study focuses on a larger group of markets.

An immense number of studies confirming the benefits of international diversification have been published. However, the empirical studies came to rather diverse conclusions as the authors used different sampling data, and analysed dissimilar states within a different time period. Furthermore, in general, the studies did not use the same empirical method. Even where the writers used the same methodology, some adjustments were made to perform the empirical analysis, consequently, their studies have yielded mixed empirical results. In addition, it has to be clearly stated that although this study concentrates on the analysis of the integration of the Malaysian stock market, we focus on different research problems. Furthermore, the dissimilar characteristics in the Malaysian equity market possibly will provide different results from the existing empirical results such as the return and correlation at different key economic events.

Subsequently, this study tries to provide more up to date integration evidence on the stock market of Malaysia, using a greater model of estimation and seeking to analyse market integration at multivariate levels. Accordingly, this study attempts, to some extent, to fill up the gap in the literature as well as to provide recent empirical evidence on the stock market integration between the Malaysian stock market and their relationship with other global markets. Furthermore, Billio and Pelizzon (2003) exploit a shorter sample period that goes from 1998-2001. The sample period goes back to 1998. The advantage of a longer sample period allows a more accurate assessment of how the country effect has changed over time.

According to Meric and Meric (1989), the longer the time period, the greater the degree of stability in international stock market relationships.

Recent studies by Yusof and Majid (2006) provide empirical verification on the impact of introducing the Malaysian stock market. However, these studies remain incomplete and have the following shortfalls: They are limited to stock market changes up to 2000 and only cover selected countries, namely, the US and Japan. The article examines long run co-movement between the Malaysian equity market and the two biggest stock markets. The paper seeks to investigate which market actually led the Malaysian stock market before, during, and after the1997 Asian financial crisis periods. Therefore, longer term, post financial crisis impact on international stock markets from the Malaysian perspective is neither well documented nor understood. The integration between Malaysian and other regions has never been fully assessed. It is not even clear to what extent the impact of post financial crisis has changed the integration process of the Malaysian stock market.

This study intends to fill the research gap by exploring the integration using more recent data, and including almost all major markets. When compared with the existing literature, several aspects of our data are significant contribution to the frontier of knowledge. First, the exposure across country is more comprehensive. For example, Kim et al. (2005) examine data in 14 European countries and large markets such as the US, the UK, and Japan. Baele (2005) collected data for 15 Western European countries. Hatemi-J and Morgan (2007) covered 17 emerging markets. The literature is obviously lacking in providing up to date insights into the linkages of Malaysia with other global markets. There is no research that clearly examines the effect for Malaysia and among other countries on integration. The greater coverage within capital markets has the advantage that the database resembles the countries true integration more closely. In addition, with the opening of so many developing markets in the last decade, the past now offers a unique experiment to explore the economic and financial effects of market integration. Not surprisingly, literature has developed to try and measure the macroeconomic and financial effects of market integration. (Rezayat and Yavas (2006), Driessen and Laeven (2007)).

Furthermore, distinct from other studies, we employ a series of statistical tests on a comparatively great number of countries with the aim of studying Malaysia with developed and developing markets more forcefully and to obtain a better understanding about them. By applying a cointegration framework to twenty-one developed and developing markets, this study provides a solid report on the stock return behaviour between Malaysia and other markets for the first time. A generalized forecast error variance decomposition and impulse response analysis are employed, where the purpose is to discover the market dynamics and contemporaneous interaction of the stock market of Malaysia. The data in this study consists of twelve years of historical data from 1996 to 2007, which includes the economic crisis year of 1997. This study is separated into three sub periods to capture the effects on the Malaysian markets of a range of periods following the study of Sheng and Tu (2000).

The rationale of these sub periods are based on key economic events. Sub period 1: 31 July 1996 to 30 June 1997 involving the period before the financial crisis, sub period 2: 31 July 1997 to 30 June 1998 involving the period of the financial crisis and sub period 3: 31 July 1998 to 30 June 2007 involving the period after the financial crisis. This study provides an in depth analysis of the effect of crisis.

2. Correlation coefficient

Diversification ideally considers the correlation coefficient of the degree to which risk is reduced by portfolio diversification. Obviously, one would expect a trend for higher positive correlation as markets around the world are liberalised and different economies are more closely integrated through trade and investment flows. However, it is suspected that instability of the underlying economy due to crisis are likely to have led to chaotic changes in covariance structure. Hence, the correlation structures, which are noted to be moving closer to unity, are doubtful to be moving closer during the crisis. This is worth to investigate in order to study whether correlation across markets including developed and developing markets increase at times of pre crisis, crisis and post crisis.

3. Market integration: short and long run relationship

The relationships among developed equity markets have been studied since the 1970s. Several researchers have researched the short-term and long-term relationship among financial markets worldwide. Swanson (1987) suggests that globe equity markets are becoming more integrated, which might be accurate for the developed countries. However, only a few studies have inspected the relationship between the emerging financial markets including Malaysia. This thesis focuses on the degree of integration among stock markets in developed and developing countries. This study is expressed in Malaysian Ringgit, as it is more relevant for investment decision purposes for Malaysian investors. Specifically, the purpose of this study is to examine the market integration and international diversification of the Malaysian equity market from the viewpoint of a Malaysian investor.

Although much has been hypothesized and written about the Malaysian market, limited research has been undertaken in the literature of economics and finance concerning the topic of stock market integration. Currently, there is a notable amount of empirical literature on stock market linkages.

In addition, while developed and developing capital market integration has been examined little attention has been directed towards the question of short and long-term co-movements between Malaysia and the world equity markets. The present thesis contributes to the recent literature on international equity market interdependence by looking into the possible diversification benefits for Malaysian investors.

4. Optimal portfolio and efficient frontier

In addition, the implication of international diversification in this study is to reduce "home bias" investment. Home bias means the trend for investors to devote a great amount of domestic equities, despite the claimed benefits of diversifying into foreign equities markets. This bias is believed to have arisen because of the extra difficulties associated with investing in foreign equities, such as legal controls, exchange risk, knowledge limitations and extra transaction costs. Furthermore, international portfolio diversifications have the potential to create profit for different markets, with different growth performance. Even though there have been numerous articles in recent decades disclosing the benefits of international diversification, many Malaysian investors are still unwilling to invest internationally. Some fund managers are sceptical about investing abroad because they are unfamiliar with foreign equity markets, rules and laws of capital controls and obviously the exchange rate risk. Therefore it is crucial to quantify the investment allocation and construct a portfolio consisting of international equities that provide optimal portfolios.

Furthermore, obviously, much of the literature on international portfolio diversification takes a US standpoint. For instance, Eun and Resnick (1994) analysed the gains from international diversification of the investment portfolio from the Japanese and the US perspectives. One of the key conclusions was that the possible gains from international, as opposed to solely domestic diversification, are much superior for US investors than for Japanese investors. However, for investors in small developing countries like Malaysia, international diversification may be much demanding. Therefore, it is worth exploring the benefits of international diversification from the perspective of Malaysia by exploring in terms of asset allocation and efficient frontier.

This study takes two approaches to investigate this issue. First, the long-run co-movements of twenty-one countries, consisting of developed and developing equity markets, with the Malaysian market are examined employing tests for cointegration. Second, mean variance analysis and construction of portfolio are employed to form efficient frontiers, thereby providing the basis for recommending the degree of diversification into the Malaysian equity market.

The study of modern portfolio theory dates to the work introduced by Markowitz (1952). Since his study, several researchers have tried to measure the rate at which risk decline benefits are realized as the figure of securities in a portfolio is increased. The majority of the research work on portfolio management has highlighted the remuneration of diversification by containing an optimal number of securities in the portfolio. Among others, Evan and Archer (1968) have modelled risk in terms of the portfolio's standard deviation, and they suggested that for a randomly selected and equally weighted portfolio, there is very little risk reduction to be obtained from expanding a portfolio beyond eight to ten securities. Poon et al. (1992) came up with a different method to examine portfolio diversification. The author constructed a series of graphs to present a visual investigation of this important issue. Their results show that there are chances for reducing risk by increasing the portfolio size beyond ten.

Most of the studies, however, concentrated on developed countries, using techniques like the multifactor model, vector autoregressive (VAR), cointegration and vector error correction model (VECM), GARCH model. These include Morana and Beltratti (2002), Billio and Pelizzon (2003), Westermann (2004), Kim et al. (2005), Davies (2006) and Bley (2007). Nevertheless, they are equally important in producing and analyzing the efficient frontiers consisting of international portfolios. In addition, we do not make a stand on an asset pricing model, but basically assume that the variables before and after market integration follow a stationary process that is well explained by vector auto regression (VAR).

In summary, given the research gaps and disparities in empirical evidence discussed above, more studies on emerging markets are warranted. Therefore, the emphasis on this thesis is to study the international linkage and construction of ideal portfolios in one of the emerging markets, namely, Malaysia. Given the divergent conclusions of the research in this field, this study adds to our understanding of the linkages between the Malaysian market with global markets, which, hitherto seems to have only received slight consideration. The empirical findings differ, depending on the selection of equity markets, the sample period chosen, the rate of recurrence of observations (daily, weekly or monthly), and the diverse methodologies utilized to investigate the interdependence of stock markets and benefits of international diversification. In addition, earlier empirical studies of the interrelationship of the most vital world stock price indices have not offered consistent findings. The literature reviews above have shown that there are conflicting facts for potential international equity market linkages. Therefore, this subject needs further investigation and to be examined through empirical evidence . The discussion in this section will lead to the following research questions addressed in the problem statement and are as follows.

1.4 RESEARCH QUESTIONS

1. To what extent developed and developing countries exhibit a change in rate of returns during pre crisis, crisis and post crisis?
2. Is there any distinctive difference in the correlation coefficient between developed and developing countries during the pre crisis, crisis and post crisis?
3. Do developed and developing countries have a significance influence on Malaysian equity market in short and long run relationships or is there any integration between Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis?
4. To what extent the asset allocation and efficient are difference between Malaysia and developed and developing financial markets during the pre crisis, crisis and post crisis?

1.5 SPECIFIC RESEARCH OBJECTIVES

1) To quantify and compare the return of developed and developing countries during pre crisis, crisis and post crisis.
2) To examine whether there is any distinctive difference in correlation coefficient between the developed and developing countries during pre crisis, crisis and post crisis.
3) To examine for short run , long run co-movement or cointegration between the Malaysian stock market and the developed and developing countries by utilizing cointegration analysis.
4) To stimulate the efficient frontier and to quantify the investment proportions and construct a portfolio consisting of international equities that will provide optimal portfolios.

1.6 SIGNIFICANCE OF FINDINGS

The numerous and varied empirical findings in the literature are partly the result of different methodologies, different country and industry classifications chosen and different periods being analysed. Therefore, this study has a couple of main thrusts and adds value to the existing literature in several respects. The significance of the study is as follows:

1. Equity market integration, as the subject matter of the research, is of particular significance for the prospective improvement of the Malaysian financial system since the integration of the Malaysian capital market may stimulate economic growth and may increase efficiency. Understanding the development of integration

of the equity market division as well as being alert to the present situation of financial integration is necessary in order to further promote Malaysia’s integration process. Measuring the degree of stock market integration may thus be important for policymakers concerning the aspects of Malaysia’s integration. The analysis of this study might assist policymakers in evaluating the interdependencies of worldwide share markets, which are segmented by imposing capital controls, thereby providing policymakers the opportunity for independent domestic policies.

2. The findings of this study specify whether the Malaysian stock is segmented or whether the international investor can benefit from international diversification when spreading their investment across the Malaysian market. If stock markets share a long run equilibrium relationship, it means they have an inclination to move together towards the same direction in the long run. Therefore, these markets are integrated and provide no diversification benefits for those who are investing their money in Malaysia. Hence, the findings of this study are very important for helping financial analysts make investment choices and in providing recent empirical evidence concerning the Malaysian stock market and its relationship with the global markets. In short, moving from a system to an integrated system affects expected returns, volatilities, and correlations with the world, all of which is important for both risk analysis and fund managers. The results from the analysis could be useful to fund managers in their essential decisions for portfolio management.

3. So far, however, not much work has been done on portfolio diversification benefits across various countries, such as between the Malaysian market and the developed and developing markets. In this study, Malaysia is investigated pertaining to the development of equity market integration at the international level over a long time.

4. Our contribution to the literature is in providing more broad evidence consisting of twenty-one developed and developing countries. In view of liberalization, it will certainly be useful to examine the linkages of the Malaysian market and other markets, as it will provide quantitative estimates on Malaysian linkages between international equity markets after the financial crisis. Hence, this study reduces the country gap in analysing the integration of worldwide markets.

5. The research objectives addressed in this thesis have an obvious impact on policymakers and investors in progressively more interdependent worldwide financial and investors' stock allocation decisions. The covariance and correlation matrix of worldwide stocks is an input determinant of asset allocation in investment portfolios. The findings of this study are of obvious importance to individual and institutional investors looking to diversify into global markets. The findings may also be of interest to policymakers who are interested in stock market co-movements, since the internationalization of markets could represent significant capital inflow or outflow, and thus influence savings and consumption decisions.

6. Apart from this policy aspect, the study also assesses the implications of worldwide portfolio diversification, in particular, to the extent the Malaysian market is segmented, it could be a possible market for international investors to diversify their portfolios. All else being equal, the reduced correlation between, for example, the US and the Malaysian market means an increase in the weight of Malaysian (US) stocks in the US (Malaysian) investors' portfolio.

7. The construction of a portfolio of universal stocks will be a useful input to fund managers, investment analysts, and individual investors as well academicians. In addition, this will allow investors to identify the right stocks to invest in and hopefully be useful to investors in making the decision to estimate the future results. It also helps the fund managers and investors to understand the behaviour of Malaysian stocks and other foreign stocks as well as the volatility of the markets. In summary, this study can provide guidance on selecting stocks abroad that offer diversification gains. Hence, this study contributes the information to global portfolio managers when deciding in which countries to invest in order to diversify risks.

1.7 SCOPE OF STUDY

This study contains secondary data for the period of July 1996 to June 2007. The study comprises daily closing Morgan Stanley Composite Index (MSCI) indices as collected from Bloomberg. The Morgan Stanley Composite Index (MSCI) is used because it provides standardization, which simplifies cross-country comparisons. To facilitate a more comprehensive investigation on the benefits of international portfolio diversification, this study estimates the diversification benefits by allowing the investor to invest in developed and developing countries. Developed or developing countries are grouped under the classification of International Finance Corporation (IFC). The choice of the countries was based on the large market capitalization of MSCI indices for developed and developing countries. These indices are expressed in terms of Malaysian returns for all countries and indices using the daily exchange rate.

In the analysis, the countries equity returns are adjusted for exchange rate swings using Ringgit based exchange rates. This study is expressed in Malaysian Ringgit, as it is more relevant for investment decision purposes for Malaysian investors. The data in this study consist of twelve years of historical data, from 1996 to 2007, which includes the economic crisis year. This study is divided into three sub periods to capture the effects on the Malaysian market of various stages following the study of Sheng and Tu (2000). The rationale for the timing of these sub periods is based on key economic events. Sub period 1: 31 July 1996 to 30 June 1997, involving the period before the financial crisis, sub period 2: 31 July 1997 to 30 June 1998, involving the period of the financial crisis and sub period 3: 31 July 1998 to 30 June 2007, involving the period after the financial crisis.

1.8 METHOD OF STUDY

This study reviews different financial and economic approaches that have been developed to measure stock market integration. The validity of some results for most of the earlier tests conducted on market integration, which were based on certain asset pricing models such as CAPM and Arbitrage Pricing Model (APT), have some shortcomings. To overcome these shortcomings, recent studies have adopted different approaches to investigate the market integration issues, such as Vector Autoregressive (VAR), Generalized Autoregressive Conditional Heteroscedasticity (GARCH), and Granger causality and cointegration analyses. Among these econometric techniques, cointegration analysis is the most commonly used in exploring the market integration. Therefore, this study adopts this approach in addressing the issue of market integration. In addition, variance decomposition and impulse response analysis are also adopted to corroborate the strength of the linkages between the Malaysian stock market with developed and developing countries. Subsequently, we employed the Markowitz theory to quantify the investment proportions and the constructed portfolio consists of international equities that will provide optimal portfolios and stimulate the efficient frontier.

1.9 CONCEPT OF CAPITAL MARKET INTEGRATION

Many countries have created many opportunities and possibilities for international investment and portfolio diversification since the recent trend of the appearance of new capital markets and the recreation of foreign capital controls. This has inspired the interest of practitioners, academicians and financial economies. Many scholars have defined capital market integration in many different ways. One definition focuses on asset pricing across markets. From the stance of asset pricing analysis, markets are integrated by definition of obeying the “law of one price”. If any two markets are integrated, identical assets should be priced identically in these markets (Naranjo and Aris 1997). The rationale is because they have an identical risk level regardless of the location in which they are traded. The integration of stock markets causes all risk factors to be traded at the same price. In other words, stock market integration means that the law of one price is fully consistent throughout all traded assets. In general, it is believed that as markets become more integrated, the cost of capital decreases, because the removal of investment barriers allows for important risk sharing between domestic and foreign agents (Bekaert and Harvey, 2000).

Another approach focuses on the correlation of asset returns across different markets. The co-movements in asset returns are linked to a set of common factors. If they are perfectly correlated, then the markets are said to be integrated. Meanwhile, from the statistical viewpoint, the markets are integrated if prices in nationwide equity markets share a long-run equilibrium relationship. This suggests that prices in nationwide markets have a tendency to move together in the long-run. Therefore, this study imposes the statistical view in measuring stock market integration.

1.10 DISPUTE AGAINST INTERNATIONAL DIVERSIFICATION

Achieving international diversification has serious disadvantages, however, the most observable is the currency risk. The failure of the Bretton Woods Agreement in 1971 and the floating exchange rate system that came into effect in 1973 has resulted in international financial instability, which has affected exchange rates by increasing exchange rate volatility. Such exchange rate activities have serious implications on the profitability of international investment through the interchange of activities between the investor’s home country currency and the foreign currency. However, there appears to be no consensus on the impact of currency risk on foreign investment. Solnik (1996) argues that the rise and fall of exchange rates have never been the main reason for the entire return on a diversified portfolio over an extensive period of time because the depreciation of one currency is often counterbalanced by the appreciation of another.

Furthermore, a smaller amount of obvious disadvantages are even more significant. For example, the buy and sell spreads and other costs of performing foreign exchange transactions must be accepted by the investors. In addition, globalization and advances in technology and communications have improved the international linkages between financial markets. This has contributed to a reduction in the distribution of information cost and other costs. Hence, investors are no longer confined by high operation costs or by the complexity of gaining information to invest abroad.

However, in exceptional occasions, overseas governments may enforce capital control. The imposition of capital control might make it difficult for a foreign investor in that market to send home dividends or principal. However, many countries have recently relaxed their security laws and rules to attract foreign investors, thereby encouraging investors to familiarize themselves with the policies and regulations of stock markets in other countries. In addition, the continuing removal of obstacles to international capital flows in recent years, have made it possible for Malaysian fund managers to buy equity in overseas companies in just about any place in the world. Malaysia has maintained a tolerant foreign exchange government policy. Performing foreign exchange administration policy in Malaysia keeps checking capital flows into and out of the county to protect its financial and economic stability.

However, against this backdrop, with the continuing globalization of the world's economies, global investors have discovered that it is becoming increasingly straightforward and convenient to engage in cross border portfolio investment. Cross border portfolio investment is an aspect of globalization, enabling knowledge, technology, ideas, services and capital to shift more effortlessly and speedily from country to country. As part of the continuous efforts of Bank Negara Malaysia (BNM) to reduce the cost of doing business in Malaysia, BNM announced further liberalization of foreign exchange administration rules with effect from 1 October 2007. As the Malaysian government has recently been increasingly adopting more flexible exchange rate rules, capital is running more liberally throughout the world's financial markets. Non-regulatory obstacles to capital movement are reducing as well. Political risk is also decreasing as governments worldwide become more fiscally cautious and alert to increased demand for greater transparency. Information technology is also strengthening the ability of individual investors to make well-researched international investment judgments.

1.11 ORGANIZATION OF STUDY

This study continues as follows. This study consists of four additional chapters. Chapter two describes the theoretical setup used to gather the basic concepts, empirical evidence and techniques of international diversification. This chapter presents a discussion of the early theoretical models on stock markets integration such as the asset pricing model and arbitrage pricing theory. In addition, the chapter reviews the theories used in this study, specifically, Markowitz's Modern Portfolio Theory and Solnik's Theory of International Portfolio Diversification. The chapter also reviews some alternative approaches for testing stock market integration. Finally, it reviews the literature comprising empirical studies relating to international portfolio diversification and integration that have been published in various journals.

Chapter three presents the methods that allow us to take implications of the model to the data using a suitable empirical theory based on Markowitz's framework and econometric techniques. Chapter three also presents a description of the data and classification of the countries. Furthermore, it summarizes the significance of each objective of the study, which includes the importance of building up the portfolio. Chapter four provides forceful confirmation of the key empirical findings and the interpretation of the findings. Finally, conclusions and recommendations for further research are presented in chapter five.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The main objectives of this section are to consider and analyse the literature relating to stock market integration and the benefits of international diversification. International financial integration has been among the most commonly tested and debated concepts in the literature of finance and financial economics, and, consequently is very diverse. Various schools of thought have been developed to measure the integration of stock markets. This chapter starts with a review of the concept of stock market integration. It also discusses the early theoretical studies related to stock market integration, for example, capital asset pricing model (CAPM), arbitrage pricing theory (APT) and other alternative approaches such as econometric techniques for testing integration.

In detail, this chapter consists of six sections. Section 2.2 looks at the concept of stock market integration. Section 2.3 talks about the gains of financial market integration. Section 2.4 presents an inclusive revision of early theoretical studies relating to the empirical evidence on cointegration approaches for testing stock market integration. Section 2.5 reviews the empirical studies of various countries on market integration and empirical evidence of international diversification. Finally, the last section presents some concluding remarks.

2.2 CONCEPT OF STOCK MARKET INTEGRATION

The linkage and long-run co-movements among international stock markets, either developed or emerging, have been studied by several researchers. Before delving into the details of these studies, an important question should be raised here, that is, why does distress in one market influence other markets? Janakiramanan and Lamba (1998) mentioned four factors that contribute to this influence:

1. Dominant economic power, actions taken by an influential economic power country, like the US, will have worldwide repercussions.
2. Macroeconomic variables in different countries play an important role in determining the cointegration among stock markets in these countries. Kasa (1992) found that when a co-movement exists among stock markets, a co-movement among macroeconomic variables in these countries also exists.
3. Ordinary investor clusters, where two countries share geographical proximity and have parallel groups of investors in their markets, these markets are more likely to influence each other. However, it is worth mentioning here that having universal economic and geographic links does not automatically lead the national stock markets to follow the same stochastic trend (Chan, et al., 1997, p. 809).
4. Multiple stock listings, once an equity is listed in two countries at the same time, any distress in one market will be transmitted to the other. Indirect influences, when stock market (A) reacts directly to a shock in another stock market, say (B), and when the same stock market (A) reacts indirectly to a shock that happened in another stock market, say (C), which already has been affected by the initial shock from stock market (B). In fact, it is not only these factors that cause the co-movements between stock markets, as major

global events, especially political conflicts that happen in some parts of the world, such as the first and the second Gulf wars, and the September 11 attacks, have caused a downward trend in different national stock markets at the same time.

Meanwhile, according to Oxelheim (2001), and Naranjo and Aris (1997), if more than two markets are integrated at that time the equal securities should be priced identically within mutual markets. The same securities should bear a similar price across all stock markets where there is no transaction cost and taxes are not taken into consideration. The existence of equity market integration entails that securities in all markets are exposed to similar risk factors. The rationale is that they have a similar risk level apart from the place in which they are traded (Phylaktis and Ravazzolo 2002; Kearney and Lucey 2004). According to Stulz (1981), assets with highly correlated returns have a similar value, regardless of the location in which they are traded.

In broad, the general factor for most of these disciplines is the rule of one price. Supported by the asset pricing view, markets are integrated by definition that they obey the “law of one price”. Given this meaning, financial integration can be measured by contrasting the returns of assets that are issued in diverse countries. According to Jorion and Schwart (1986, p.603), a fully integrated market is defined as a circumstance where investors receive the equal risk adjusted expected return on comparable financial instruments in dissimilar nationwide markets. Therefore, researchers normally rely on asset returns or prices to measure international financial integration in different markets.

In addition, the interpretation that no cointegration among two or more national stock markets means long-run gains from international portfolio diversification has been suggested by quite a few authors (Taylor and Tonks 1989, p.335; Byers and Peel, 1993; Allen and MacDonald, 1995, p.39). Additionally, Kasa (1992, p.97) has argued that cointegration among countrywide equity markets implies no long-run gains from portfolio diversification.

2.3 FINANCIAL MARKET INTEGRATION BENEFITS

Financial market integration has potential benefits. According to Rangvid (2001), there are several benefits of financial market integration. Financial market combination allows global resources to flow to emerging markets, allowing them to increase investment ratios, thereby encouraging genuine growth. Moreover, it facilitates superior risk sharing among investors who are attempting to diversify their risk, as caused by divergence in the time guides of returns to actual capital investment. In other words, market financial integration reduces the expenditure of capital and smoothens the growth of investment.

However, in rare instances, overseas governments may enforce capital controls. The imposition of capital controls might make it challenging for a foreign investor in that market to repatriate dividends or principal. However, recently, many countries have relaxed their security laws and rules to attract foreign investors. Thus, encouraging investors to familiarize themselves with the policy and regulations of other countries stock markets. Furthermore, Narayan et al. (2004) suggested that the removal of barriers across national borders leads to an increase in the flow of capital, the diminution in transaction costs and to a reduction in the dissemination of information cost and other costs, which commensurable increase in the flow of information will advocate the investors diversify their assets across different stock markets granted that returns to stock in these markets are not as much of perfectly correlated with domestic market.

In addition, monetary policy is affected greatly by the integration of stock markets. It is broadly acknowledged that economic and financial policies have a great influence on the status of equity markets. Bekaert and Harvey (1995) report that*, "whether a market is integrated with world capital markets or segmented is greatly influenced by the economic and financial policies followed by its government or other regulatory institutions".*

2.4 THE EARLY THEORETICAL STUDIES RELATING TO STOCK MARKET INTEGRATION

In recent decades, various schools of thought have focused on the subject of equity market integration and have been developed to compute the integration of equity markets. This subsection will review the early theoretical models relating to equity market integration. In particular, the study analyses the literature relating to equity market integration using different models, for example, Modern Portfolio Theory (MPT), Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT) and International Capital Asset Pricing Theory (ICAPM).

2.4.1 Modern Portfolio Theory (MPT)

One of the earliest investigations that designate the importance of the diversification of risk was the seminal work by Markowitz (1952). Markowitz chose to relate mathematics to the study of the stock markets. Markowitz's insights were nothing short of ground-breaking. His 1952 paper laid the foundation for the development of Modern Portfolio Theory (MPT), and a range of fresh ways of thinking about investing. His ideas also added to various practical applications that are often used by investors today. This led to the expansion of his seminal theory of portfolio allocation under uncertainty, which was published in 1952 by the Journal of Finance.

MPT creates several very sensible statements about the way investors act regarding risk. Markowitz begins with the statement that all investors would like to stay away from risk whenever feasible. Even though a quantity of investors can take more risk than others are capable of, investors are assumed to be risk-averse. A risk-averse individual is one who when faced with assets that are sure to offer similar return, will choose the asset with the lowest risk. In order for investors to agree to higher risk, they will desire to be recompensed with the possibility of earning a higher return, and vice versa. Portfolio theory shows how risk averse investors construct portfolios with the aim of optimizing expected returns for a given stage of market risk. The theory measures the benefits of diversification. Out of a world of risky assets, an efficient frontier of optimal portfolios can be constructed. Each portfolio on the efficient frontier recommends the highest expected return for a given risk level.

Repeatedly mentioned as the father of modern portfolio theory, Markowitz was among the initial attempts to compute risk and demonstrate quantitatively why and how portfolio diversification works to lessen risk for investors. Markowitz theorized that an appropriately diversified portfolio would offer the highest return for a given level of volatility – or lowest amount volatility for a given stage of return. He also developed a model that illustrated how this “efficient” portfolio may perhaps be constructed. He was also the earliest to establish the concept of an "efficient portfolio". An efficient portfolio is one, which has the smallest attainable portfolio risk for a given level of expected return (or the largest expected return for a given level of risk).

By defining investment risk in quantitative terms, Markowitz gave investors a mathematical approach to asset selection and portfolio management an option come close to organize investments engages conclusions based upon modern portfolio theory. Modern portfolio theory was developed as an outcome of studies linking investor activities and the apparently noticeable investor anxiety with risk and return. Markowitz thought that investors should be equally concerned with the volatility or risk of investments as they are with the return on investments. He describes risk as a standard deviation of expected returns. Owing to the likelihood of falling risk through diversification, the risk of the portfolio, measured as its variance, will depend not only on the individual variances of the return on different assets, but also on the pair wise covariance of all assets.

Markowitz was further credited with the formulation of two conditions vital to the growth of the portfolio theory: the expected rate of return and the expected risk measure. Thirty-eight years later, this pioneering, useful theory earned him the 1990 Nobel Prize in Economics. This sign input to the investment globe was first published in 1952 in an essay entitled, "Portfolio Selection". He also authored a book entitled, Portfolio Selection:

Efficient Diversification (1959). For a number of decades, many institutional and urbane investors used his notions in the construction and management of their investment portfolios.

Regarding diversification, Markowitz (1952) concluded that it *"reduces risk only when assets are combined whose prices move inversely, or at different times, in relation to each other."* In other words, to increase the advantages defined by Modern Portfolio Theory, portfolios need to include diverse classes of assets whose prices move independently of each other. The model has won extensive acclaim due to its algebraic simplicity and suitability for practical purposes.

2.4.2 Inputs Required for Portfolio Analysis

The aim of Modern Portfolio Theory is to produce portfolios with the lowest potential volatility for any given investment return, and the highest return for any given level of risk. Markowitz showed investors that the information needed to estimate the risk/return ratio on any portfolio can be resolved by using three statistical equations: Expected return (mean), standard deviation of returns (risk), correlation and covariance. Awareness of these terms is crucial to understanding how Modern Portfolio Theory aids investors establish the efficiency of their portfolios.

2.4.2.1 Expected Return on Portfolio

The anticipated return of a portfolio is a weighted average of the expected return of stock market indices for a particular country. Portfolio return is the proportion-weighted combination of the constituent equities market indices returns. Regardless of the amount of asset held in a portfolio or the quantity of total investable funds put in each asset, the expected return on the portfolio is for all time a weighted average of the expected returns for individual assets in the portfolio. The expected return on any portfolio can be computed as follows:

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

Where

$\sum W_i = 1$; assume no short sales

$E(R_p) =$ the expected return on portfolio p

W_i = the proportion of stock market indices in the total portfolio

R_i = the expected return on stock market index i

n = the number of stock market indices in the portfolio.

2.4.2.2 Portfolio Variance (Risk)

While there are many types of risk and different methods of measuring them, the Standard Deviation of (historical) returns is probably the most common measure of the risk of listed securities and portfolios. It is a statistical measure, which measures the variability of returns (about the mean or average). The higher the standard deviation, the more uncertain the outcome over any period. Standard deviation is very useful in that it enables us to compare the riskiness of different types of investment.

In MPT, risk is described as the sum variability of returns, approximately, the mean return and is calculated by the variance, or equally, standard deviation. By explanation, risk is the hazard or likelihood of loss and is frequently clarified in terms of unsystematic risk and systematic risk in the investment world. Unsystematic risk is the risk of price change due to the unique circumstances and can be practically eradicated through diversification. Whereas, systematic risk is also called market risk and it is general to an intact group of assets or liabilities as an outcome of investor activities. The systematic risk of an investment or portfolio is calculated by the standard deviation of its rate of return. The standard deviation is a guide that tells you how near, or far away, all the various return numbers are from the average when monitoring a set of figures. With investments, systematic risk refers to volatility. Volatility is found by scheming the standard deviation of modifies in return rates. If returns of a security move up and down speedily over short time periods, it has high volatility. If returns are stable, it has low volatility. The greater the volatility, the greater your risk of loss. Markowitz determined that asset allocation could protect against systematic risk because different portions of the market tend to underperform at different times.

Furthermore, the rate of recurrence and total price fluctuation of an investment are called volatility. Volatility is also a measure of investment risk. The more volatile an investment is, the more risk there is for a return. The Modern Portfolio Theory proposes that there is a connection between risk and reward and that investors are rewarded for taking investment risk over time.

The portfolio risk is symbolized by the weighted average of the variability and the correlation of the returns from the sampled equity market indices. For this, the mean variance model is used to recognize an optimal allocation of portfolio in some equity market indices. The fundamental principal behind the exploration for an optimal allocation is the Markowitz Efficient Frontier Model as stated below:

$$\sigma_p^2 = \sum_{i=1}^{n} W_i^2 \sigma_i^2 + 2 \sum_{i=1}^{n} \sum_{i=1}^{n} W_i W_j \sigma_i \sigma_j \rho_{ij} \qquad (2)$$

And $W_i \geq 0$

Where

i $\neq$ j

$\sum W_i = 1$; no short sales permitted

$\sigma_p^2 =$ the portfolio variance

$\sigma_i \sigma_j =$ the standard deviation of stock market index i and j, respectively,

$\rho_{ij} =$ the correlation coefficient of stock market index i and j, respectively,

$W_i W_j =$ the proportion of stock market index i and j, respectively, in the portfolio.

Subject to:

1) $W_i \geq 0$ i=1,…..N that implies that short selling is not allowed

2) $\sum W_i = 1$ ensures that the portfolio is fully invested.

2.4.2.3 Volatility

The Portfolio volatility can be related in the following manner:

$$\sigma_p = \sqrt{\sigma_p^2} \qquad (3)$$

2.4.2.4 Covariance

Covariance is a different statistical measure for volatility. However, variance cannot inform us of the risk of the whole portfolio; the average of a series of variances is not a helpful measure for portfolio risk. What Markowitz recommended, now viewed as his best success, was to adopt covariance as a measure of portfolio risk, supported on the accessible method for the variance of a weighted sum. Covariance measures the correlations of a group of securities, when two stocks have high covariance it means their prices move together in pace, when covariance is low the stock trends in opposite directions. To Markowitz, the risk of a portfolio is not the variance of individual stocks, but the covariance of the holdings. The key was to agree to a portfolio with the lowest possible covariance, thus removing the risk that a single event could force down all investments at the same time. The formula is an argument for diversification. A portfolio of highly risky shares could have a small overall risk if their effects were to move in opposite directions.

The common evaluation of the accuracy of a relation between two variables *x* and *y* is the correlation coefficient (r_{xy}). It is calculated in part from the creation of the deviation of each observation of *x* from the mean of the *x* values and the deviation of each observation of *y* from the mean of the *y* values and multiplies these differences together – a measure called the covariance of *x* and *y* (cov *xy*).

Traditionally the formula for covariance is given as below:

$$Cov\ \mathrm{xy} = \frac{(x_1 - \bar{x})(y_1 - \bar{y}) + (x_2 - \bar{x})(y_2 - \bar{y}) + \ldots + (x_n - \bar{x})(y_n - \bar{y})}{n}$$

$$\text{Cov xy} = \frac{1}{n}\sum_{i=1}^{n}(x_1 - \bar{x})(y_1 - \bar{y}) \tag{4}$$

Computationally, it is more efficient to use the following equivalent formula to calculate the covariance. A rule that is precisely algebraically comparable but that formulates calculation easier, as shown below.

$$\text{Cov xy} = \frac{1}{n}\sum_{i=1}^{n} x_1 y_1 - \bar{x}\bar{y} \tag{5}$$

Where;

n = the number of stock market indices in the portfolio.

$\bar{x}$ = average of stock index x

$\bar{y}$ = average of stock index x

x_1 = a single sample of stock index x

y_1 = a single sample of stock index y

2.4.2.5 Correlation Coefficient

Every asset division will normally have dissimilar levels of return and risk. They also behave in a different way. At the time one asset is rising in value, another may be declining or, at least, not increasing as much and vice versa. The computation used for this phenomenon is described as the correlation coefficient.

A key notion of the Modern Portfolio Theory is the idea that investors frequently fail to consider the degree of “correlation” between different investments held in a portfolio. Correlation is the degree to which the prices of different investments move in the same direction. When different investments move in the same direction a great deal of the time, there is a high degree of correlation. When different investments do not move “in sync” with each other, there is a low degree of correlation. Markowitz held the position that risk in a portfolio could be reduced and rates of return increased when there is a low degree of correlation between the investments held in a portfolio.Correlation coefficient is a gauge of the extent to which two assets (or investments) move together. The significance of the correlation coefficient ranges from -1 to +1. Assets, which have a correlation coefficient of -1, are completely negatively correlated. Their values move concurrently in reverse directions and scale.

For a value of +1 they are absolutely optimistically correlated. Their values move concurrently in a similar direction and magnitude. A correlation coefficient of 0 indicates that there is no connection at all. In reality, most assets have some positive correlation, even though it may be very small.

Markowitz then mulled over how all the investments in a portfolio can be expected to move collectively in value under the identical conditions. This is called "correlation," and it computes how much you can anticipate diverse securities or asset classes to change in price in relation to each other.

The correlation, ρ_{xy} is defined as

$$\text{Correlation xy} = \rho_{xy} = \frac{\operatorname{cov} xy}{\sigma_x \sigma_y} \tag{6}$$

Where

ρ_{xy} = the correlation coefficient of stock market index x and y, respectively,

Cov xy = covariance of x and y

$\sigma_x \sigma_y$ = the standard deviation of stock market index x and y, respectively,

In the technique for correlation, the results of the deviations are divided by the result of the standard deviations of *x* and *y* (σ_x and σ_y). This normalization by the standard deviations has the effect of making ρ_{xy} a dimensionless number that is self-determining of the units in which *x* and *y* are calculated. So defined ρ_{xy}, will vary from −1, which indicates a completely linear negative relation between *x* and *y*, to +1, which points to a perfectly linear positive relation between *x* and *y*. If $\rho_{xy} = 0$ there is no linear relation between the variables.

2.4.3 Efficient Portfolios (Optimal Portfolios)

The Markowitz Portfolio Theory also inspects the arch called the efficient frontier. The thought behind this arch is a graphic appearance of a set of portfolios that offer the highest rate of return for any given stage of risk. However, the efficient frontier identifies portfolios that recommend the least amount of risk for any given stage of return.

When a portfolio is capable of gathering its expected returns with the smallest possible risk, it is called an optimal portfolio. By altering the portion of investments in a portfolio, we can construct a number of diverse optimal portfolios with varying returns. All of these portfolios offer the lowest stage of risk possible for each stage of return. They also offer the highest returns for each risk stage.

This whole set of possible optimal portfolios is known as the efficient frontier. The Efficient Frontier is the compilation of all efficient portfolios and is represented on the attached graph as a solid line. Given that our objective is to raise expected return and to decrease risk, we will only be concerned with those portfolios that lie near the solid line. Because diversification is an influential way of accomplishing risk reduction, the investment verdict is not merely which securities to own, but how to segregate the assets among securities.

For each risk level, the efficient frontier locates the portfolio with the highest returns. It also reveals the portfolio with the smallest amount of risk for each level of return. An efficient frontier is charted as a curve as below. The Efficient Frontier graph below shows the relationship between risk and return. From this graph, the line area is the efficient frontier. The investor then uses the efficient frontier to choose a portfolio that matches his or her risk tolerance.

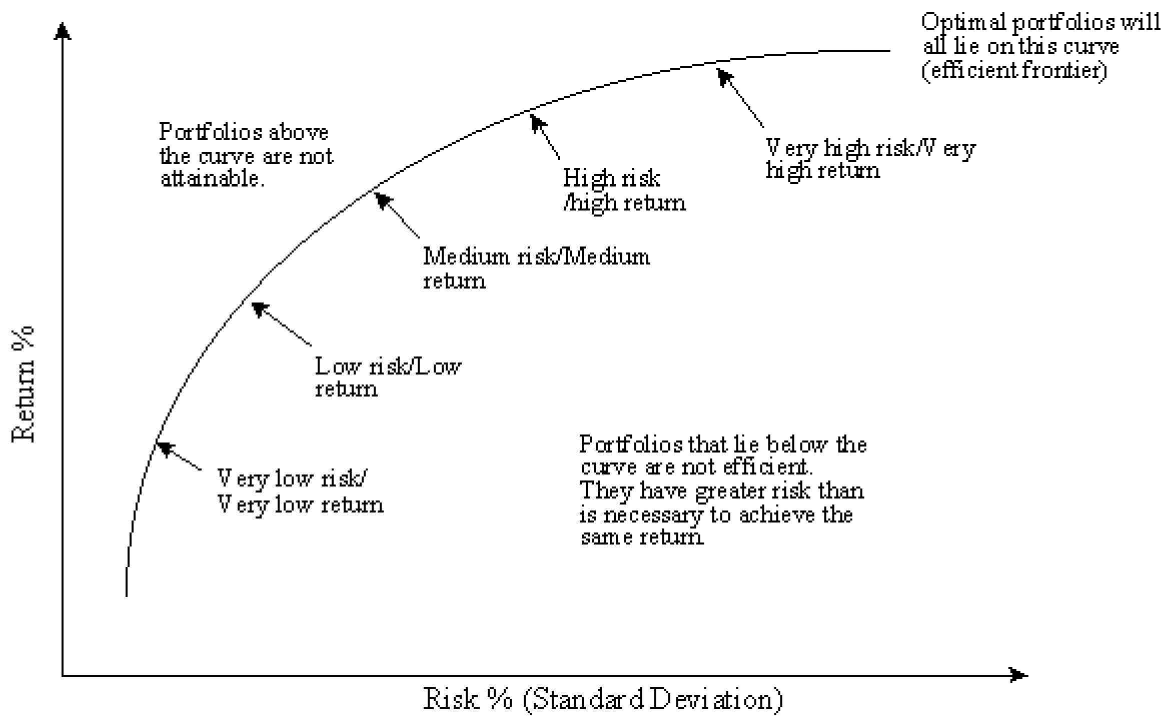

Figure 0.1 The Efficient frontier

Source: Elton Edwin J., Gruber Martin J., Brown Stephan J., and Goetzmann William N., Modern Portfolio Theory and Investment Analysis, 6th ed, Wiley, 2005.

The portfolio optimization process starts after the initial selection of asset classes. Minimum and maximum holding ranges are established for each asset class to ensure adequate diversification before running the optimization program using Microsoft Excel. We use historical and or forecasted returns, standard deviations, correlations, and covariances in calculating an optimal mix of assets for a portfolio at any level of desired volatility (risk). The optimization process requires adding and deleting asset classes and or changing holding constraints until an optimal mix of assets is achieved that meets the investor's risk tolerance and rate of return. The optimal portfolio is then further compared against other portfolios and/or independent variables to calculate beta, alpha coefficient, Sharpe ratios values etc. These values fairly indicate how the portfolio will react in different "what if" scenarios.

The core centre is given to portfolio composition rather than individual security analysis. Risk and reward restrictions are quantified for portfolios then contrasted and optimized with past data. Dissimilar combinations of asset class construct an efficient frontier curve that gives the highest possible rate of return for every level of risk that the investor is willing to take. Any further portfolio not on the efficient frontier curve, which displays the same standard deviation (risk), will produce lower returns and, consequently, will be considered inefficient.

In Markowitz's investigation of investor activities, Markowitz identified diverse categories of investment knowledge as positive or negative investment operations – distinctiveness of return and volatility – at dissimilar times. From this, he also concluded that when merging two investments that achieve in a different way together, the portfolio revealed a lesser amount of volatility than expected. Taking this inspection significantly advance, Markowitz developed a resourceful computational model to recognize all potential portfolios that recommends to investors both highest expected return for diverging stages of risk and lowest risk for diverging stages of expected return. Once illustrated graphically, this set of efficient portfolios form a locus line referred to as the efficient frontier – this is where the most excellent portfolios are.

The Markowitz efficient investor will try to find his or her optimum portfolio someplace along the efficient frontier arch, depending on their personal view of the return-risk link. Every portfolio on the arch will either have a greater rate of return for the same or lower risk, or lower risk for an equal or better rate of return when matched to portfolios or securities that are not on the efficient frontier.

As portfolios have the benefit of diversification due to the improperly correlated assets contained within them, the efficient frontier is in actuality composed of portfolios rather than individual securities or assets. The two potential exceptions would be the efficient frontier curve's end points, at the start of which could be the asset with the lowest risk and at the end of which could be the asset with the highest return.

Assume there are no short selling and no risk less lending and borrowing, this yields the following formula:

$$\text{Minimize} \sum_{i=1}^{n}(x_i^2\sigma_i^2) + \sum_{i=1}^{n}\sum_{\substack{j=1 \\ j\neq i}}^{n}(x_i x_j \sigma_{ij}) \qquad (7)$$

Subject to:

$$\sum_{i=1}^{n} x_i = 1$$

$$\sum_{i=1}^{n}(x_i \overline{R}_i) = \overline{R}_p$$

$x_i \geq 0$, i =1,…,n

Where

R_p = total return to the portfolio

x_i = fraction of portfolio represented by asset i

R_i = return to asset i, i=1,…,n

σ_i^2 = variance of asset i and

σ_{ij} = covariance of asset i and j, i=1,…,n, j=1,…,n, i≠j

In summary, Modern Portfolio Theory quantifies the benefits of diversification. Through an arithmetical method called mean-variance optimization, Markowitz illustrated precisely how an investor could lessen the volatility (risk as measured by standard deviation) of portfolio returns by deciding assets that do not move closely simultaneously. When he charted volatility (risk) against expected return, Markowitz developed a technique to analyse the efficiency of a portfolio. A portfolio is believed to be optimally efficient if there is no portfolio comprising the identical volatility (risk) with a larger expected return and there is no portfolio having the identical return with a smaller volatility.

Going beyond Markowitz, Tobin (1958), argues that investors would diversify saving between a risk free asset and a single portfolio of risky assets. By joining a risk free asset with risky assets, there is the potential to build portfolios whose risk return profiles are superior to those of the portfolios on the efficient frontier. By doing this, what is called the capital market line has been constructed as a tangent line to the efficient frontier that passes through the risk free rate.

An immense amount of investigation presenting confirmation of the benefits of international diversification has been published. Grubel (1968), and Levy and Sarnat (1970) were among the earliest to demonstrate that intensifying the investment universe from only US stocks to take account of foreign stock enhanced portfolio diversification. Grubel (1968) published the first theoretical paper on international portfolio theory employing the Markowitz model. Levy and Sarnat (1970) gave further details on Grubel's work. Both of these papers employed the price indices of the common stocks of different countries in testing the benefits of Markowitz diversification on an international level. Both papers concluded that when an American investor diversified his portfolio to incorporate securities from other countries he was able to obtain a superior rate of return or a lower standard deviation.

2.4.4 Capital Asset Pricing (CAPM)

An innovation within the field of portfolio theory started with the formulated asset pricing models, such as Capital Asset Pricing Model (CAPM). Sharpe (1964), and Lintner (1965), independently, developed the capital asset pricing model. CAPM extended the previous effort of Harry Markowitz on diversification and Modern portfolio. In their model, they assumed that markets are segmented. CAPM performs a very important role in setting up the foundation of the modern portfolio theory. The capital market line graphically represents the model. It is implied by the following relationship:

$$E(r_i) = r_f + \beta_i [E(r_m) - r_j] \qquad (8)$$

Where $E(r_i)$ and $E(r_m)$ represent the expected return on stock *i* and the market portfolio, respectively, r_j is the return on the risk free stock and β_i (beta) measures the sensitivity of stock i to the market risk factor – the slope of the lines. It is calculated by:

$$\beta = \frac{\mathrm{cov}(r_m, r_i)}{\mathrm{var}(r_m)} \tag{9}$$

Where $\mathrm{cov}(r_m, r_i)$ is the covariance of returns of the *i* th asset with the market, $\mathrm{var}(r_m)$ is the sum risk of the *i* th asset. This sum risk is able to be partitioned into a fraction by using ordinary least squares, as follows:

$$\mathrm{Var}(R_i) = \beta_i^2 \,\mathrm{var}\,(R_m) + \mathrm{var}\,(e) \tag{10}$$

Where $\beta_i^2 \,\mathrm{var}(R_m)$ is the market risk (systematic risk) or the undiversifiable risk, which is the fraction of an asset that cannot be removed via diversification. This risk designates how including a particular asset in a diversified portfolio will contribute to the riskiness of the portfolio, in other words, this sort of risk relates to general market movements. Var (e) is the firm precise risk or unsystematic risk that can be diversified or eliminated away by counting the stocks as fraction of diversifiable portfolio.

According to Bekaert & Harvey (2003), the CAPM is based on the following assumptions:

1. Investors investment decisions are based on expected return and the variances of security return.
2. Investors are risk averse.
3. Asset returns are multivariate normally distributed.
4. Investors can borrow and lend at the same riskless rate.
5. There exists a free risk asset.

6. Perfectly competitive markets and all information are reflected fully in prices.
7. There are no transactions cost and taxes.
8. Capital markets are in equilibrium.
9. All investors have "one-period" time horizon.

According to this model, national markets are considered to be integrated if securities with the same risk characteristic are priced the same, even if they are traded on different markets. CAPM has been developed in the framework of the domestic market and the idea of diversification is well thought out as the core concept of this model.

Barari (2004) examines stock market integration in Latin America by calculating tie-varying integration scores supported on the Capital Asset Pricing Model's (CAPM) betas over moving estimation windows.

2.4.5 Arbitrage Pricing Theory (APT*)*

An alternative model to CAPM is called Arbitrage Pricing theory (APT). The economist Stephen Ross initiated APT in 1976. The APT is unlike CAPM. APT involves some unrealistic assumptions and only has one source of systematic risk (market return). In other words, it assumes that stock prices can be influenced not simply by the market risk, but also by several sources of systematic risk in the economy. These sources of risk can be thought of as factors, in addition to the market, such as inflation and interest rate. The model has the following general form:

$$E(R_i) = B_0 + \sum_{i=1}^{n} B_i F_i + u_i \tag{11}$$

Where $E(R_i)$ = expected return of asset i

B_0 = a constant

$F_1...F_n$ = values of factors from 1 to n

B_i = sensitivity of asset return to particular factor

u_i = residual term

Basically, most of the early theoretical research on market integration has been built according to these two models, the CAPM and the APT. CAPM has been developed in the perspective of the domestic market. The core idea of this concept is diversification.

Cauchie et al. (2004) concentrate on the topic of the determinants of security returns in a tiny open economy. The empirical focal point of studies attributing small, open markets focuses on the consequence of international markets such as the UK, Germany and the US. They implement the APT to model Swiss stock returns and present confirmation of the significance of global conditions, including the general economic activity, credit conditions and the stock market atmosphere.

2.4.6 International Capital Asset Pricing Model (ICAPM)

Black (1974) developed an international capital asset pricing model in which there are specific obstacles to international investment in the structure of a tax on the holding of assets in one country by residents of another country. His theoretical model took the following form:

$$E(R_i) - R - \tau_i = \beta_i [E(R_m) - R - \tau_m] \tag{12}$$

Which after rearranging we obtain:

$$E(R_i) = R + \tau_i + \beta_i[E(R_m) - R - \tau_m] \tag{13}$$

Where R is the short-term interest rate in country C

τ_i = the tax rate on security *i* for investors in country C

$E(R_m)$ = the expected return of the market portfolio specific to country C

τ_m = the tax rate on market portfolio for investors in country C

β_i = defining by the $\mathrm{cov}(R_i, R_m)/\mathrm{var}(R_m)$, which is the systematic risk of security i

Equation 13 is a modified form of equation 8, which represents CAPM. If the taxes on the international investment are zero ($\tau_i = \tau_m = 0$) then equation 13 will be the same as CAPM. He also suggests a uniform tax rate across countries. The tax rates become much easier to approximate the strength of difficulties to international investment in risky assets.

2.5 EMPIRICAL EVIDENCE

Section 2.5 reviews most of the literature related to the integration of stock markets in equally developed and emerging stock markets. It also presents the empirical evidence on market correlation. Finally, this section reviews relevant research on international portfolio diversification.

2.5.1 Empirical Evidence on Market Correlation

The expression “stock market integration” refers to an area of research in the literature of finance and economics. It covers a lot of phases of interrelationship across equity markets. A mixture of schools of thought have been developed to measure the integration of equity markets. A number have used the correlation of the domestic market return with the globe return as a computation of integration. Several papers demonstrate the advantages of international diversification stemming from low correlation (Levy & Sarnat 1970, Lessard 1973, Solnik 1974; Lessard 1976, Watson 1978, Levy & Lerman 1988, Meric & Meric 1989, Divecha et al., 1992., De Fusco R. A. et al., 1996, Michaud et al., 1996, Meric et al., 2001, Kearney & Lucy 2004, Kearney & Poti 2006).

In addition, Levy and Sarnat (1970) concluded that the level to which diversification can decrease risk depends upon the correlations amongst stock returns. If the returns are not correlated, diversification could remove risk. If stock returns are entirely correlated, no amount of diversification can influence risk. Despite the fact that the monitored stock returns for any particular nation are extremely correlated, they are not completely correlated, which means a reduction (but not the elimination) in risk through diversification. The existence of a relatively high level of positive correlation within an economy suggests the likelihood that diversifying securities portfolios internationally might assist risk reduction. As long as the correlation of returns among investment options is not perfect, an essential, but not adequate, situation for portfolio diversification exits. Thus, the addition of even relatively low return foreign stocks might materially reduce the variance of the overall portfolio.

Early empirical investigations of financial integration, including studies by Ripley (1973) examined contemporaneous correlations between various international market indices. Using various statistical methods and data sets, none of the studies found much evidence of market comovements during the period of the 1960's through to the early 1970's. Ripley (1973) reached the conclusion that the degree of interdependence between individual national markets depends on restrictions to international capital flows and differ considerably across countries.

Further evidence of stronger interdependencies between national stock markets was provided by Longin and Solnik (1995). Longin and Solnik (1995) used monthly data on seven major financial markets including France, Germany, Switzerland, the UK, Japan, Canada and the US. They documented increases in contemporaneous correlations over the thirty-year period 1960 to 1990 and noted that the correlations rose during the phase of high volatility. Even though growing international correlations would reduce the benefits of international diversification, rule changes such as financial liberalization could diminish market risk and raise the expected return, potentially compensating the effects of larger correlations (Meric et al., 2001). Gains from international portfolio diversification do not depend exclusively on correlations. Other obstacles to international investment include transaction cost, liquidity and other investment constraints (Bekaert & Harvey 2003).

Goetzmann et al. (2005) found an increase in the international correlation between stock markets. However, Rezayat and Yavas (2006) provided diverse results for the hypothesis that the international market correlations transform after an exogenous shock. The tests of constancy of correlation were based on before and after analyses of two events: the introduction by the European Union of the euro, as authorized money and the 11 September 2001, terrorist events in the US. In contrast, King et al. (1994) did not find evidence of increasing cross-country correlations.

Utilizing a straightforward correlation approach to the securities markets of the US, Hong Kong, Malaysia, Singapore and the Philippines, Aggarwal and Pietra (1989) document that there is a significant trend towards day-to-day linkages between equity price performance in the US and equity prices performance in Hong Kong, Singapore, the Philippines and Malaysia. Other studies provide evidence of a significant increase in correlations between equity markets during and after the 1987 stock market shock and, hence, a reduction in the potential gains from international diversification (Meric & Meric 1989, Arshanapalli & Doukas 1993, Lau & McInish 1993, Lee & Kim 1994, Arshanapalli et al., 1995. Koutmos & Booth 1995).

Groundwork information on possible risk reduction is acquired all the way through the inspection of uncomplicated correlation structures. Current studies suggest that since such correlation structures may be temporally unbalanced, the signs for a suitable combination of assets to unite the portfolio may be complicated to deduce. However, it becomes clear that relying on correlation analysis for testing integration or other phenomena is quite questionable. Many studies have pointed out the problems of using this technique. One of them is that it does not eliminate the spurious relationships. Some studies also show that “the conventional cross-correlation coefficients are biased upwards during a period of increased volatility” (Wilson et al., p. 8, 2002).

Nevertheless, an additional way by which preface information on asset combinations can be obtained is through the use of the cointegration framework. If assets in a similar group, but held in two or more different geographic regions are cointegrated, this would signify that the markets are trending collectively over the long run. Likewise, if assets in dissimilar property sub groups are cointegrated this would indicate that there are one or more common stochastic trends in the assets. Under such conditions, there would only be narrow (if any) opportunity the gain risk reduction benefits through investing in the markets of both regions and or groups. There are a number of approaches that can be taken to analyse the existence of cointegration. Two or more commonly cited methods are the Johansen (1991, 1995) and Engle-Granger (1987) cointegration technique; the Johansen methodology is applied in this thesis.

2.5.2 Empirical Evidence on Cointegration Approaches for Testing Stock Market Integration

Alternative approaches have been used to test stock market integration. Various studies have used simple correlation (Abidin and Hamid 2008), and multiple regression models to test the market integration. However, many studies have identified the problems of using correlation analysis. One of the reasons is that it does not eliminate the spurious relationship. The central intention of this section is to review the literature relating to using different cointegration approaches for testing stock market integration.

In the last four sections, it has been recognised that a huge volume of earlier research on financial market integration has been done using capital asset pricing models or arbitrage pricing theory. In this section, a review of some of the literature that has used the cointegration and modern econometrics techniques will be presented. There is a growing amount of theoretical and empirical literature that deals with stock market integration. Most recent studies rely on econometric techniques. Among others are the cointegration approach, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, Granger-causality, vector autoregressive (VAR) model and variance decomposition to measure the stock market integration between stock markets. The empirical methodology and framework, which can be found in the literature, are noticeably diverse. The papers usually do not affect the equal empirical methodology. However, if the writers are determined to use the similar standard model, they mostly change some features. Therefore, their empirical studies come to rather diverse conclusions even though their papers concentrated on the analysis of integration.

One of the peculiarities of stock prices is that over long periods they tend to move together and follow a common upward trend (Azman Saini, et al., 2002). Many studies have tried to calculate the amount of general stochastic trends. If equity markets are integrated, it is expected for the indices in these markets to display common trends. Nevertheless, since these indices are non-stationary, then using the cointegration method becomes necessary (Dickinson, 2000).

To review the literature that uses modern econometric techniques, particularly the use of cointegration, this present study starts with Kasa (1992) who tries to give evidence related to the quantity of general trends in the equity markets of five major industrialized countries, namely, the US, Canada, Germany, England and Japan. More specifically, the study tries to count how a lot of common stochastic trends exist in these countries. What are the causes of these trends? Do they replicate the economic integration of international financial markets, or are they cointegrated for other reasons? The study uses monthly and quarterly data from January 1974 to August 1990. It uses Johansen's maximum likelihood approach (1990) to test for Cointegration. VAR (k) model is the starting point of this approach. It takes the following form:

$$X_t = \mu + A_1 X_{t-1} + \ldots + A_k X_{t-k} + \varepsilon_t \tag{14}$$

with some rearrangement, Johansen rewrote the equation above as follows:

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \varepsilon_t \tag{15}$$

where

X_t : a vector of non-stationary variables.

$\Gamma_t = -(I - A_t - \ldots - A_t$, i=1,…, k-1)

$\Pi = -(1 - A_t - \ldots - A_k)$

The long–run information in the X_t process is summarized by the matrix Π, and the rank of the matrix established the quantity of cointegration vectors. Therefore, if matrix Π has rank r then we conclude that there are r-cointegrating relationships among elements of X_t or equivalently $n-r$ common stochastic trends. The outcomes indicate that the price indices for the five equity markets are all cointegrated around a single common stochastic trend. In the long-run, the total return indices are closely linked, which indicates the existence of a cointegration relationship. Kasa found that the Japanese market has the most important trend, and Canada has the least important trend. The study takes the analysis a little bit further by comparing the cointegration structure of equity prices with the cointegration structure of their dividend payments. Therefore, the existence of stochastic trends among equity markets indices can be explained by the common stochastic trends among dividends.

Finally, the study indicates that as these markets are entirely correlated in excess of long horizons, the gain from international diversification has most likely been overstated in the literature. However, Kasa implies that as national equity markets can diverge from the trend they show for a number of years, then the benefits of diversification may still be achievable over the short-run. Kasa indicates another two important results. First, he found a single common stochastic trend when using capital international as dividends data. Second, when employing GNP data to proxy for dividends, he found a single common stochastic trend, which means that macroeconomic variables perform an imperative role in the long-run co-movements of equity prices.

These results were later supported by Janakiramanan and Lamba (1998) who have speculated about the factors that cause the national equity market to move together over the long period, especially the "common investor groups" factor. In general, the findings of Kasa (1992) show a clear and strong link between financial integration and cointegration among stock prices.

On the subject of the effect of some macroeconomic variables on the equity market movements, many studies investigate this issue; Campble and Ammer (1993) use vector auto regression (VAR) to estimate the dynamic responses of the system when including stock dividends, short-term interest rate and price increases as additional explanatory variables. The results of their study indicate that the real long-term interest rate has a positive, but minimal shock on the variance of excess equity returns, despite the fact that the big impact is due to the changes in forecasts of future dividends.

In a similar approach to Kasa (1992), Corhay et al. (1993) use both the static regression and the VAR-based maximum likelihood framework to calculate the approximate degree of equity market integration in five major European stock markets: France, Germany, Italy, Netherlands and the United Kingdom, from 1 March 1975 to 30 September 1991. Using weekly data during this period, the study found verification of cointegration among the equity price series of these countries, except for Italian equity prices, which do not appear to influence this long-run relationship.

The introduction of new statistical techniques such as the vector auto regression (VAR) as well as technological and regulatory advances on the world stock exchanges have begun to emerge in support of the integrated market hypothesis. Eun and Shim (1989), Chelley-Steeley (2005), Ibrahim (2006) and Bley (2007), are among those who examined national stock market interdependencies in a VAR system. For example, Eun and Shim (1989) used daily returns on nine national market indices from the period January 1980 to December 1985 and find a considerable quantity of interdependence between them. The US market is found to be the most prominent market in the world. The US market affects all other markets with its innovations being rapidly transmitted. Furthermore, from the 1990s onwards, researchers have modified the univariate and multivariate GARCH models in turn to study interdependencies between the equity market, for example, Santis and Imrohoroglu (1997), Bekaert and Harvey (2000) and Bekaert, Harvey and Ng (2005). However, Berben and Jansen (2005) build up and estimate a bivariate GARCH model for equity returns with a smoothly time-varying correlation and test the constant correlation hypothesis for four international markets on weekly data. They found that correlations among the German, the UK and the US markets have doubled over the 1980-2000 time period. Surprisingly, correlations between the three countries with Japan have remained constant over the same time frame.

In contrast, Longin and Solnik (1995) investigated correlation patterns of monthly surplus returns for seven major states, over the period 1960-1990, by utilizing a multivariate GARCH model. They suggest that the international covariances and correlation matrices are unbalanced over time. In addition, they reported that conditional correlations arise during times of high volatility. Bodart and Reding (1999) employed correlation analysis and threshold analysis to gain insight into long-term modification in equity market integration.

Masih and Masih (1997) examined the pattern of dynamic relationships among the national equity prices of four Asian countries, namely, Taiwan, South Korea, Singapore and Hong Kong, and four developed markets, Japan, the US, the UK and Germany. The authors use different econometric techniques including unit root testing, multivariate cointegration, vector error correction modelling (VECM), forecast error variance decomposition (VDC) and impulse response functions (IRFs). In particular, the study employs a multivariate dynamic framework, which allows for both short-run and long-run relationships to manifest over time. The concept of cointegration is employed to analyse whether the four Asian markets share any level of long-run integration with developed markets. By using monthly data during the period from January 1982 to June 1994, the study reaches the following three conclusions:

1. A cointegration between the Asian markets and the developed markets. This result according to the study is significant and helpful for assisting financial analysis.

2. The Granger-causal chain implied by the dynamic analysis (based on VECMs and VDCs) suggests that the Hong Kong market principally led the other markets. The Hong Kong market was the early receptor of exogenous shocks to its equilibrium relationship and the other markets have to allow the burden of short-run modification. The study found that short-run linkages ran from Korea to Taiwan, Taiwan to Singapore and Singapore to Korea.
3. The US market plays an important role in dominating the region (four Asian countries) by explaining the greatest percentage of variances in these Asian markets, not including those explained by any other market.

Another interesting result is that the Singaporean stock market does not significantly influence the long-run relationship in either the Japan or US vectors. In a similar approach to Masih and Masih (1997), Phylaktis (1999) tried to observe whether there was an increase in the level of capital market integration between Taiwan, South Korea, Singapore and Hong Kong with the US and Japan, and to examine with which of these two countries (US and Japan) the degree of capital market integration is greater. The sample is divided into two sub-periods in order to examine the effect of deregulation. The first period ended in December 1980, which represents the period of regulation, while the second sub-period starts on January 1981, and ended in October 1993, which represents the liberalization period. The study examines the capital market integration by looking at the equalization of real interest rates using the cointegration methodology. The study uses different indicators for capital market integration other than the one usually used in the literature. These indicators relate to the pace of adjustment of interest rate to re-establish long-run equilibrium following a shock in one of the rates using improvement accounting analysis.

Finally, the study explores the short-run dynamic through the multivariate Granger-causality test to identify whether it is the real interest rate of US or of Japan that drives the interest rate in the Pacific Basin countries. According to the study, the multivariate approach is superior to the bivariate approach. The results indicate the existence of integration and real interest rate parity in the Pacific Basin region and that the degree of integration is greater than before the post-liberalization period in Singapore, Taiwan and Korea. Another important result is that there is superior capital market integration with Japan than with the US in the second sub-period, which shows the domination of Japan's influence over the region.

Akdogan (1996) suggests a different approach to measure the financial markets integration; this approach depends on an international risk decomposition model. The study introduces a scientific measure of market integration that can be utilized to order countries by their level of integration; first, it starts with the single-index return generating, which is given by:

$$R_i = \alpha_i + \beta_i R_w + \varepsilon_i \tag{16}$$

where: β_i is the i th country vis-à-vis the global benchmark index R_w, and ε_t is the random error term. The variance of the i th portfolio is decomposed into the following two components:

$$\mathrm{var}(R_i) = \beta_i^2 \,\mathrm{var}(R_w) + \mathrm{var}(\varepsilon_i) \tag{17}$$

Dividing both sides by $\mathrm{var}(R_i)$ yields,

$$p_i + q_i = 1 \tag{18}$$

$$p_i = \frac{\beta_i^2 \operatorname{var}(R_w)}{\operatorname{var}(R_i)} \tag{19}$$

where P_i is the portion of systematic risk in country i vis-à-vis the global yardstick portfolio, which computes the contribution of this market to the global market risk, in other words P_i measures the integration of market i with the globe market, so a market with a smaller fraction of systematic risk is more segmented from the world market, and markets with a larger fraction of systematic risk are more integrated with the world market. A sample of 26 countries has been used in this study for the period (1972-1989). The results suggest that some small and medium-sized European markets along with most emerging markets exhibit segmentation.

Furthermore, numerous researchers have used other empirical methodologies such as Regime-Switching Volatility Spillover Model (Bekaert and Harvey, 1995), Smooth Transition Regression (STR) model (Bredin and Hyder, 2008) and the Case-wise bootstrapping method (Hatemi- J and Morgan, 2007) to examine the integration relationship.

2.6 The Market Crash, Asian Financial Crisis and Stock Market Integration

The degree of financial integration has also often been associated with the risk to national stock markets in the event of financial crisis. The Asian financial crisis in 1997 and 1998 started in some South Asian Countries in July 1997 when the Thai Baht was undervalued, followed by the crash of Hong Kong in late October 1997, then the Korean crisis in November 1997. The panic spread to many countries. The Asian financial crisis in 1997 and 1998 was considered as the first emerging stock market crisis with global impact.

Many researchers have investigated the global impact of the Asian financial crisis in 1997 and 1998 and numerous studies have discussed this crisis from different points of view. Some of those researchers concentrated on the issue of the link between this crisis and stock market integration in different parts of the world. Others concentrated on the cointegration among some Asian capital markets before, during, and after the crisis.

Sheng and Tu (2000) investigated the linkage among some national stock markets (12 Asian-Pacific countries) before and during the Asian financial crisis. They used Johansen (1988) multivariate cointegration, the error correlation model (ECM) and Granger causality in turn to examine the linkages among the markets; the data were separated into two sets before the crisis and crisis period. When Thailand was excluded from the cointegration testing due to its stationary properties, one cointegrated vector appeared during the period of the crisis but not before, and when it was included two cointegration vectors appeared. This indicates that Thailand played an important role in the crisis. When applying the Granger causality test, the results show that the US market causes some Asian countries during the crisis, and only three markets feedback the US, namely, Hong Kong, South Korea and China.

Yang et al. (2003) used the same techniques as Wang et al. (2003) to estimate the long-run relationship and short-run dynamic casual linkage across ten Asian emerging equity markets, in addition to the US and Japan. The study used daily index closing prices during three periods: Pre-crisis (2 January 1995 – 31 December 1996), during crisis (1 July 1997 – 30 June 1998) and Post-crisis (July 1998 – 15 May 2001). The results show that equity markets under investigation are further integrated after the crisis than before the crisis. It also shows that the US substantially influences the Asian markets during the three periods, but was not influenced by these markets. The level of integration among countries tends to be changed, especially around the periods marked by financial crisis.

However, Ibrahim (2006) utilizes cointegration and vector auto regression (VAR) to assess integration or segmentation of the Malaysian stock market both preceding the Asian crisis and following the imposition of capital controls.

They regard as both regional and international financial forces correspondingly by the ASEAN markets and the highly developed markets US and Japan. They also structure three systems of share prices: (i) ASEAN markets; (ii) US, Japan and Malaysia; and (iii) US, Japan and ASEAN. The study used monthly data for the time stage covering January 1988 to December 2003. The activities of the Malaysian market were reviewed for two sample periods – pre-crisis period (January 1988 – December 1996) and post-capital control period (January 1999 – December 2003). Their results imply no long-run relationship among share prices in all systems either before the Asian crisis or after the implementation of capital controls. However, there are considerable short-run dynamic relations among the regional markets of ASEAN. They note important reactions of the Malaysian market to ASEAN shocks despite the sample times. The US market is comparatively more influential in accounting for fluctuations in the ASEAN markets. In summary, they contend that capital controls played a number of roles in protecting the Malaysian market from international disorders.

Hillard (1979) inspected interdependencies in world equity indices during the OPEC oil embargo of 1973-1974. He found strong links in daily data throughout the crisis period. In spite of this, he also argued that geographic locality is an important factor. He claimed that stock markets positioned in close geographic proximity are more strongly related than those separated by large geographic distance. This disagreement is in favour of international diversification as opposed to purely domestic diversification. In an interrelated study, Arshanapalli and Doukas (1993) reported that the cointegrating relationship between daily stock market indices for the US, Japan, the UK, Germany and France has been amended significantly since the equity market crash of October 1987. In the pre October 1987 time, there was no important cointegration between the markets while in the post crash period there was cointegration among the stock markets of the US, the UK, Germany and France. The Japanese market remains outside of the cointegration vector.

A range of studies was carried out which centred on the relationship between the developed markets and the emerging Asian markets. For example, Bhoocha-oom and Stansell (1990) discovered that there is a significant degree of financial market integration between the US, Hong Kong and Singapore. However, Cheung and Ho (1991) studied the comovements between the developed markets and the Asian-Pacific markets and they discovered that the relationships are not stable over time. Fisher and Palasvirta (1990) found that the US index prices led nearly each state index in their sample of 23 countries.

A study was conducted by Cha and Sekyung (2000) on the four Asian emerging equity markets (Hong Kong, South Korea, Singapore, and Taiwan) and the two largest stock markets in the world (the US and Japan). The study covered from 1980 to 1998 and documented that the relations between the two largest equity markets and the Asian emerging markets began to increase after the stock market crash in 1987 and have significantly strengthened ever since the occurrence of the Asian financial crisis in July 1997. From the cointegration analysis by Jang and Sul (2002), the study reveals that the comovement among Asian stock markets since the 1997 financial crisis has indeed increased. However, this comovement has remained strong even after the crisis.

In a more current study, Majid et al. (2009) empirically investigated the dynamic linkages among ASEAN countries equity markets. By using two-step estimation, cointegration and Generalized Method of Moments (GMM), they found that the stock markets in the ASEAN region were cointegrated not only in pre and in post 1997 financial crisis but have been moving towards greater integration after the post financial crisis.

2.6.1 Empirical Evidence on Integration of European Stock Markets

Among the articles that centred on the investigation of the integration of European stock markets and European monetary Union (EMU) are those by Billio and Pelizzon (2003), Kim et al. (2005), Morana and Beltratti (2002), Rouwenhorst (1999), Westermann (2004), Chelley-Steeley (2005), Gilmore and McManus (2002), Hassan, Haque and Lawrence (2006), Choudhry (1996) and Meric and Meric (1997). Most of the reviewed studies found an increase in integration among European stock markets due to the introduction of the euro. Similarly, Corhay et al. (1993) examined cointegration among five main European equity markets on biweekly data over the period 1975-1991. They found that the equity markets of the UK, France, Germany and the Netherlands form a cointegrating vector, from which Italy is excluded. Byers and Peel (1993) investigated monthly equity market data for the US, the UK, Germany, Japan and the Netherlands. The study covered the time frame from October 1979 to October 1989 and discovered little evidence of cointegration except in the UK-Japan pair. Given the small cointegrating coefficient between the two equity markets, Byers and Peel (1993) concluded that gains from diversification across these two countries are important. Byers and Peel (1993) also claimed that although international diversification gains may be inadequate when cointegration is present, they are not necessarily zero. They show that gains depend on cointegrating coefficients, with lesser coefficients resulting in extra gains.

Meric and Meric (1997) investigated the alteration in the co-movement of the 12 European equity markets after the 1987 crash. Their end results indicate that the co-movements of these equity markets increased significantly after the crash. This implies that the benefits of international diversification declined significantly after the crash.

Rangvid (2001) employs a recursive general stochastic trends analysis to observe whether European equity markets became more integrated during the period 1960-1999. Particularly, the study tests the proposition of increased convergence by computing the quantity of significant cointegration vectors at dissimilar periods and investigates whether this number increases as the sample period is extended. To test this proposition, the equity price indices for the UK, France and Germany are used. The results indicate that the price indices for the three countries share common stochastic trends over the whole sample, and the recursive approach points in the direction of an increase in the quantity of cointegration vectors as the sample period is extended. This increase in cointegration vectors implies that these markets were being progressively more integrated during the last two decades, especially in the early

1980s. Nevertheless, Pascual (2003) expressed concern and criticized the validity of the result. He argued that the increasing values of the trace statistics – that had previously been interpreted by Rangvid (2001) as an increase in cointegration – may possibly be a reflection of the superior power of the Johansen test as the sample size increases from 20 to 156 inspections. Pascual (2003) presented an option approach to test the increase in the equity market integration. The study estimates the time-path pursued by the coefficient of the error correction term (ECT). He studied the same countries as Rangvid (2001) during the period 1964 to 1999.

Pascual (2003, p. 198) argued that:

"The error correction term (ECT) reflects deviations from the long-run cointegration relationship; therefore the coefficient of the ECT represents the speed adjustment to deviations from the long-run equilibrium. Higher values of those coefficients can be interpreted as a higher degree of stock market integration".

The study obtained different results from Rangvid's (2001). The cointegration test shows an increasing financial integration in the case of France, but none in the case of the UK and Germany. Bredin and Hyde (2008), studied the impact of the US, the UK and German macroeconomic and financial variables on the equity returns of two relatively small, open European economies – Ireland and Denmark. The authors used different econometric techniques within a non-linear framework, they allowed for time variation via regime switching using a smooth transition regression (STR) model. The data employed in the study was monthly observations from 1979 to 2005, which were obtained from Datastream. The study reaches three conclusions, as follows:

1. They found that the US (global), the UK, and German (regional) stock returns are significant determinants of returns in both markets.
2. Global information represented by oil and the US asset price movements drive changes between states in each market.
3. Significantly, the role of country specific domestic variables is typically confined to a single country while global and regional variables spread through all countries.

Kim et al. (2005) discovered that relationships among European equity market have strengthened following currency union.

2.6.2 Empirical Evidence on Integration of Developed Stock Markets

A recent study by Tahai et al. (2004) investigated the financial cointegration of the G7 stock markets. They utilized monthly stock indices of the G7 the period from March 1978 to December 1997. To establish the integration indices, I (2) and VAR model with two lags and trend restricted to lie in the cointegration space was calculated approximately for the seven equity markets. This model was developed by Johansen (1992), and takes the following formula:

$$\Delta^2 x_t = \Pi x_{t-1} - \Gamma \Delta x_{t-1} + \sum_{i=1}^{k-2} \Psi_i \Delta^2 x_{t-i} + v_t \tag{20}$$

where x (log of price index) is a ρ -dimensional vector of I (1) time series,

Π : a matrix, which is used to determine the cointegration rank (p) of the VAR,

v_t : an error having a nonsingular matrix,

$$\Gamma = I - \sum_{i=1}^{k-1} \Gamma_i , \Psi = -\sum_{j=i}^{k-1} \Gamma_i \text{ and i=1,…, k-2} \tag{21}$$

This model is defined as a subclass of the VAR with parameters that satisfy the following two reduced ranked conditions

$\Pi = \alpha\beta'$, where α , β are p × r matrices of rank r < p

The results show comovements of stock returns of market indices of the G7.

Kasa (1992) inspected cointegration in the equity markets of the US, Japan, England, Germany and Canada. He found that the five markets are cointegrated and driven by one common stochastic trend. The single common stochastic trend indicates that in the long - run cross country diversification benefits disappear. Furthermore, Kasa illustrated that the cointegration test yielded a great deal stronger findings when applied to quarterly data than to monthly data. The markets' dividend yields are also cointegrated. Simultaneously, Kasa noted that it is the pace of adjustment coefficient that determines the determination of deviations from the common trend and how appropriate cointegration is for diversification at any restricted scope.

In an effort to analyse the benefit of international equity diversification for Australian investors, Allen and Macdonald (1995) used a cointegration framework that covered the period 1970-1992. The study found proof of cointegration over the sample period between Australia and Canada, Australia and the UK, and Australia and Hong Kong. The results imply that Australian investors can have possible long-run portfolio diversification benefits in other countries where no evidence of cointegration have been found. The results of using the Johansen maximum likelihood procedure suggest that the Australian market is cointegrated with the German and Swiss markets, therefore, both techniques lead to dissimilar conclusions.

Similar to the study of Allen and Macdonald (1995), Kanas (1998b) investigated whether long-run gains exist for Canadian investors from diversifying in eight major world equity markets – the US, Japan, and the six largest European markets, namely, those of the UK, Germany, France, Switzerland, Italy and the Netherlands. Specifically, to explore the potential for long-run diversification gains for a Canadian investor by exploring whether the Canadian stock market is pair wise (bivariate) cointegrated with all of the eight-world equity markets considered. To analyse for cointegration, he used the Johansen (1988). The time under inspection extends from 3 January 1983 to 29 November 1996, with a sum of 3,630 observations. The study also considered the pre-October 1987 crash period (3 January 1983-30 September 1987) and the post-October 1987 period (1 November 1987 – 29 November 1996). From the results it was concluded that the Canadian stock market is not pair-wise connected with the six largest European markets or the markets in the US and Japan. Therefore, long run benefits exist in risk cutback for a Canadian investor from diversifying in any of these markets. This finding contrasts with those of Lee and Kim (1993) who found evidence of noteworthy short-run linkages of the Canadian market with quite a few world equity markets.

Chatrath et al. (1996) studied the diversification benefits of the Indian stock market from the perspective of a US investor. Their study took a two-pronged approach to examine this issue. First, the long-run comovements of six developed equity markets with the Indian market were examined employing a test for cointegration. Second, mean variance analysis was employed to find the efficient frontiers, providing the basis for recommending the degree of diversification into the Indian equity model. To assist the calculation of optimal portfolios, the data set was divided into three sub periods: 1984-1986, 1987-1989 and 1990-1992. The choice of sub periods was based on the trends in the Indian market. The findings indicate that, principally, the Indian stock market is not linked with the markets in the US, Europe and Japan, stressing the long-run potential for diversification into the former market. Furthermore, in spite of the major depreciation of the Indian rupee over the 1984 through 1992 interval, the computed efficient portfolios involved substantial investment outlays (consistently over 19 per cent) in the Indian market.

In a recent study, Phengpis and Swanson (2006), continued discussing the issue of equity market interdependencies and their connection with diversification benefits for three North American Free Trade Agreements (NAFTA) over the period 1988 to 2003, which presents 835 weekly observations for each index. The issues relate to both short- and long-run interdependencies through correlation of equity market returns and cointegration of equity market prices. Cointegration analysis was employed to estimate the model. The essential results include: 1) the existence of a long interrelationship that is time varying and statistically unstable. 2) Diversification benefits with cointegration not consistently lower than without cointegration. 3) US investors' diversification benefits have lessened since the implementation of NAFTA.

However, studies intended for NAFTA effects on equity market integration granting conflicting results and implications. With monthly data from November 1987 until March 1997, Ewing et al. (1999) found no evidence of cointegration among stock market prices indices in the three NAFTA countries. In a related study, Ewing et al. (2001) reported no data for everyday volatility transmission among NAFTA stock markets during the pre NAFTA period (1992-1993). However, they detected important volatility transmission for the US to the Canadian and Mexican stock markets, but not vice versa, during the post – NAFTA period (1994-1999). Equally, these two investigations imply that the channel of NAFTA brought larger short-run linkages, but not necessarily long-run equilibrium relations among the members' equity markets. On the contrary, other connected investigations report confirmation of cointegration among NAFTA stock markets, especially after the passage of NAFTA in 1994. Darrat and Zhong (2001), utilizing weekly data from 1989 to 1999, found no evidence of cointegration during the pre NAFTA period but evidence of cointegration during the post NAFTA period. Furthermore, Gilmore and McManus (2004), who only studied the post period (1994-2002), report a cointegrating linkage based on weekly and monthly data. These examinations jointly suggest that NAFTA implementation has reinforced equity market integration and linkages among the member nations.

2.6.3 Empirical Evidence On Integration Of Emerging Stock Markets (Latin America, South Asia And Pacific-Basin, Mena)

Chouldhry (1997) empirically investigates the long-run relationship between six Latin American stock indices (Argentina, Brazil, Chile, Colombia, Mexico and Venezuela) and the United States The study uses the log weekly equity indices from January 1989 to December 1993. All these markets are considered to be emerging markets. The study was looking for a potential multivariate long-run stationary linkage between these six Latin American emerging stock markets themselves, and then between these markets and the

United States stock price index. Empirical investigations were conducted by means of unit root tests, cointegration tests, and error-correction models. To test cointegration, the study used the Johansen maximum likelihood approach, which is a multivariate cointegration test that can identify the number of cointegration vectors:

$$\Delta X_t = C + \sum_{i=1}^{N} \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \eta_t \tag{22}$$

where X is a vector of nonstationary variables.

Moreover, the study used error-correction model in order to capture the short-run dynamic modification of cointegrated variables (Engle and Granger 1987). The model has the following form:

$$\Delta X_i = C + A(L)\Delta X_t + \theta u_{t-1} + \varepsilon_t \tag{23}$$

where C is a vector of constant terms.

A (L) is a matrix of finite order lag polynomials.

The results find common stochastic trends between the dissimilar indices with and without the United States index. This means that there is a long-run stationary linkage between the six Latin American stock markets indices, and also between the indices of these markets and the United States index. According to the study, this is because of the globalization of the emerging markets in the late 1980’s and early 1990’s.

Garrett and Spyrou (1997) examined whether the finding of common trends is sufficient to justify reports such as the long-run benefit to diversification that is eliminated. More specifically, the study examined this issue relative to emerging markets, and how it would affect an investor in the UK and the US. The study used monthly data over the period from January 1976 to December 1994 in Argentina, Brazil, Chile and Mexico; and over the period from January 1985 to December 1994 in India, Malaysia, the Philippines, South Korea, Taiwan and Thailand. By implementing the Johansen and Juselius (1990) approach, the results suggest that both groups of countries (Latin American and Asia-Pacific) are determined by a single common stochastic trend for each region. The study still argues that the composition of the common trend is restricted to a small number of markets that really react to it. Therefore, this fact proposes that emerging stock markets – in these two regions – offer benefits in terms of diversification, even in the long-run.

Narayan et al. (2004) examined the dynamic linkages among the four equity markets in South Asia, namely, India, Pakistan, Sri Lanka and Bangladesh. The investigation covered the period from 2 January 1995 to 23 November 2001. The autoregressive distributive lag (ARDL) approach to cointegration was applied to test for the existence of long-run relationships. This approach engaged two steps. In the earliest step, the existence of the long-run relation between the four stock price indices was tested by computing the F-statistics. In the second step, the coefficients of the long-run relations were calculated approximately. The study reached three main findings. First, there is a long-run linkage between the equity prices of the four countries when stock prices in Pakistan are considered as the dependent variable. Second, in the long-run, equity prices in Bangladesh, India and Sri Lanka Granger-cause equity price in Pakistan. In the short-run, there is unidirectional Granger-causality from equity prices in Pakistan to India, stock prices in Sri Lanka to India and from stock prices in Pakistan to India. Third, from Granger causality analysis, it was found that Bangladesh is the most exogenous market. The ARDL approach used by the study is a recent and advanced approach and is preferred over other methods like Engle and Granger (1987) and Johansen (1988). It has also become one of the recent techniques for cointegration for many reasons like being more robust for small sample sizes, and being applied irrespective of whether the regressors are I(0) or I(1).

Barari (2003) extended the work of Akdogan (1996, 1997), and used an international risk decomposition model. He extended the equation to measure R_i against two yardstick portfolios, a district index and an international index. The two-index, return-producing process of the i th country portfolio is given by:

$$R_i = \alpha_i + \beta_{ir} U_r + \beta_{ig} R_g + \varepsilon_i \qquad (24)$$

The study empirically estimates the global and regional integration scores for a sample of six Latin American countries, namely, Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela, during the period 1988-2001. The results show that there was a shift in the direction of district integration but not international integration for most of the countries in the sample.

One of the earliest studies that examined stock market integration among the MENA countries was by Darrat, et al. (2000). The study estimated the linkages among three emerging markets in the MENA region; namely, Cairo (Egypt), Casablanca (Morocco), and Amman (Jordan), and then between them and the US stock market as a world market. Cointegration techniques and the error correction model were employed by the study. The study used a time-series cross sectional estimation for the three emerging markets and the US during the stage from October 1996 to August 1999. The study arrived at the following results:

1. It is possible for one market to drift away from other markets in the short-run, but the Johansen-Juselius cointegration test shows the existence of a long-run relationship between the three MENA markets. In other words, the indices of these markets are moving collectively in the long run. These long run comovements, according to the study, are due to socio-economic or political factors that force all markets to move together.
2. No significant cointegration was found between these countries and the US. This indicates that these markets are segmented from the international market (the US market). Therefore, it is an excellent opportunity for investors to target these markets to get the benefit from international diversification of financial risks.
3. Based on the Gonzalo-Granger (1995) test, the results show that the Egyptian market is the main driving force in the region, therefore, it occupies an important position in the financial stability.
4. The Granger-causality test reveals that short-run causality primarily runs from the Jordanian and Egyptian markets to the Moroccan market, without feedback. However, the small size of the sample and the short period of time that is covered are the main weak points in the study. Usually, the Johansen-Juselius approach is valid for a large sample size not for a small sample like this sample. Other techniques such as the autoregressive distributed lag (ARDL) is more robust and performs well for such a sample.

Neaime (2002) uses the Johansen (1991, 1995) efficient maximum likelihood test to study the existence of the long-term connection among the MENA markets themselves and between the MENA markets and the world markets represented by the US, the UK and French markets. In his study about liberalization and financial integration in a group of stock markets in the MENA region, namely, Bahrain, Egypt, Jordan, Kuwait, Morocco, Saudi Arabia and Turkey. By using weekly data, the study covered the period up to December 2000, and started differently according to the availability of data for each country as follows: Amman, Istanbul since 1990, Morocco since 1992, Saudi Arabia, Egypt since 1993, Bahrain since 1995, Kuwait since 1994 (due to the Gulf war). The MENA markets were divided into two sets. The first comprised three GCC countries: Bahrain, Kuwait, and Saudi Arabia. The second: the rest of the countries. In order to identify the number of cointegration vectors, the study used the following multivariate cointegration test. To facilitate investigation of the direction of the relationship between the world main stock markets and the MENA stock markets, the study employed the Engle and Granger(1987).

The findings of the study can be summarized as follows:

1. The stock markets of Egypt, Jordan, Morocco and Turkey show a significant level of cointegration with the world financial markets, which means that these markets do not offer good opportunities for international investment that are seeking diversification.
2. The financial integration between the previous markets is still weak.
3. GCC equity markets are integrated with each other, and the results indicate one cointegrating vector at the 5 per cent significant level.
4. GCC stock markets are segmented from the rest of the world, which means they can offer diversification potential to foreign investors.
5. The findings using the Engle and Granger-causality test show that there is a unidirectional effect from the world financial markets to the MENA markets.

The study indicates that the increase in liberalization between the MENA stock markets will increase the efficiency of these markets and provide the investors with a good opportunity to diversify their portfolios and reduce risks. It also mentions other benefits of liberalizing the MENA stock markets – reducing the borrowing costs of local firms and enhancing economic growth.

Maghyereh (2003) examined the integration among four MENA emerging markets, namely, Egypt, Jordan, Morocco and Turkey. According to the investigation, the investigation of equity markets integration in the same geographical region helps provide evidence concerning the degree of intra-regional trade and macroeconomic coordination. The study used daily data for the national stock indices of the four markets during the period from 28 November 1997 to 12 December 2002. In order to capture the dynamic interaction among these four countries, the study used a vector autoregression model (VAR).

The main finding of the study shows feeble linkages among the four markets, however, no market is found to be completely isolated. The Turkish stock market affects all other markets because it is relatively bigger than the others. The Jordanian stock market is the most open one, 3.5 per cent of its innovations are explained by other markets, which indicates a high degree of openness in comparison to other equity markets. The study suggests that this weak integration among MEEMs equity markets gives the international and regional investors many opportunities for portfolio diversification by investing in the MEEMs.

However, the study presents the following suggestions to make these markets more attractive to domestic and foreign capital (Maghyereh, 2003, p. 20):

1. Introducing a single region-wide electronic trading system.

2. Developing a uniform investment law and market oriented official and regulatory system.

3. Introducing transparent and accessible accounting and taxation handling.

4. Providing suitable mechanisms to settle disagreement.

By contrasting the findings of this study with that of Neaime (2002), we notice a similarity regarding the weak linkages between the equity markets of Egypt, Jordan, Morocco and Turkey. However, Neaime's study seems more comprehensive than Maghyereh (2003), as it includes three other Gulf countries. It also studies the integration not only among the regional stock markets, but also between the stock markets in the MENA and the world stock markets. However, the core criticism of Maghyereh (2003) is that it does not examine the integration between the MENA stock markets and developed markets, as it only concentrates on the geographical integration. In addition, the study covers a short period of time, which means it is not appropriate to use the conventional cointegration approaches. Other techniques, such as ARDL, are more robust and perform well for short periods compared to the conventional approaches.

In a more comprehensive study, Girard and Ferreira (2004), investigated the contribution of the Middle East and North African (MENA) capital markets to global asset distribution strategies. They used the data on a large number of assets traded in eleven MENA stock markets from January 1990 to December 2001, which is more than the countries in Darrat, et al. (2000). The studies have numerous concerns that have yet to be addressed: 1) Are there any intraregional spillovers between MENA markets? 2) Are there any interregional spillovers between MENA capital markets and other regional blocks? 3) Were MENA markets affected by any of the three major international financial crises that occurred during the 1990s? and 4) Does the evolution of the change in the dynamics of short-run price linkages in MENA capital markets reveal a globalization trend that was observed in most emerging markets during the 1990s? The results of the study are as follows: First, the findings of their study for the stock markets in Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Saudi Arabia and Turkey specify that most MENA markets are segmented (with the exception of Turkey and Israel). Second, they also discovered an increasing sensitivity to exogenous intraregional shocks throughout the period of study. Finally, they summarized that MENA capital markets offer diversification benefits for the international investors.

In a similar study to Girard and Ferreira (2004), Lagoarde-Segot and Lucey (2007) studied the existence of portfolio diversification gains in seven MENA markets, namely, Morocco, Tunisia, Egypt, Jordan, Lebanon, Turkey and Israel. They employed a rolling block-bootstrap methodology based on five optimization models stemming from modern portfolio theory over the 1998-2006 period, both in domestic currencies and in dollars. They also calculated optimal portfolios based on an asymmetric risk measurement by following the studies of Gilmore et al. (2005) and Stevenson (2000). The results of this study highlight the presence of outstanding potential diversification benefits in the MENA region, regardless of whether transactions are denominated in domestic currencies or in dollars.

In a recent study, Gupta and Mollik (2008) examined the varying correlations between the stock returns of Australia and the emerging equity markets, namely, Brazil, Chile, Greece, India, Korea, Malaysia, Mexico, Pakistan, the Philippines, Sri Lanka and Turkey. The study covered the period from February 1988 to December 2005. The study used the Asymmetric Dynamic Conditional Correlation Model (ADCC model) of Cappielo, Engle and Sheppard (2006), a precise class of multivariate GARCH model to calculate approximately pair-wise time varying correlations between the Australian and emerging markets. According to the authors, the use of the model is theoretically recommended for estimating correlations as the model efficiently captures the time varying nature of the correlations and gives more trustworthy approximation of correlations compared to the unconditional estimate of correlations. The study reaches two main findings. First, the correlation between Australia's stock return and emerging markets' equity return change over time and the variation in correlation is inclined by the volatility of the emerging market returns. Second, the linkages between the correlations and the volatilities is well-built in some country pairs (with Brazil, Chile, India, Malaysia and the Philippines) and very weak for Sri Lanka and Turkey.

Studies on the international integration of Latin American stock markets have recently gained momentum in the finance literature (Bekaert and Harvey 1995, Heimonen 2002 and Carrieri et al., 2007). To review the literature that used modern econometric techniques, particularly the use of cointegration and studies that are more recent, we start with Jawadi et al. (2009). They presented a new non-linear essay of modelling.

2.6.4 Empirical Evidence on Integration of Pacific Basin Stock Markets

Janakiramanan and Lamba (1998) examined the dynamic linkages between daily returns of eight Pacific-Basin countries (Australia, Hong Kong, Japan, New Zealand, Singapore, Indonesia, Malaysia, and Thailand) and the US over the period 1988-1996. The study utilizes vector autoregression (VAR), which takes the following form:

$$R(t) = C + \sum_{k=1}^{p} A(k)R(t-k) + e(t) \tag{25}$$

In order to analyse the dynamic linkages in the system, the (VAR) model is altered to its moving average form:

$$R(t) = \sum_{k=0}^{\infty} C(k)u(t-k) \tag{26}$$

So, by estimating equation (26), the study can trace the dynamic responses to shocks in the system. The findings show evidence of the US influence on all other markets except for Indonesia. Subsequently, when the study excluded the US market from the VAR system it found linkages between these markets, which, in turn, and according to the study, were traced to the indirect influence of the US market. In addition, the investigation found an important mutual influence between the markets that are geographically and economically close to each other.

2.6.5 Empirical Evidence of International Diversification

In the context of this study concerning international portfolio diversification, the theory that laid the foundation for international diversification is the theory of international portfolio diversification by Bruno Solnik (1974).

2.6.5.1 INTERNATIONAL DIVERSIFICATION – BRUNO SOLNIK'S THEORIES

Solnik (1974) made an important development of international diversification. Solnik in his study provides a technique for explicitly taking care of the exchange risk. Solnik's aim was to identify how many securities are necessary to significantly decrease risk by diversifying internationally. His technique entails arbitrarily generating portfolios with rising numbers of stocks. The technique was repetitive for local portfolios, international portfolios, and international portfolios unhedged against exchange risk. He also averaged the findings on a number of portfolios of equal size to decrease sampling error. The study was based on weekly movements of stocks on the exchanges of the US and seven European countries from 1966 to 1971. The United States and United Kingdom results are shown in Figures 2.1 and 2.2 below.

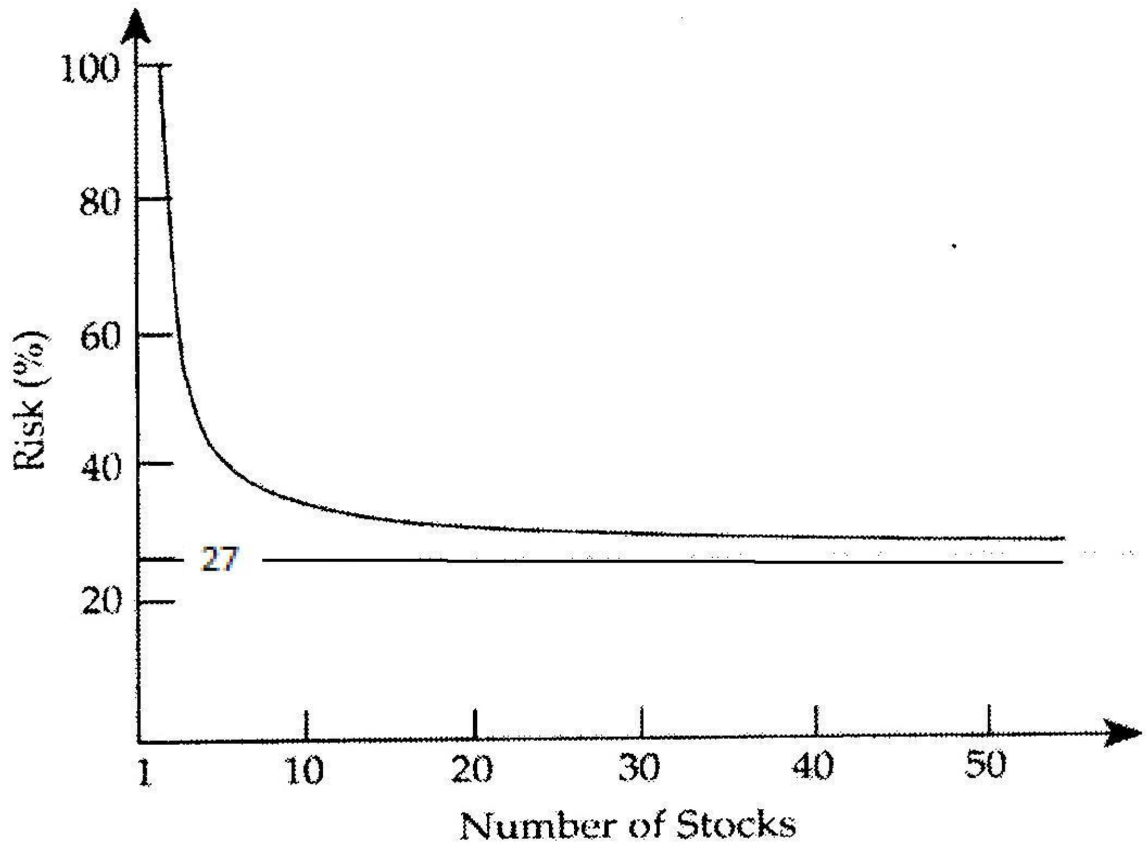

Figure 2.0. United States

Sources: Solnik, B. H. (July/August 1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, 48-54.

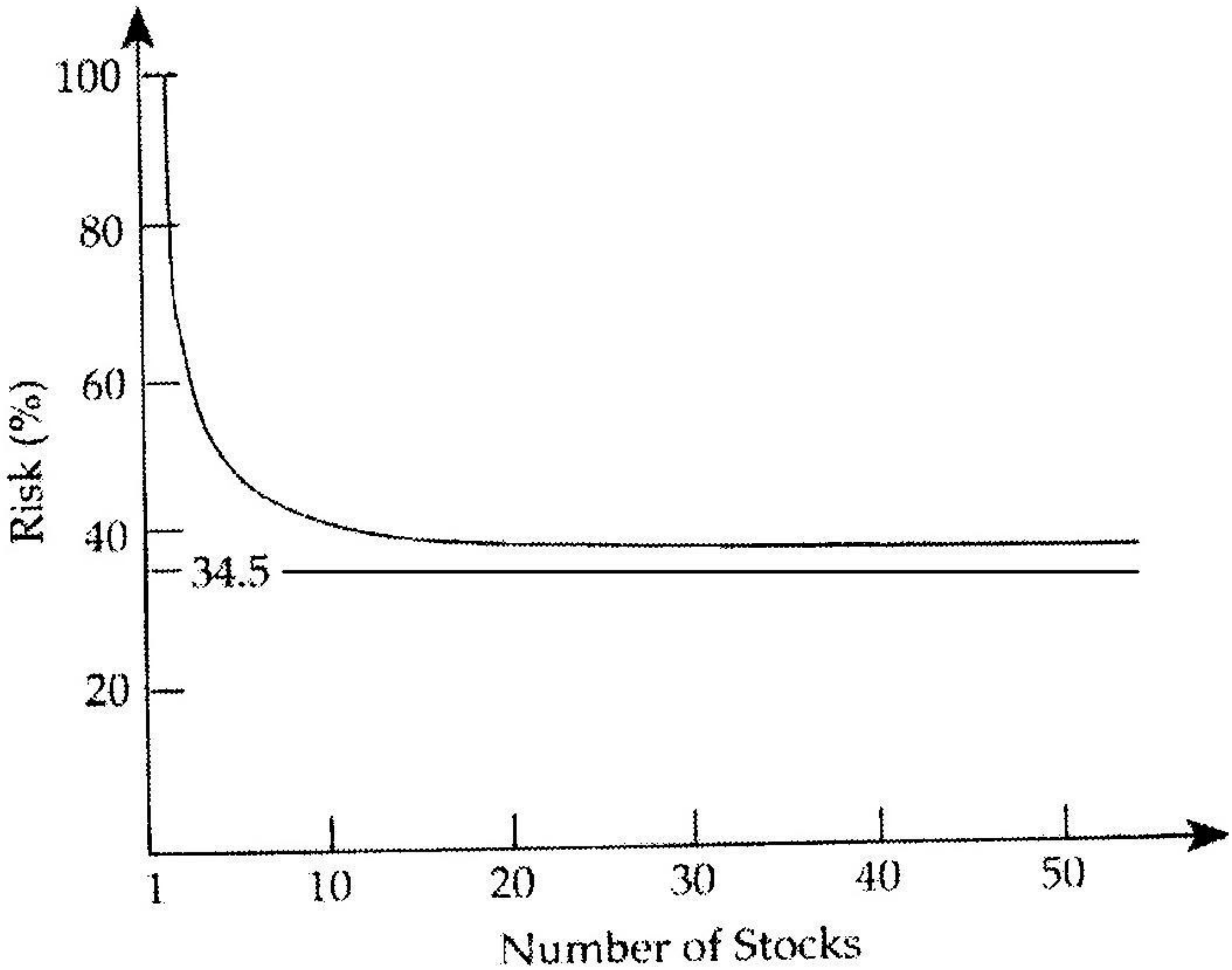

Figure 2.3 United Kingdom

Sources: Solnik, B. H. (July/August 1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, 48-54.

In each situation, the diminishing marginal reduction from adding an extra security to the portfolio is evident. However, in each country there is a certain level of risk, which cannot be reduced through further diversification. This is what Sharpe termed “systematic risk”. Countries are seen to have different levels of systematic risk depending on the unique “economic, psychological, and political environment”. Solnik uses the same method to generate international portfolios. The portfolios are generated randomly (i.e. there is an equal chance of holding securities in each of the eight countries). For the sake of comparison, the US and international portfolios are presented in Figure 3 below.

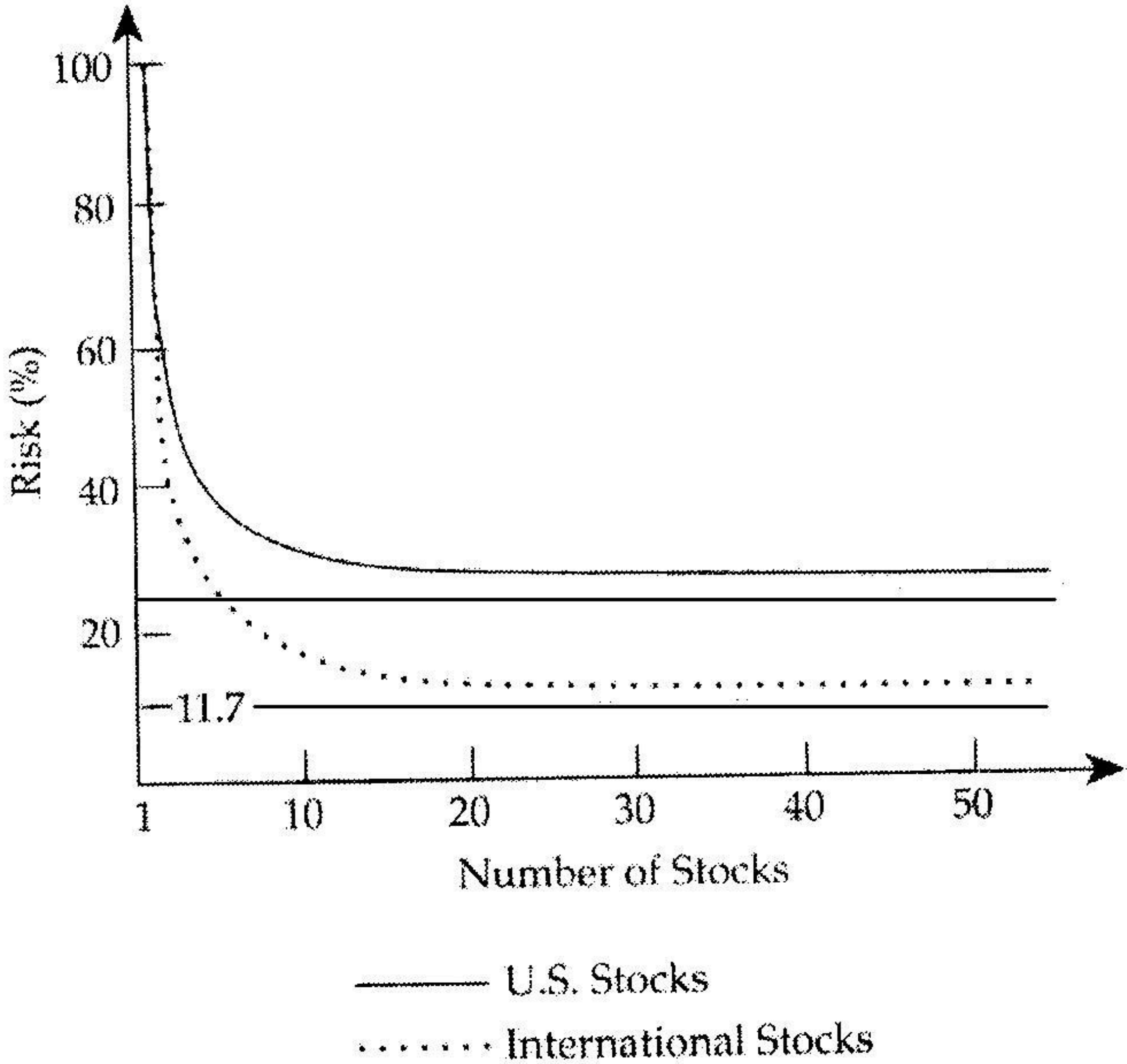

Figure 2.4 International Diversification

Sources: Solnik, B. H. (July/August 1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, 48-54.

The advantages of international diversification, as depicted in the diagram above, may be described as delaying the diminishing returns to diversification through providing investors with an expanded opportunity set. This is possible not only because of the increased number of stocks but also because of the relationship between the national markets. As noted above, much of the risk is accounted for by unique characteristics of the national markets. These studies are based on the positive but small correlation coefficients between price movements on the national markets.

As noted earlier, Solnik's analysis provides a way to explicitly incorporate exchange risk. The international portfolio was implicitly hedged against exchange risk in the above diagrammatical presentation; we can now observe the effects of exchange risk by comparing an uncovered portfolio in Figure 4 below. Solnik's analysis concludes with a recommendation of an uncovered international portfolio as a hedge against the devaluation of the dollar.

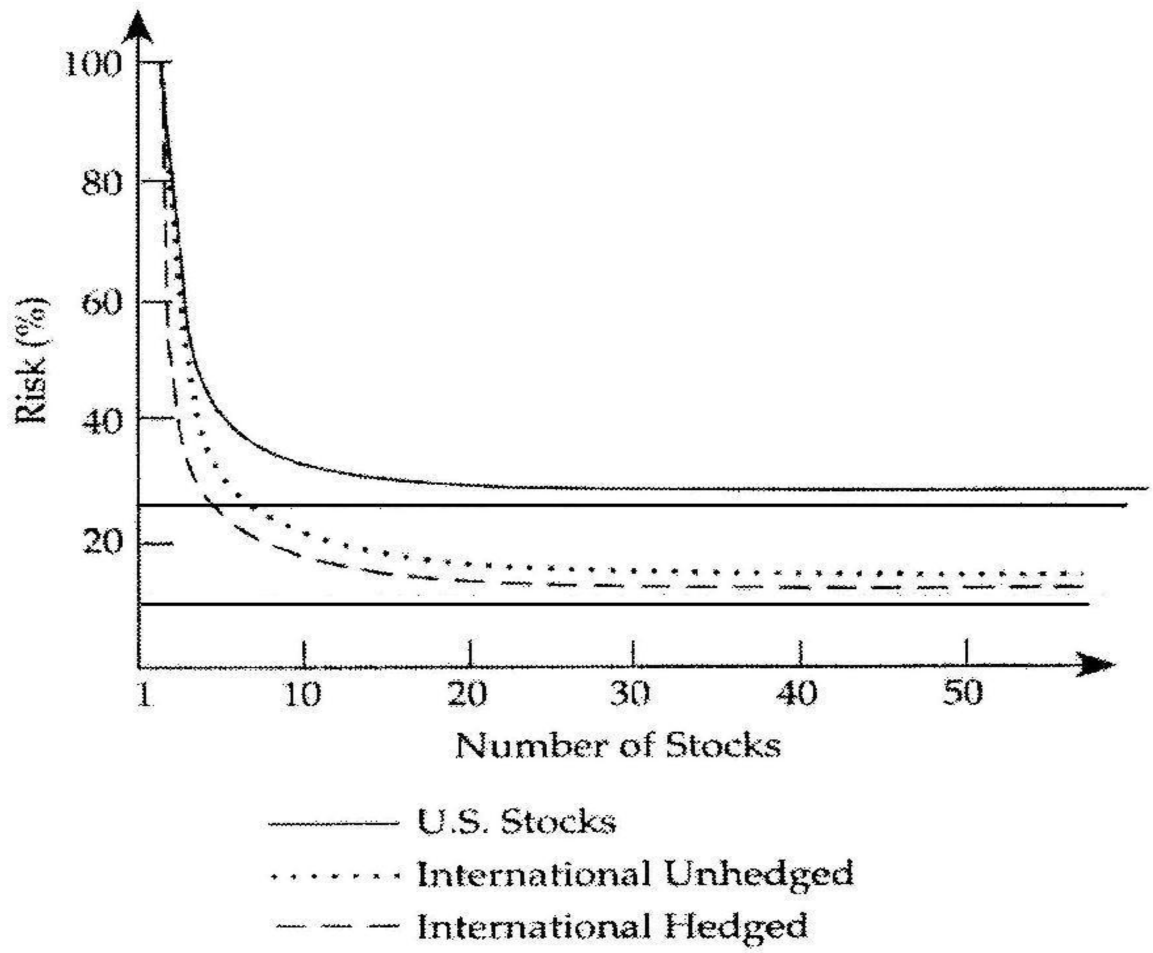

Figure 2.5 International Diversification with and without Exchange Risk

Sources: Solnik, B. H. (July/August 1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, 48-54.

A large amount of the literature on international portfolio diversification takes a US standpoint and focuses on equity markets. It is generally found that international diversification gains are little for US investors (Driessen and Laeven, 2007). Other evidence on the benefits of international investment that can be accomplished ultimately at home by way of investment in equities of multinational firms (Rowland and Tesar, 2004) or country funds and depositary receipts (Errunza et al., 1999).

Eun and Resnick (1994) analysed the benefits from international diversification of investment portfolio from the Japanese and the US perspectives. One of the main findings was that the possible benefits from international, as opposed to just local diversification are much greater for US investors than for Japanese investors. The benefits accumulate not so much in terms of lower risk but in terms of higher return. In addition, Gilmore et al. (2005) investigate the diversification benefits among the Czech Republic, Hungary, Poland, the US and Germany between 1995-2003 and found that diversification gains are statistically significant for US investors, but not for German investors. Investors could have benefited from diversifying into Central Europe stock markets.

The long debated discussion of how many assets build a diversified portfolio was initiated by Evans and Archer (1968). Evans and Archer (1968) conducted a study on diversification and the process of risk reduction. The data for the study consists of 470 securities listed in the Standard and Poor’s Index for the period January 1958 to July 1967. The statistic used in the calculation of ex post returns and the dispersion of these return were geometric mean and the standard deviation of the logarithms of the value relatives. The results showed that a relatively stable and predictable relationship exists between the number of securities included in a portfolio and the level of portfolio dispersion. On average, risk can be reduced when additional assets were randomly included in a portfolio, however, such a reduction becomes insignificant for holdings of eight assets or more. Evans and Archer (1968) are of the opinion that if the covariation between individual securities returns arises solely as a result of their common correlation with the market return, it follows that the decline in variation of a portfolio return resulting from raising diversification must be entirely a function of the reduction of the unsystematic portion of the whole variation. If the quantity of securities included in a portfolio were to approach the number of stocks in the market, the individual would anticipate the variation of the portfolio return to approach the level of systematic variation, that is, the variation of the market return, suggesting a relationship that behaves as a decreasing asymptotic function. Then the dispersion about the mean portfolio standard deviation should approach zero, since, at the limit, all observations will include the same securities

In contrast, Diamond et al. (1997) employed cluster analysis techniques to determine the efficiency of international diversification across economic sectors in contrast to the traditional approach by fund managers of allocating assets by country and then by sector. Using data from seven economic sectors in 20 countries covering the period from 1986 to 1993, they found statistical evidence to suggest that the market sector approach has a great deal of merit as a basis for portfolio diversification. Subsequently, the findings of Diamond et al. (1997) were corroborated by Cavaglia et al. (2000) whose findings show that portfolio diversification that intends to branch out across countries and across industries offers an obviously better return to risk ratio than the traditional asset allocation strategies that intend to select country positions and then index local broad market indices. As such, fund managers can benefit more by allocating the funds across various economic sectors within a market. Not surprisingly, Dinne (1999) advised European investors to seek the benefits of portfolio diversification by investing on a cross-border sector basis since it can also contribute to better liquidity and transparency within the financial markets.

Lintner (1965) said that apart from negatively correlated stocks, all the gains from diversification come from “averaging over” the independent components of the returns and risk of individual stocks. Among positively correlated stock, there would be no gains from diversification if independent variations (i.e., unsystematic risk) were absent.

Solnik (1974) showed in his article that significant advantages in risk reduction could be achieved through portfolio diversification in overseas stocks as well as in local common stocks. An internationally diversified portfolio is expected to bear a much lesser risk than a classic local portfolio. The paper assesses the advantages of building an internationally diversified portfolio and recommends a few practical recommendations to portfolio managers for achieving reasonable diversification at small cost. It appears likely that ample channels and structures for international stock investment can be found even in these times of international monetary uncertainty. Jorion (1985) also agreed that through international portfolio diversification, investors could reduce portfolio risk while achieving average return gains. Jorion’s results affirm that the major benefits of diversification will be risk reduction.

Lessard (1976) noted that if markets were fully integrated, international diversification (relative to national diversification) would allow the investor to decrease the unsystematic risk of his portfolio. However, if markets were segmented, the possible benefits from international diversification might be even greater. This is because some of the systematic risks, when measured using a national market portfolio will become unsystematic due to a redefinition of the market portfolio to now include foreign stocks. In a sense, national international diversification can be viewed as analogous to industry national diversification. The evidence presented by Lessard and others suggests that while a world index is important in explaining individual security returns, country factors are also extremely important.

Madura and Soenen (1992) investigated gains from international diversification by looking across a time and country perspective. They used quarterly stock indices and exchange rates were compiled from January 1974 to January 1988. In addition, the database was segmented into two-sub periods: 1974 – 1980 and 1981 – 1988 to offer valuable insight into whether the benefits from international diversification decrease over time. They concluded that gains from international diversification persist to exist, despite the country standpoint. Furthermore, less than half of the pairwise correlations for all country perspectives in aggregate increased. Therefore, there is no conclusive evidence that the benefits from international diversification are decreasing over time.

Driessen and Laeven (2007) investigated how benefits of international portfolio diversification differ across countries from the perspective of a local investor, namely, the Netherlands. They found that the gains of investing in a foreign country are largest for investors in developing countries. They also found that a huge part of the diversification benefits disappears when controlling for short-sales constraints and currency effects, even for developing countries. The study also concluded that differences across countries in the stock market characteristic, such as liquidity, do not seem to affect the benefits from international portfolio diversification beyond the first order effect of the level of economic development.

Investigation in the area of portfolio management has also examined the factors that may drive the changes in the correlations over time. Jithendranathan (2005) tested whether macroeconomic factors can cause changes in correlations in equity returns for the US and Russian equity markets. He found that interest rate spread, change in exchange rates and change in energy price index had a statistically significant relationship with the correlations between two market returns.

Based on portfolio theory and empirical evidence, the level of interdependencies across countrywide stock markets affects the magnitude of international diversification benefits. These benefits to US investors can be determined from an increase in average return when switching from the US stock market to an international efficient portfolio, which maximizes average portfolio return at the level of risk of US stock market return (e.g. Li et al., 2003). As a result, return correlations or short run comovements between national stock markets are important inputs in identifying the portfolio and resultant gains. Numerous studies have shown that diversification gains to US investors from international stock portfolios are substantial (e.g. Errunza, 1977, Harvey, 1991), and especially so if emerging markets are included due to their relatively low return correlations with developed markets (Li et al., 2003).

2.7 SUMMARY

After reviewing the notion of stock market integration, this chapter presents a thorough discussion of the early theoretical models relating to stock market integration, such as asset pricing models and arbitrage pricing theory. According to the asset pricing models, stock markets are considered to be integrated if securities with the same risk are priced the same. Therefore, in the case of implementing CAPM, there will be a unitary price risk, and the price of all assets reflects the level of systematic risk they possess, and so the assets are considered to be integrated. Regarding the Arbitrage Pricing Theory (APT), this model assumes that stock prices can be influenced by not only the market risk, but also by several sources of systematic risk in the economy. This chapter also presents and analyses the extensive literature relating to stock market integration in both developed and emerging markets. It covers most schools of thought that have been developed for measuring stock market integration, focusing on theoretical background and empirical studies. The use of the cointegration approach for measuring the integration is also discussed through the chapter. Different cointegration approaches have been employed by several studies for measuring stock market integration. Numerous studies use the conventional approaches such as Engle-Granger and Johansen and Juselius, others use the VAR model, and many of the recent studies use the ARDL approach because of the many advantages it has over other conventional approaches. In addition, the chapter reviewed some alternative approaches for testing stock market integration. These approaches include the correlation coefficients approach, the capital flow between stock markets, monitoring volatility interaction for measuring integration, and the international risk decomposition model.

The relationship between the existence of cointegration between stock markets and the efficiency of these markets is also reviewed in this chapter. Several studies provide controversial results about this relationship. A new point of view regarding this issue is adopted by this current study. This chapter sheds more light on the integration of the emerging stock markets in the Latin America, Pacific Basin, and MENA region. Finally, this chapter discusses the ASEAN market and crisis, which has not been discussed deeply enough despite the exceptional international importance of this region from economic and political perspectives. Only a few studies, discuss the integration among stock markets in an emerging market, namely, Malaysia. This shortage of studies gives incentive to discuss the stock markets integration in Malaysia more deeply using recent techniques, including more stock markets and covering a long period of time, which is what this current study tries to do.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter emphasizes the theoretical framework, research questions, the hypothesis development, and research design. This chapter also highlights the econometric techniques and Markowitz's theory to analyse the two key research issues, namely, the integration of the Malaysian market with developed and developing markets and international portfolio diversification from the Malaysian perspective. Based on a review of relevant literature in chapter 2, section 3.2 discusses the theoretical framework. Section 3.3 highlights the research question. Section 3.4 discusses the development of each testable hypothesis. Section 3.5 continues with a detailed explanation on research design, which includes the sample data and variable definition, sample period and sampling selection. This is followed by a discussion on the econometric techniques and portfolio theory used in this study in section 3.6 and 3.7, respectively. Section 3.8 ends this chapter with a summary.

3.2 THEORETICAL FRAMEWORK

Figure 3.1 presents the theoretical framework. The diagram shows all the variables to be investigated in the study. The purpose of this study is to empirically explore market integration , short and long run relationship among developed and developing markets with the Malaysian market during the pre crisis, crisis and post 1997 financial crisis. The issue of linkages among stock markets has been broadly researched in the literature of financial econometrics. According to Ibrahim (2005), the integration among the stock markets has important implications for the potential benefits of international portfolio diversification. Various schools of thought have been developed to measure the integration of stock markets. Some have used the correlation of the local market return with the world return as a measure of integration. Several papers demonstrate the advantages of international diversification stemming from low correlations (Levy & Sarnat 1970, Lessard 1973, Solnik 1974; Lessard 1976, Watson 1978, Levy & Lerman 1988, Meric & Meric 1989, Divecha et al., 1992. De Fusco R. A. et al., 1996, Michaud et al., 1996, Meric et al., 2001, Kearney & Lucy 2004, Kearney & Poti 2006). However, over the past decade, the world capital markets have become increasingly integrated and co-movements among the leading world financial markets have been increasing (Blackman et al., 1994; Masih and Masih, 1997).

INDEPENDENT VARIABLE DEPENDENT VARIABLE

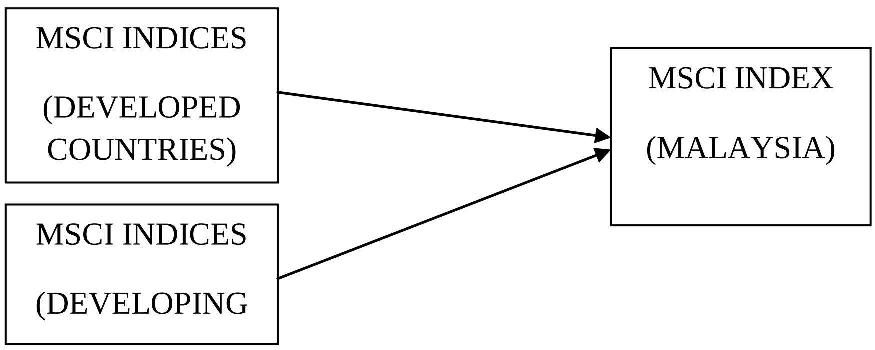

Figure 3.1 The Theoretical Framework

3.3 HYPOTHESIS DEVELOPMENT

Four hypotheses were developed to answer the questions discussed in chapter one. The hypotheses are related to Malaysian market integration with developed and developing countries. The testable null hypotheses of this study have been developed as follows.

3.4.1 Hypothesis 1: Developed, Developing countries and Performance

The field of investment involves the study of the investment process. Stated in the simplest terms, investors are interested in two dimensions, risk and return. The risk and return analysis of stocks is an important input for investors to make informed investment decisions to achieve the highest return per unit of risk or lower risk per unit of returns. Investors have their own risk preference and, therefore, the degree of the risk assumed by investors will affect their selection decision. Investors would like their returns to be as large as possible, however, this objective is subject to constraint, primarily risk. In line with this, Harry Markowitz (1952) recognized the power of diversification and demonstrated mathematically that by combining different stocks in a portfolio the level of risk can be reduced.

Early studies by Roll (1992) found that the country factor provided the greatest risk reduction. Prior studies by Brooks and Negro (2004), Gilmore McManus and Tezel (2005), found that combining different stocks in a portfolio could reduce the level of risk and enhance the level of return. Brooks and Negro (2004) considered examples of companies of forty-two developed and emerging countries. The study period was between January 1985 and February 2002. Their results show that diversifying across countries may still be effective in reducing portfolio risk.

In addition, Gilmore et al. (2005) also investigated the benefits of diversification by using mean variance Markowitz (1959). They investigated how the benefits of international portfolio diversification differ across the Czech Republic, Hungary, Poland, the US and Germany. Their findings show that diversification benefits are statistically significant for US investors, but not for German investors. They pointed out that investors could have benefited from diversifying into Central European equity markets. Research comparing the benefits of the country of international diversification has produced mixed results. Therefore, the testable null hypotheses of the study have been developed as follows:

$H_0$1a: Developed countries exhibit no difference in return compared to developing countries during pre crisis, crisis and post crisis.

H_a1a: Developed countries exhibit difference in return compared to developing countries during pre crisis, crisis and post crisis.

$H_0$1b: Developed countries exhibit no difference in return during pre and post financial crisis as compared to during financial crisis.

H_a1b: Developed countries exhibit difference in return during pre and post financial crisis as compared to during financial crisis.

$H_0$1c: Developing countries exhibit no difference in return during pre and post fin

H_a1c: Developing countries exhibit difference in return during pre and post financial crisis as compared to during the financial crisis.

3.4.2 Hypothesis 2: Developed, Developing countries and Correlation

Other studies focus on the correlation between stock returns including Erb et al. (1994), Meric and Meric (1997), Bekaert and Harvey (2000), Rezayat and Yavas (2006), Li and Rose (2008) with mixed conclusions. Erb et al. (1994) examined the correlation among the US and G7 countries, namely, Canada, France, Germany, Italy, Japan and the UK using semi correlation analysis. They found evidence that cross equity correlation of the G7 countries are affected by the business cycle. Correlations are highest when any two countries are in common recession and they are lower during recovery. The results are consistent with the findings of Longin and Solnik (1995). While the studies by Meric and Meric (1997) found that the European equity market and US markets are highly correlated. Their findings indicate that the correlations among the twelve largest European equity markets and between these equity markets and the US equity market increased substantially. In contrast, Bekaert and Harvey (2000) found evidence that the stock market correlations in developing markets are less correlated than the developed markets. Their studies include twenty-two of the emerging markets, namely, Argentina, Brazil, Chile, Colombia, Greece, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Portugal, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe. They pointed out that there was only a small increase in correlation with the world market return. In addition, Rezayat and Yavas (2006) documented mixed evidence. Using high frequency data on the stock prices for the period of January 1999 to February 2002 and cross correlation analyses, they found mixed results for the hypothesis that the international market correlations change after an exogenous shock. In recent studies, Li and Rose (2008) stressed that the relationship between market integration and correlation varies across markets. They used daily returns and focused mainly on APEC emerging markets, namely, Chile, China, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Russia, Taiwan and Thailand. As there are mixed results of the correlations between developed and developing countries, the following null hypothesis is developed as shown below:

$H_0$2a: There is no distinctive difference in the correlation coefficient between developed and developing countries during the pre crisis, crisis and post crisis.

H_a2a: There is distinctive difference in the correlation coefficient between developed and developing countries during the pre crisis, crisis and post crisis.

3.4.3 Hypothesis 3: Developed, Developing countries and Integration

Many efforts have been made to examine financial integration in either developed or developing countries. The main issues concerning the literature on financial integration are whether financial markets are integrated or segmented with global markets. For developed countries, the studies by Choudhry (1994), Kanas (1998b), Morana and Beltratti (2002) Billio and Pelizzon (2003), Kim Moshirian and Wu (2005), among others, have yielded mixed results. Choudhry (1994) found no evidence of a long run relationship among developed countries, namely, the US, the UK, Japan, Italy, France, Canada and Germany for the period of 1953 to 1989. The results are consistent with the findings of Kanas (1998a). In contrast, Morana and Beltratti (2002) found evidence of strong integration among five developed countries (France, Germany, Spain, Italy, the UK and the US). The results are consistent with the findings of Billio and Pellizzon (2003) and Kim, Moshirian and Wu (2005). Studies on developing countries by Yang et al. (2003), Ibrahim (2006), and Hatemi-J and Morgan (2007) have also yielded mixed results. In investigating whether developing markets are globally integrated, Yang et al. (2003) and Ibrahim (2006), particularly using data on the Asian emerging markets, focused on the influence of two major world economies: the US and Japan for three periods: pre crisis, during crisis and 1997 post crisis. Yang et al. (2003) investigated the long-run relationship and short-run dynamic causal linkage across ten Asian emerging stock markets. They found that these markets were more integrated after the crisis than before the crisis. It also showed that the US substantially influenced the Asian markets during the three periods and that the degree of integration among countries tends to change over time, especially around the periods marked by financial crisis. In contrast, Ibrahim (2006) found evidence that there was no long-run relation among share prices in all systems either before the Asian crisis or after the imposition of capital controls. However, there were substantial short-run dynamic interactions among the regional markets of ASEAN and the US market, which is comparatively more influential for fluctuations in the ASEAN markets. Studies by Hatemi-J and Morgan (2007) found evidence that only four out of the seventeen emerging markets have become more integrated with the world market. Their study included seventeen developing markets (Argentina, Brazil, Chile, Colombia, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, the Philippines, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe) to examine the integration among developing stock markets.

Several other studies have examined integration across the European countries and found evidence that these markets are regionally integrated. Westermann (2004) and Chelley-Steeley (2005), among others, to some extent, have confirmed that European markets are integrated. Westermann (2004) using the GARCH model, focused mainly on the stock market to examine financial integration in European countries, namely, France, Germany and Italy with the US market. Chelley-Steeley (2005), examined stock market integration in four European markets (Poland, Hungary, Czech Republic and Russia), using daily returns and VAR and smooth transition analysis. They pointed out that there was increasing integration among European stock markets.

Therefore, the testable null hypotheses of the study have been developed as follows:

$H_0$3a: There is no integration between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_a3a: There is integration between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

$H_0$3b: There is no short-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_a3b: There is short-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_03c: There is no long-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_a3c: There is long-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_03d: There is no difference of strength in the linkages between the Malaysian stock market and the developed and developing countries during the pre crisis, crisis and post crisis.

H_a3d: There is difference of strength in the linkages between the Malaysian stock market and the developed and developing countries during the pre crisis, crisis and post crisis.

3.4.4 Hypothesis 4: Developed, Developing countries and asset allocation

Modern Portfolio Theory explores how investors construct portfolios to optimize market risk against expected returns. Markowitz (1959) quantified the benefits of diversification where out of a universe of risky assets, an efficient frontier of optimal portfolios can be constructed. Each portfolio on the efficient frontier offers the maximum possible expected return for a given level of risk. There is growing theoretical and empirical literature dealing with stock market diversification. Bruno Solnik (1974) made an important impact on the development of international portfolio diversification. He proved that substantial advantages in risk reduction could be attained through portfolio diversification in foreign securities as well as in domestic common stocks. The article evaluates the advantages of constructing an internationally diversified portfolio and offers some practical recommendations to portfolio managers for achieving reasonable diversification at low cost. Similarly, in a more recent study, Driessen and Leaven (2007) investigated how the benefits of international portfolio diversification differ across twenty-three developed countries and 29 developing countries. They found that the benefits of investing abroad were largest for investors in developing countries, including when controlling for currency effects. They also provide evidence that diversification benefits vary over time as country risk changes. Based on this empirical evidence, it is hypothesized that:

$H_0$4a: There is no difference in asset allocation between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_a4a: There is difference in asset allocation between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

$H_0$4b: There is no difference in the efficient frontiers between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

H_a4b: There is difference in the efficient frontiers between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis.

Table 3.1Summary of Null Hypotheses

Null Hypothesis	Description of Null Hypothesis Development
Hypothesis 1	Developed, Developing countries and Performance
$H_0$1a	Developed countries exhibit no difference in return compared to the developing countries during the pre crisis, crisis and post crisis
$H_0$1b	Developed countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis
$H_0$1c	Developing countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis
Hypothesis 2	Developed, Developing countries and Correlation
$H_0$2a	There is no distinctive difference in the correlation coefficient between the developed and developing countries during the pre crisis, crisis and post crisis
Hypothesis 3	Developed, Developing countries and Integration
$H_0$3a	There is no integration between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis
$H_0$3b	There is no short-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis

$H_0$3c	There is no long-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis
$H_0$3d	There is no difference in the strength of the linkages between the Malaysian stock market and the developed and developing countries during the pre crisis, crisis and post crisis
Hypothesis 4	Developed, Developing countries and asset allocation
$H_0$4a	There is no difference in asset allocation between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis
$H_0$4b	There is no difference in the efficient frontiers between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis

3.5 RESEARCH DESIGN

In this section, the study will explain in detail the sets of data used and the definition of the variables. This includes the list of indices, classification of countries and the sample period of study.

3.5.1 Sample Data and Definition of Variables

This study contains secondary data for the period of July 1996 to June 2007. The study comprises daily closing Morgan Stanley Composite Index (MSCI) indices as collected from Bloomberg. The Morgan Stanley Composite Index (MSCI) is used because it provides standardization, which facilitates cross-country comparisons. In addition, the MSCI indices are preferred to the standard indices because of their feature of being constructed on a uniform basis across countries (Kanas, 1998a). This feature is important because, according to Roll (1992), diverse technical aspects of index construction across countries may cause these indices to have a disparate behaviour. By using the MSCI indices, we ensure that any observed diverse behaviour (i.e. lack of linkage among national indices cannot be attributed to diverse methods of index construction). Moreover, these indices have the additional advantage that they are constructed based on a very large sample of firms in each market (Kasa, 1992, p.98). According to Allen and Macdonald (1995), the companies in the MSCI indices represent approximately sixty per cent of the aggregate market capitalization of the stock exchanges included. Furthermore, the indices are constructed using a weight arithmetic average and are adjusted for capitalization changes. In addition, the comparison is also standardized because all the countries indices are dividend adjusted. The indices with dividends reinvested provide an estimate of the total return that would be achieved by reinvesting one twelfth of the monthly dividend yield reported at every end month. It is also quoted in a single currency, namely, in US dollars or a currency of one's preference. The MSCI series is particularly suited for this study because all the indices are constructed on a consistent common basis. Several studies used MSCI indices in their research, examples include Abidin et al. (2004), Driessen and Leaven (2007), to name a few.

Furthermore, to facilitate a more comprehensive investigation on the benefits of international portfolio diversification, this study estimated the diversification benefits by allowing the investor to invest in developed and developing countries. Developed or developing countries are grouped in accordance with the classification of the International Finance Corporation (IFC).

According to the International Financial Corporation of the World Bank Emerging Markets Database, a stock market is classified “developing” if it is in a low or middle-income economy as opposed to “developed” with a high income. The developing country investable market capitalization is low relative to its per capital gross domestic product (GDP).

The comparison is standardized because inflation differences between countries are captured somewhat with the exchange converted US dollar returns, given that these incorporate inflation through purchasing power parity and the international Fisher effect. The IFC defines an emerging stock market as any stock market located in a developing country, as defined by the World Bank’s GNP per capita criterion (Hassan et al., 2006).

These twenty-one MSCI indices markets of developed and developing countries are designed to serve as benchmarks that are consistent across international boundaries. This study includes the MSCI index, which satisfies the criteria of size with the top large capitalizations. The choice of the countries was based on large market capitalization of MSCI indices for developed and developing countries. These indices are expressed in terms of Malaysian returns for all countries and indices using the daily exchange rate. In the analysis, the countries equity returns are adjusted for exchange rate fluctuations using Ringgit based exchange rates. This study is expressed in Malaysian Ringgit, as it is more relevant for investment decision purposes for Malaysian investors. The Malaysian Ringgit denominated returns are calculated based as log price relatives based on the Malaysian Ringgit for all the developed and developing countries. The daily nominal excess returns are calculated from the per cent logarithmic difference between closing prices. Taking the position of institutional investors, we also make the assumption that an investor cannot participate in short selling.

Dilemmas arise in examining the integration of different stock markets. First, the missing observation is due to different stock market holidays. Using a complicated interpolation, this study follows the studies of Jeon and Von (1990), and Hirayama and Tsutsui (1998) by adopting the method of Occam's razor, which means filling in the previous day's price. Second, the differences in trading hours among the international stock markets. In this study we adjust for the different trading hours by regressing today's with yesterday's by lag 1. For example, MSCI Malaysia with yesterday's MSCI US by lag =1.

The lists of developed and developing countries based on market capitalization are presented in tables 3.2 and 3.3, respectively.

Table 3.2 List of developed countries

Developed Country	Market Capitalization (US Million)	MSCI country Indices
United States	10,606,275	MSCI United States Index
Japan	3,264,750	MSCI Japan Index
United Kingdom	1,995,657	MSCI United Kingdom Index
France	1,490,645	MSCI France Index
Hong Kong	1,328,880	MSCI Hong Kong Index
Germany	1,077,138	MSCI Germany Index
Canada	1,007,069	MSCI Canada Index
Switzerland	852,025	MSCI Switzerland Index
Australia	656,044	MSCI Australia Index
Spain	636,740	MSCI Spain Index

Source from Bloomberg, World Bank data and MSCI Barra retrieved on 31 December 2008

Table 3.3 List of developing countries

Developing Country	Market Capitalization (US Million)	MSCI country Indices
China	1,775,591	MSCI China Index
India	637,281	MSCI India Index
Brazil	588,478	MSCI Brazil Index
Argentina	352,258	MSCI Argentina Index
Russia	265,217	MSCI Russia Index
Mexico	245,482	MSCI Mexico Index
South Africa	242,942	MSCI South Africa Index
Malaysia	186,323	MSCI Malaysia Index
Chile	130,046	MSCI Chile Index
Turkey	117,025	MSCI Turkey Index
Israel	100,397	MSCI Israel Index

Source from Bloomberg, World Bank data and MSCI Barra retrieved on 31 December 2008

3.5.2 Sample Period

Sheng and Tu (2000) investigated the linkage among certain national stock markets (12 Asian-Pacific countries) before and during the Asian financial crisis. They used Johansen (1988) multivariate cointegration, the error correlation model (ECM) and

Granger causality. Similarly, Yang et al. (2003) used the same techniques by Wang et al. (2003) to estimate the long-run relationship and short-run dynamic casual linkage across ten Asian emerging stock markets, in addition to the US and Japan. The study used daily index closing prices during three periods: Pre-crisis (2 January 1995 – 31 December 1996), during crisis (1 July 1997 – 30 June 1998) and Post-crisis (July 1998 – 15 May 2001). The analysis of the data above includes the period prior to the Asian Financial Crisis (1995-1998), however, during that time, most Asian currencies fluctuated against the US dollar creating a massive source of risk.

The data in this study consists of eleven years of historical data from 1996 to 2007, which include the economic crisis year. This study is divided into three sub periods to capture the effect on the Malaysian market at various stages following the study of Sheng and Tu (2000). The rationale for the timing of these sub periods is based on key economic and political events.

Sub period 1: 31 July 1996 to 30 June 1997 involving the period before the financial crisis

Sub period 2: 31 July 1997 to 30 June 1998 involving the period of the financial crisis

Sub period 3: 31 July 1998 to 30 June 2007 involving the period after the financial crisis

3.5.3 Sampling selection

Only the ten top developed and developing countries were chosen based on market capitalization. Thus, this study implements non-probability sampling. Non-probability sampling relies on the judgment of the researcher rather than chance to select sample elements (Malhotra, 2007, p. 332). The total sample of 84,315 observations for twenty-one countries across eleven years from 1996 to 2007 was used in this analysis. In addition, it is crucial to ensure that all indices were active for the entire period of study (1996 to 2007), as this is a longitudinal study. The greater coverage market has the advantage that the database comes closer to approximating the true universe of stock indices. Stock index returns are computed as logarithmic prices relatives $R_t = \log (P_t/P_{t-1})$ X100, where P_t is the stock index level in period t.

3.6 METHODOLOGY

The methodology used will be discussed in this section. Econometric techniques and modern portfolio theory were used in this study. Cointegration is particularly adapted for diversification testing for two main reasons. First, stock index time series may be non-stationary and cointegration is ideal to analyse the impact of country non-stationarity on portfolio covariances (DeFusco, McLeavey, Pinto and Runkle, 2004). Second, countries may share long-term stochastic trends that can mitigate diversifying properties. Thus, the countries divergent of the cointegrating relationship make them more desirable candidates for portfolio inclusion (Gallo, Phengpis and Swanson, 2007). The cointegration methodology detects convergent long-term economic or financial relationships among the index time series and, therefore, separates the cointegrated and independent series.

Furthermore, a number of studies in both economics and finance literature utilize vector auto regression (VAR) in addition to the standard methods of integration and cointegration (Ibrahim 2003). This study is based on standard methods of cointegration and vector auto regression. We adopted this approach for a range of reasons. First, the method is straightforward where one does not have to worry about making a priori distinction between exogenous and endogenous variables. According to Sims (1980), the distinction is often subjective and, therefore, it is wise to treat them on an equal footing. Second, according to Yusof and Majid (2006), this technique sets no restriction on the structural relationships of the variables and, hence, misspecification problems may be avoided. Finally, the variance decomposition and impulse response functions derived from VAR allow us to evaluate the strength and direction of variables in the system.

Our analysis starts with detection of the integration and cointegration properties of the variables before working with an unrestricted vector auto regression (VAR) model. The results from the cointegration tests enable us to model short-run dynamic interactions among the variables within our VAR system. If the variables are found to be non stationary and non cointegrated, the dynamic interactions among the variables are assessed according to the standard VAR model with variables expressed in first difference. Accordingly, if the variables are found to be cointegrated, error correction models should be employed and, accordingly, this justifies the use of the VAR model in levels. Furthermore, this study examines the interrelationships among the markets using both bivariate and multivariate frameworks. In the bivariate case, the causal nexus is only examined between the two markets whilst in the multivariate case, the causality model includes all the variables. Accordingly, two channels of causation may be observed. First, the standard Granger tests, examining the joint significance of the coefficients of the lagged independent variables. Meanwhile, the second channel of causation is the adjustment of the dependent variable to the lagged deviations from the long-run equilibrium path, represented by the ECT. If the ECT is found to be significant, it substantiates the presence of cointegration as established in the system earlier and, at the same time; it tells us that the dependent variable adjusts towards its long-run.

3.5.4 Stationary Time series

We begin the analysis by examining the stationarity properties of the data series. According to Thomas (1997), the classical regression techniques become invalid if applied to variables that do not meet the definition of stationarity. Time series data for empirical work requires that the underlying time series is stationary. Stationary means that the fundamental form of the data generating process remains the same over time. Most time series are non-stationary. This means that the variance and auto covariance change over time. The least squares (OLS) requires a condition of stationarity and, therefore, using OLS on non-stationary variables can lead to spurious results. The use of standard inference procedures for the estimation of non-stationary series could lead to spurious results. These spurious regressions usually exhibit a high R^2 but low Durbin Watson (DW) statistic and the residual series of the regression has a Unit Root. This spurious result is because if the time series involved in the regression exhibit a strong trend, then the high R^2, which is observed, is due to the presence of the trend and not a true relationship. Any time series can be thought of as being generated by a stochastic (random) process. We first need to establish variables to be stationary or convert non-stationary variables into stationary variables before undertaking OLS for time series. The mean stationary means that the expected value of the process is constant over time:

Let Y_t be a stochastic time series, then:

The Mean: $E(Y_t) = \mu \forall t$ (1)

Also, variance stationary means that the variance is temporarily stable:

The Variance: $\operatorname{var}(Y_t) = E(Y_t - \mu)^2 = \sigma_y^2 \forall t$ (2)

The covariance stationary is similar:

The covariance: $\gamma_k = E\left[(Y_t - \mu)(Y_{t+k} - \mu)\right]$ (3)

$$= \operatorname{cov}(Y_t, Y_{t+k}) \quad (4)$$

If k=0, we obtain γ_0, which is the variance of Y ($=\sigma^2$)

This form of stationary is called "weak stationary". Another form of stationary is called strict stationary and that is if the joint probability distribution of any set of observations (Y_1, Y_2,…Y_t) is the same as that for (Y_{1+k},Y_{2+k},…Y_{t+k}), for all t and k.

This study employs the standard Augmented Dickey Fuller tests (ADF) and Phillips-Peron tests (PP) unit root tests (Dickey and Fuller, 1979 and 1981; Phillips and Perron 1988) with and without time trend to test for stationarity.

3.5.5 Unit Root tests

The unit root test is the most widely used for stationary. The unit root test was first presented by Fuller (1976) and Dickey and Fuller (1979), which is referred to as the

Dickey-Fuller (DF) tests. A simple form of the DF test is based on the following model:

$$Y_t = \rho Y_{t-1} + \mu_t \tag{5}$$

Where μ_t is a white noise error term with zero mean, constant variance σ^2, and non-auto correlated. In the case that the coefficient of $Y_{t-1}(\rho)$ is equal to 1, then we have a unit root problem. This means that the stochastic variable Y_t has a unit root or what is known as a random walk time series, which is an example of a non-stationary time series. However, the test is named unit root because it is the root of a polynomial.

Equation (5) can alternatively be expressed as:

$$\Delta Y_t = (\rho - 1) Y_{t-1} + u_t \qquad 6)$$

$$\Delta Y_t = \beta Y_{t-1} + u_t \tag{7}$$

Where $\beta = \rho - 1, and \Delta Y_t \ = Y_t - Y_{t-1}$

The null hypothesis for a unit root is $\beta = 0$ (equivalently $\rho = 1$) and it is tested against the alternative of $\beta < 0$ or stationary series.

The Dickey Fuller test can be applied not just for equation (7) but also for more extended formula as follows:

$$\Delta Y_t = \alpha_1 + \beta Y_{t-1} + u_t \tag{8}$$

Where Y_t is a random with drift and α_1 is a constant. The null hypothesis $H_0 : \beta = 0$

$$\Delta Y_t = \alpha_1 + \alpha_{2t} + \beta Y_{t-1} + u_t \tag{9}$$

Where Y_t is a random walk with drift around a stochastic trend, t is the time or the trend variable. Again the null hypothesis is $H_0 : \beta = 0$

Furthermore, it is required that we test whether the estimated value of ρ is significant less than 0. If the finding rejects the hypothesis that $\rho = 0$, the series is concluded to be stationary. If, however, the variables are found to be non-stationary, in conventional regression models one would typically differentiate non-stationary variables before utilizing them in further analysis.

3.5.6 Augmented Dickey Fuller (ADF)

In equations 8 and 9 both constant (α_1) and trend term (t) have been included assuming that the error term is non-auto correlated. In the case that the error term (u_t) is auto correlated (not white noise), then to make the error term non-autocorrelated (serially independent), Dickey and Fuller have augmented equation (9) by including the lagged value of the dependent variable ΔY_t, the result is known as the Augmented Dickey Fuller (ADF) test, it has the following form:

$$\Delta Y_t = \alpha_1 + \alpha_2 t + \beta Y_{t-1} + \delta \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{10}$$

Equation (10) is the most extended form of the Augmented Dickey Fuller (ADF) test; it can be reduced to the following forms:

$$\Delta Y_t = \alpha_1 + \beta Y_{t-1} + \delta \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{11}$$

$$\Delta Y_t = \beta Y_{t-1} + \delta \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{12}$$

Where the first model represented by equation (10) includes a constant term (α_1) and a trend term $(\alpha_2 t)$ together with order autoregressive term. The second model, represented by equation (11), includes just a constant term only, and the third model in equation (12) does not include intercept and trend terms.

In all previous equations 10, 11 and 12, the null hypothesis is that $\beta = 0$, that is, there is unit root.

The finding that many macro and financial time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series is said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship amongst the variables.

The ADF and DF test statistics have the same asymptotic distribution, therefore, they have the same null hypothesis and same critical values. However, two important things should be considered. First, not to include too few lags because this will leave autocorrelation in the errors, and, second, not to include too many lags because that will reduce the power of the test statistics. Various ways have been suggested to overcome this problem.

Practically, one of the best options is to estimate models with a range of values for (m), and then use one of the following tests: the Akaike information Criterion (AIC) or Bayes Information criterion (BIC) or Schwarz information criterion (SC) to determine which is the best option,

The Akaike Information criterion (AIC) takes the following formula:

$$AIC(m) = \ln \hat{\sigma}_m^2 + \frac{2m}{N} \tag{13}$$

Where m is the number of parameters in the model and N is the number of observations in the regression.

The Bayes Information Criterion (BIC) takes the following formula:

$$BIC(m) = \ln \hat{\sigma} m^2 + \frac{m \ln N}{N} \tag{14}$$

The Schwarz information criterion (SC) takes the following formula:

$$SC(m) = \frac{2l}{N} + \frac{m \ln N}{N} \tag{15}$$

Where *l* is the value of the log likelihood function evaluated at these m estimates and q is the number of equation in the system. As the models considered involve systems of equations, the full system log likelihood is used to compute SC. Assuming a multivariate normal distribution, this function is given by:

$$l = -\frac{mq}{2}(1 + \ln 2\pi) - \frac{m}{2}\ln|\Omega_v| \tag{16}$$

3.5.7 Phillip-Perron tests

Phillips-Perron (PP) (1988) developed a more comprehensive theory of unit root non-stationary. They introduced a different method to overcome the problem that the error term is serially correlated (not white noise), without including lagged difference error term as the Augmented Dickey-Fuller (ADF) tests. The Phillips-Perron tests take the following formula:

$$y_t = \alpha + \rho y_{t-1} + u_t \tag{17}$$

$$y_t = \alpha_0 + \alpha_1 (t - T/2) + \rho y_{t-1} + u_t \tag{18}$$

Still as (ADF) tests, a constant and time trend can be included in the equation (17). This equation is estimated by using OLS. In general, Phillip-Peron (PP) tests give the same conclusions as the (ADF) test and suffer from most of the same important limitations (Brooks, 2002, p.381)

In order to avoid spurious regression, the non-stationary time series should be transformed to a stationary time series. One way of doing this is to differentiate the non-stationary time series d times to achieve stationary. This series is called integrated of order d, denoted x_t ~I (d). However, if the time series is already stationary then it is called I (0) (Granger, 1986).

3.5.8 Cointegration Tests

By tradition, financial analysts and researchers use the correlation coefficient to measure the degree of integration between any two markets using historical data. The major disadvantage of the correlation coefficient is that it can only represent the short-run relationship (Levy & Lerman 1988; Burik & Ennis 1990). However, using this correlation parameter may be misleading since markets often diverge considerably in the short-run (i.e. periods up to one year), but may actually be well integrated over longer periods. For example, a low correlation coefficient might suggest that markets A and B offer diversification opportunities relative to other international equity markets, However, if the markets are in fact integrated to an extent that is not obvious by looking at the simple correlation coefficients then investors may not achieve the degree of diversification initially expected. To avoid this problem, cointegration tests have been widely used to reveal any long-run linkages between international markets.

Having established that each of the series is non-stationary, we will then proceed to examine whether some long-run equilibrium relationships exist among the stock indices. Formally stated, a set of variables is said to be cointegrated if they are individually non-stationary and integrated of the same order, and yet their linear combination is stationary. If two or more of the stationary time series share a common trend, then they are said to be cointegrated. In econometrics, this suggests error correction models and Granger causality tests to capture both the short-run dynamics and the long-run equilibrium in the regression (Engle and Granger 1987).

Cointegration is a well-known technique to investigate the relationship between economic and financial time series. To investigate the international stock market cointegration, where the perfect market integration means a pair of stock prices is cointegrated, this also implies that there is little gain from international diversification. Many authors investigate the co-movement in the long-run of the stock market prices using the technique of cointegration to pinpoint whether such long-run benefits from international equity diversification exist (Kwan et al., 1995; Masih and Masih1997; Kanas 1998a, 1998b). Nevertheless, the two most widely used tests for cointegration are the Engle-Granger (1987) two-step estimator, and the Johansen (1988), and Johansen and Juselius (1990) maximum likelihood estimator. In short, both tests are called EG and JJ, respectively. Compared to the EG two step approach, the JJ procedure poses many advantages in testing for cointegration. Among the superiorities of the JJ procedures over the EG two step approach are: 1) the JJ test does not assume a priori that the existence of at most a single cointegrating vector and, instead, it explicitly tests for a number of cointegrating relationships; the JJ test is not sensitive to the choice of dependent variables as it assumes all variables are endogenous (Masih and Masih 1997). Therefore, this study utilizes the maximum likelihood approach Johansen and Juselius (1990) to test the cointegration.

In addition, many of the previous studies have focused on the diversification benefits of international investment in relation to the cointegration concept. The interpretation that no cointegration among two or more national stock markets implies long-run gains from international portfolio diversification has been suggested by several authors (Byers & Peel 1993; Allen & MacDonald 1995;). The current chapter will employ the cointegration technique to investigate the linkages of the Malaysian equity markets. In addition, the analysis of these links has strong implications for international diversification, especially, investment with the long-term horizons.

In general, international investors will normally hold equity from more than one national market in the expectation of achieving a reduction in risk. This study will consider the diversification benefits from the perspective of the Malaysian investors considering investing in global equity markets. If the Malaysian equity market is very strongly correlated in the long-run, which is an indication of a high degree of international financial integration, diversification will be less effective. However, if the Malaysian equity market functions independently (segmented), which is an indication of a lower degree of international integration, Malaysian investors will achieve international diversification benefits. Hence, an important indication of the degree to which long-run diversification is available to international investors is given by determining whether the Malaysian equity market is integrated or segmented. In order to test for cointegration, the first step is to check if each series (in levels) is integrated of the same order. It is common in financial market data that most of the macroeconomic and financial time series are integrated of order one, in other words, they are following an I (1) process.

Consider the relationship between two times series y_1 and x_1 represented by:

$$y_t = \beta_0 + \beta_1 x_1 + u_t \tag{19}$$

Equation (19) can be written as:

$$u_t = y_t - \beta_0 - \beta_1 x_1 \tag{20}$$

If the u_t is found to be stationary I(0), then the other side of the equation (the linear combination $y_t - \beta_0 - \beta_1 x_1$) must also be stationary. Depending on this, both variables are considered cointegrated. This example can be extended to a more general case by assuming x_t to be an n X1 column vector of variables that represents the transpose of the t the row of a t X n matrix of variables, X. As the vector x_t will be in long run equilibrium when:

$$\beta_1 x_{1t} + \beta_2 x_{2t} + ... + \beta_n x_{nt} = 0 \tag{21}$$

Any deviation from this relationship will represent equilibrium errors such that:

$$e_t = \delta x_t \tag{22}$$

Where δ is an n x1 row vector of linear weights referred to as the cointegration vector.

3.5.9 Error Correction Model (ECM)

To examine the causal relationship between the Malaysian stock and most developed and developing markets, the error correction model (ECM) is employed. The main idea behind cointegration is that if two variables have a long-run equilibrium relationship, then they are considered cointegrated. However, what about the short-run? It has been widely accepted that shocks in the short-run disturb this relationship causing disequilibrium. The Error Correction Model (ECM) has been used to describe the short-run dynamics between two variables. The main idea of the Error Correction model (ECM) is that "a proportion of the disequilibrium from one period is corrected in the next period" (Granger, 1986). Therefore, changes in one of these variables are related to the past in both variables and to past equilibrium error. According to the Granger representation theorem, for the cointegrated series, we need to employ the ECM. This error correction term (ECT) is included in the case of cointegration, otherwise, it is omitted from the regression.

Now, consider a system of two variables $x_{t,}$ y_t and both of these variables are I (1), depending on that, a simple form of (ECM) can be shown as follows:

$$\Delta x_t = \alpha_1 + \beta_1(x_t - \delta y_t) + a_{1x}\Delta x_{t-1} + a_{2x}\Delta y_{t-1} + \varepsilon_{x_t} \quad (23)$$

$$\Delta y_t = \alpha_2 + \beta_2(x_t - \delta y_t) + a_{1y}\Delta x_{t-1} + a_{2x}\Delta y_{t-1} + \varepsilon_{y_t} \quad (24)$$

Where ε_{x_t} and $\varepsilon_{y_t} \sim I\mathrm{N}(0,\sigma^2)$, $(x_t - \delta y_t)$ is the error correction term that measures past equilibrium error, and β represents the speed with which the model adjusted itself to its equilibrium level. So, from an economics point of view any deviation from long-run equilibrium must be corrected to keep the stability of the system as a whole.

3.5.10 A maximum likelihood approach for testing cointegration

A maximum approach is considered to be a multivariate generalization of the Dickey-Fuller test. The starting point of their approach is the following VAR (k) model:

$$y_t = \mu + \mathrm{A}_1 y_{t-1} + \mathrm{A}_2 y_{t-2} + ... + \mathrm{A}_k y_{t-k} + e_t \quad (25)$$

Where y_t is an n x 1 vector of stochastic non stationary variables or I (1), and μ is an intercept vector. Now consider $\Delta = 1 - L$, the lag operator is, equation (25) is rewritten as follows:

$$\Delta y_t = \mu + \Gamma_1 \Delta y_{t-1} + ...\Gamma_{k-1}\Delta y_{t-k+1} + \prod y_{t-k} + e_t \quad (26)$$

Where

$\Gamma = -(I - \mathrm{A}_1 - ... - \mathrm{A}_i),$ i=1,…,k-1

$$\prod = -(I - A_1 ... - A_k)$$

I = identity vector

$\prod$ is an n X n long-run response matrix. This matrix summarizes all the long-run relationships in y_t. The number of cointegration vectors is determined by the rank r of the matrix $\prod$, which is equal to the number of its characteristic root. Three possible cases have to be considered:

1. If the matrix $\prod$ has full rank r = n, all the variables in y_t are stationary.
2. If the matrix $\prod$ has zero rank r = 0, i.e. null matrix, then there are no stationary long-run relationship among variables in y_t.
3. If the rank of the matrix $\prod$ is 0<r<n, then there are r linear combinations of non-stationary variables that are stationary, and there are multiple cointegrating vectors, and the matrix $\prod$ can be expressed as $\prod = \alpha\beta^{'}$, where α and β are n x r matrices with r cointegration vectors.

Johansen and Juselius proposed two statistic tests in order to determine the number of cointegration vectors in the matrix $\prod$. The first statistic test is called the maximum eigenvalue, and it takes the following formula:

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \lambda^{'}_{r+1} \qquad (27)$$

Where T is the number of observations, λ'_i the estimated values of the characteristic roots (also called Eigenvalues) and $\lambda^{'}_{r+1},...\lambda^{'}_{n}$ the n-r smallest squared canonical correlations.

The maximum Eigenvalue statistic tests the null hypothesis of r cointegration relations

$$H_r : Rank(\prod_y) = r \tag{28}$$

Against the alternative hypothesis

$$H_{r+1} : Rank(\prod_y) = r + 1 \tag{29}$$

The second statistic test is called the Trace statistic, and it takes the following formula:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i^{'}) \tag{30}$$

It tests the null hypothesis of r cointegration relations

$$H_r : Rank(\prod_y) = r \tag{31}$$

Against the alternative hypothesis

$$H_{n_y} : Rank(\prod_y) = n_y \tag{32}$$

At this juncture, it is also important to note that the estimated results of the VAR model are easier to interpret in its moving representation, from which variance decomposition and impulse response functions are derived. Here, the strategy involves inverting the estimated model to derive its moving average representation using Sims' (1980). Accordingly, it also involves orthogonalizing innovations in each variable using Cholesky's decomposition of the residual covariance matrix, imposing a recursive structure on the contemporaneous relationship among the variables. Nevertheless, the variance decompositions and impulse response functions generated from this procedure may be sensitive to the ordering of the variables. In this study, the ordering variables are based on the assumption that higher economy countries will influence the Malaysian market. For example, both the US and Japanese will influence the Malaysian market (Yusof and Majid, 2006).

3.5.11 The Granger Causality

The general idea about the Granger Causality test is that it measures the dependency between two (or more) variables, and which one causes the other. The Granger Causality method seeks to determine how much of a current variable, y, can be explained by past values of y and whether adding lagged values of another variable, x, can improve the explanation. Then, y is said to be "Granger-caused" by x if x helps to predict y. Before applying this test to any times series, one should be aware that the time series is stationary. Therefore, if the time series of any variable is not stationary, the Granger Causality test cannot be applied. According to Granger's first definition "… we say that Y is causing X, denoted by $Y_t \Rightarrow X_t$ if we are better able to predict X_t using all available information that if the information apart from Y_t had been used (Granger,1969,p.428). A simple causality model is given as follows:

$$Y = \beta_0 + \sum_{i=1}^{n} a_i X_{t-1} + \sum_{i=1}^{n} b_i Y_{t-i} + \varepsilon_t \tag{33}$$

$$X = \beta_0 + \sum_{i=1}^{n} c X_{t-1} + d_i Y_{t-i} + e_t \tag{34}$$

Where ε,e are uncorrelated white noise series, i.e., $E[\varepsilon_t \varepsilon_s] = 0 = E[e_t e_s]$ and $E[\varepsilon_1 \varepsilon_s] = 0$ for all t, s.

Equation (33) indicates that X_t is causing Y_t if a_i is not zero, and Y_t causing X_t if d_i is not zero. If both events occur then it is said to be a feedback relationship between X_t and Y_t. If both variables fail to Granger cause each other it means that both variables are independent. In general, this kind of causality is called bilateral causality, since it deals with two variables. However, it can be extended to multivariate causality by using the (VAR) technique (Gujarati, 2003).

3.5.12 Variance Decompositions and Impulse Response Functions

The Granger causality of the dependent variable within the sample period in VECM framework not only provides an indication of the dynamic properties of the system but also prevents us from capturing the relative strength of the causality among the variables beyond the sample period. Therefore, variance decomposition allows us to examine the out of sample causality among the variables in the VAR system. The VAR model is a system of reduced form dynamic linear equations in which each variable is expressed as a function of serially uncorrelated errors and an equal number of lags of all variables in the system (Enders 1995). This VAR model assumes that the contemporaneous correlations of errors equations are nonzero, hence, there are no contemporaneous explanatory variables in the model. The error terms also referred to as innovations can provide a potential source of new information about the movements in a variable during the current period. In order to interpret economic implications from the VAR model, we use Sims (1980) innovation accounting procedure. This procedure involves the decomposition of forecast error variance of each variable into components attributable to its own innovations and to shocks of other variables in the system. The above procedure of variance decompositions together with impulse response analysis (also known as innovation accounting in the literature) allows us to examine the relationships among the economic variables. If the correlations among the various innovations are huge, the identification problem is likely to be important. The alternative orderings should yield similar impulse response and variance decompositions.

3.6 CONSTRUCTION OF OPTIMAL PORTFOLIO (EFFICIENT PORTFOLIO)

The main concern of the study is also to create a portfolio of indices that maximizes return at a given level of risk, or minimizes risk at a given level of return. In order to examine the potential gain from international diversification, mean rates of return on MSCI indices and their standard deviation are calculated for selected countries for the period of 1999 to 2008. The daily rate of return for each index is defined as the percentage change in Ringgit Malaysia value of its MSCI index. In this study the return and risk are calculated as follows:

$$r_{i(t)} = \log(\frac{P_{i(t)}}{P_{i(t-1)}}) X 100 \tag{35}$$

Where:

$r_{i(t)}$ = return of index *i* at the end of day *t*.

$P_{i(t)}$ = the ringgit value of the ith country’s index at the end of day t.

$P_{i(t-1)}$ = the ringgit value of the ith country’s index at the end of day t-1.

According to Levy and Sarnat (1970), the rates of return have a downward bias owing to the neglect of dividends, however, the use of the arithmetic, rather than the geometric mean imparts an offsetting upward bias to the historical rates of return. The mean rate of return for each stock is calculated by taking the arithmetic average of the monthly returns:

$$R_i = \frac{1}{N}\sum_{t-1}^{N} r_{i(t)} \qquad (36)$$

Where:

$R_i =$ mean rate of return of index i

$r_{i(t)}$ = return of index i at the end of day t

N= number of days

Subsequently, a correlation matrix among the monthly rates of return of the countries index in different regions making up the population is calculated. The variances and covariance are used in later computations. The variance for the ith stock is defined as:

$$\sigma_i^2 = \frac{1}{N}\sum_{t=1}^{N}(r_{i(t)} - R_i)^2 \qquad (37)$$

Where

σ_i^2 = variance of index i over N days

$r_{i(t)} =$ return of index i at the end of day t

$R_i =$ mean rate of return of index i

Then, the standard deviation is determined as follows:

$$\sigma_i = \sqrt{\sigma_i^2} \tag{38}$$

Where

σ_i = standard deviation of stock i

σ_i^2 = variance of stock i over N days

Hence, the correlation ρ_{xy} is defined as:

$$\text{Correlation xy} = \rho_{ij} = \frac{Cov(ij)}{\sigma_i \sigma_j} \tag{39}$$

Where

ρ_{ij} = The correlation coefficient of stock i and j, respectively,

Cov ij = covariance of i and j

$\sigma_i \sigma_j$ = The standard deviation of stock i and j, respectively,

Meanwhile, in order to make an empirical test of the benefits to the Malaysian investor from international diversification, we must first calculate the set of optimal portfolios. Markowitz's (1952) mean variance approach will be used to construct an optimal portfolio, the composition and risk of which are calculated with the aid of computer software Excel Solver, which can be found in the tools menu under Add-Ins. An efficient international portfolio is defined as a combination of investments in various stocks in many countries, which either have a higher expected rate of return for the same risk level or a lower risk level with the same rate of return. The set of points comprises the efficient curve, with each point on the curve representing a particular combination of investment proportions in various indices. For each risk level, the efficient frontier locates the portfolio with the highest returns. It also reveals the portfolio with the smallest amount of risk for each level of return. The computation procedure of the optimal portfolio subject to certain constraints. First, the negative investment is not permitted. It means we assume there is no short sale. Second, the range of proportions to $0 \leq X_i \leq 1$. The initial inputs required for building up the optimum portfolio is to calculate the expected return of the portfolio, the variance and the covariance. The steps for calculation can be stated as follows.

3.6.1 Expected Return on Portfolio

The expected return of a portfolio consisting of “n” indices is a weighted average of the expected return of securities. In other words, portfolio return is the proportion-weighted combination of the constituent of expected stock returns. Regardless of the number of stocks held in a portfolio or the proportion of total investable funds placed in each stock, the expected return on the portfolio is always a weighted average of the expected returns for individual stocks in the portfolio. Therefore, the expected return on any portfolio consisting of “n” securities can be defined as follows:

$$\mathrm{E}\,(R_p) = \sum_{i=1}^{n} W_i R_i \qquad (40)$$

Where

E (R_p) = The expected return on portfolio p

$\sum W_i = 1$; assume no short sales

W_i = the proportion or percentage of each stock security in the total portfolio.

R_i = the expected values of the rates of return from each security

n = the number of securities in the portfolio.

3.6.2 Portfolio variance (Risk)

While there are many types of risk and different methods of measuring them, the Standard Deviation of (historical) returns also known as volatility in other literature is probably the most common measure of the risk of listed securities and portfolios. It is a statistical measure, which measures the variability of returns (about the mean or average). The higher the standard deviation, the more uncertain the outcome over any period. Standard deviation is very useful in that it enables us to compare the riskiness of different types of investment. The greater the volatility, the greater is the risk of loss.

Furthermore, the frequency and amount of price fluctuation of an investment are called volatility. Volatility is also a measure of investment risk. The more volatile an investment, the more risk there is for reward. The Modern Portfolio Theory suggests that there is a relationship between risk and reward and that investors are rewarded for taking investment risk over time.

The portfolio risk is represented by the weighted average of the variability and the correlation of the returns from the sample securities. For this, the mean variance model is used to identify an optimal allocation of portfolio in several securities. The basic principal behind the search for an optimal allocation is the Markowitz Efficient Frontier Model as stated below. The variance of a portfolio is calculated as follows:

$$\sigma_p^2 = \sum_{i=1}^{n} W_i^2 \sigma_i^2 + 2 \sum_{i=1}^{n} \sum_{i=1}^{n} W_i W_j \sigma_i \sigma_j \rho_{ij} \qquad (41)$$

Where

i $\neq$ j

$W_i \geq 0$

$\sum W_i = 1$

$\sigma_p^2 =$ the portfolio variance

$\sigma_i \sigma_j =$ the standard deviation of security i and j, respectively,

$\rho_{ij} =$ the correlation coefficient of security i and j, respectively,

$W_i W_j =$ the proportion of security i and j, respectively, in the portfolio.

Subject to:

1) $W_i \geq 0$, i=1, 2, 3…..200 which implies that short selling is not allowed

2) $\sum W_i = 1$ (Ensures that the portfolio is fully invested.)

3.6.3 Volatility

The Portfolio volatility can be related in the following manner:

$$\sigma_p = \sqrt{\sigma_p^2} \tag{42}$$

3.6.4 Covariance

Covariance is another statistical measure for volatility. What variance cannot tell us though is the risk of an entire portfolio, the average of a series of variances is not a useful measure for portfolio risk. What Markowitz suggested, now regarded as his greatest achievement, was to adopt covariance as a measure of portfolio risk, based on the existing formula for the variance of a weighted sum. Covariance measures the correlations of a group of stocks, when two stocks have high covariance it means their prices move together in step, when covariance is low the stock trend is in the opposite direction. To Markowitz, the risk of a portfolio is not the variance of individual stocks, but the covariance of the holdings. The key was to adopt a portfolio with the lowest possible covariance, thus, eliminating the risk that a single event could drive down all investments at the same time. A portfolio of highly risky shares could have a low overall risk if their effects were to move in opposite directions.

The usual measure of the precision of a relation between two variables x and y is the correlation coefficient (r_{xy}). It is calculated in part from the product of the deviation of each observation of x from the mean of the x values, and the deviation of each observation of y from the mean of the y values, and these differences are multiplied together – a quantity called the covariance of x and y (cov xy). Traditionally the formula for covariance is given as below:

$$Cov\ \text{xy} = \frac{(x_1 - \bar{x})(y_1 - \bar{y}) + (x_2 - \bar{x})(y_2 - \bar{y}) + ... + (x_n - \bar{x})(y_n - \bar{y})}{n}$$

$$\text{Cov xy} = \frac{1}{n}\sum_{i=1}^{n}(x_1 - \bar{x})(y_1 - \bar{y}) \qquad (43)$$

Computationally, it is more efficient to use the following equivalent formula to calculate the covariance. A formula that is exactly algebraically equivalent but that makes computation easier is shown below.

$$\text{Cov xy} = \frac{1}{n}\sum_{i=1}^{n} x_1 y_1 - \bar{x}\bar{y} \qquad (44)$$

Where;

n = the number of stock market indices in the portfolio.

$\bar{x}$ = Average of stock index x

$\bar{y}$ = Average of stock index x

x_1 = a single sample of stock index x

y_1 = a single sample of stock index y

3.6.5 Correlation Coefficient

Each asset class will generally have different levels of return and risk. They also behave differently. At the time one asset is increasing in value, another may be decreasing or, at least, not increasing as much and vice versa. The measure used for this phenomenon is called the correlation coefficient.

A key thesis of the Modern Portfolio Theory is the idea that investors frequently fail to consider the degree of “correlation” between different investments held in a portfolio. Correlation is the degree to which the price of different investments moves in the same direction. When different investments move in the same direction a great deal of the time, there is a high degree of correlation. When different investments do not move “in sync” with each other, there is a low degree of correlation. Markowitz held the position that risk in a portfolio could be reduced and rates of return increased when there is a low degree of correlation between the investments held in a portfolio.

The correlation coefficient is a measure of the degree to which two assets (or investments) move together. The value of the correlation coefficient ranges from -1 to +1. Assets, which have a correlation coefficient of 1, are perfectly negatively correlated. Their values move simultaneously in opposite directions and magnitude. For a value of +1 they are perfectly positively correlated. Their values move simultaneously in the same direction and magnitude. A correlation coefficient of 0 indicates there is no relationship at all. In reality, most assets have some positive correlation, although it may be very low. Markowitz then considers how all the investments in a portfolio can be expected to move together in price under the same circumstances. This is called "correlation," and it measures how much you can expect different securities or asset classes to change in price relative to each other.

The correlation, ρ_{xy} is defined as

$$\text{Correlation xy} = \rho_{xy} = \frac{\text{cov } xy}{\sigma_x \sigma_y} \tag{45}$$

Where:

ρ_{xy} = The correlation coefficient of stock market index x and y, respectively,

Cov xy = covariance of x and y

$\sigma_x \sigma_y$ = The standard deviation of stock market index x and y, respectively,

In the formula for correlation, the products of the deviations are divided by the product of the standard deviations of *x* and *y* (σ_x and σ_y). This normalization by the standard deviations has the effect of making ρ_{xy} a dimensionless number that is independent of the units in which *x* and *y* is measured. So defined ρ_{xy}, will vary from −1, which signifies a perfectly linear negative relation between *x* and *y*, to +1, which indicates a perfectly linear positive relation between *x* and *y*. If $\rho_{xy} = 0$ there is no linear relation between the variables.

3.7 SUMMARY

This chapter has presented, elaborated and explained the theoretical framework, hypothesis development, the research design, and the methodology. The research design explained the sets of data used as well as the basis of selecting the countries for analysing. It continued with an explanation of the period of the study. It also presented the econometric techniques and Markowitz's theory used for cointegration analysis and the portfolio construction for this study.

Table 3.4 Summary of Hypotheses and Associated Analyses

Null Hypothesis	Description of Null Hypothesis Development	Analyses
Hypothesis 1	Developed, Developing countries and Performance	
$H_0$1a	Developed countries exhibit no difference in return compared to developing countries during the pre crisis, crisis and post crisis	Descriptive Statistics Summary Statistics of Stock Returns
$H_0$1b	Developed countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis	Descriptive Statistics Summary Statistics of Stock Returns
$H_0$1c	Developing countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis	Descriptive Statistics Summary Statistics of Stock Returns
Hypothesis 2	Developed, Developing countries and Correlation	
$H_0$2a	There is no distinctive difference in correlation coefficient between developed and developing countries during the pre crisis, crisis and post crisis	Correlation Of Stock Returns
Hypothesis 3	Developed, Developing countries and Integration	
$H_0$3a	There is no integration between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis	Unit root test Cointegration Analysis

$H_0$3b	There is no short run dynamic relationship between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis	Bivariate Granger Causality Tests
$H_0$3c	There is no long run dynamic relationship between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis	Multivariate Causality Analysis
$H_0$3d	There is no difference of strength of the linkages between the Malaysian stock market with the developed and developing countries during the pre crisis, crisis and post crisis	Variance Decompositions and Impulse Response Functions
Hypothesis 4	Developed, Developing countries and international diversification	
$H_0$4a	There is no difference in the asset allocation between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis	Markowitz's theory
$H_0$4b	There is no difference in the efficient frontiers between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis	Markowitz's theory

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the empirical findings to answer the research questions and, subsequently, to achieve the objectives of the study that were discussed earlier in chapter one. Furthermore, the testable hypotheses, which were presented in chapter 3 will also be examined. This chapter is organized as follows. Section 4.2 will discuss the descriptive statistics of the developed and developing countries. Section 4.3 will discuss in detail the empirical data analysis based on the hypotheses testing and results. Finally, section 4.4 concludes this chapter with a summary.

4.2 DESCRIPTIVE STATISTIC

This section explains the descriptive statistics for the variables used in this study. Tables 4.1 and 4.2 present summary statistics of developed and developing countries for eleven years of historical data from 1996 to 2007, which include the economic crisis year of 1997. This study is divided into three sub periods to capture the effects on the Malaysian market of various stages of economics circumstances.

Table 4.1 Descriptive Statistics of Malaysian and Developed Markets

Equity Markets	Index returns(Per cent) Mean	Standard Deviation	Skewness	Kurtosis
	(a) Entire Period (July 1996 – June 2007)			
Malaysia	0.008	1.884	-1.725	82.339
United States	0.039	1.233	0.019	8.402
Japan	0.010	1.490	0.294	7.077
United	0.040	1.220	-0.203	9.953
France	0.051	1.399	-0.107	6.051
Hong Kong	0.024	1.630	0.000	14.169
Germany	0.046	1.558	-0.125	5.863
Canada	0.060	1.305	-0.442	8.858
Switzerland	0.045	1.248	-0.024	8.998
Australia	0.049	1.202	-0.120	9.385
Spain	0.061	1.455	0.066	6.176
Average	0.039	t-value:-6.66E-05	P-value for T-test:0.999	
	(b) Pre-Crisis (July 1996 – June 1997)			
Malaysia	-0.017	0.864	-0.448	5.154
United States	0.111	0.868	-0.266	3.497
Japan	-0.033	1.139	0.057	4.265
United	0.108	0.728	-0.370	3.749
France	0.068	0.900	-0.672	5.487
Hong Kong	0.094	1.078	0.016	5.149
Germany	0.092	0.862	-0.613	5.075
Canada	0.102	0.783	-0.484	5.346
Switzerland	0.099	0.833	-0.483	5.103
Australia	0.052	0.891	-0.330	4.022
Spain	0.146	0.962	-0.022	2.850
Average	0.075	t-value:1.65E-05	P-value for T-test:1.0	
	(c) Crisis (July 1997 – June 1998)			
Malaysia	-0.356	3.246	1.228	9.278
United States	0.291	2.055	-0.094	6.725
Japan	0.033	2.321	0.388	4.997
United	0.281	2.073	-0.322	8.717
France	0.318	2.119	-0.090	5.043
Hong Kong	-0.077	3.173	0.123	7.629
Germany	0.332	2.257	-0.222	4.997
Canada	0.231	2.011	-0.231	7.199
Switzerland	0.296	2.089	-0.059	6.605
Australia	0.107	2.086	0.104	7.251
Spain	0.341	2.295	0.012	4.501
Average	0.163	t-value:-5.48E-06	P-value for T-test:1.0	

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(d) Post-Crisis (July 1998 – June 2007)				
Malaysia	0.048	1.752	-3.310	23.329
United States	0.003	1.139	-0.054	6.077
Japan	0.010	1.401	0.209	6.664
United	0.005	1.129	-0.240	5.680
France	0.018	1.339	-0.185	5.150
Hong Kong	0.027	1.418	-0.051	9.138
Germany	0.010	1.521	-0.141	5.170
Canada	0.037	1.250	-0.561	7.464
Switzerland	0.010	1.157	-0.135	6.980
Australia	0.040	1.093	-0.304	5.999
Spain	0.021	1.376	-0.019	5.466
Average	0.021	t-value:3.95E-05	P-value for T-test:1.0	

Source: Computed from the data

Table 4.1 presents descriptive statistics of the index returns for Malaysia and ten top developed markets over the entire period of 11 years , pre-crisis period, crisis period, and post-crisis period. Several points are notable from Table 4.1. The Malaysian market is distinct from the rest in that it recorded a negative return over the pre-crisis and crisis period. The average equity market return of Malaysia drastically fell during the Asian financial crisis in 1997 but bounced back after the crisis as the Malaysian index recorded an average daily return of 0.048 per cent. It is interesting to note that during the pre-crisis period, all stock markets recorded positive average daily returns with the exception of the Malaysian and Japanese markets, which recorded a negative return of -0.017 per cent and -0.033 per cent, respectively. The findings from the pre-crisis analysis that recorded a negative return for Japan are in line with the studies of Ibrahim (2006) and Majid et al. ((2008). In addition to the stock market of Japan, the Malaysian and Hong Kong markets also recorded negative returns of -0.356 per cent and -0.077 per cent, respectively, over the period of crisis, reflecting the stock market crash in 1997. The United States exhibited an upward trend until the crisis period but then reverted downward owing to various global political and economic uncertainties. During the Asian crisis, except the

Malaysian and Hong Kong markets, other markets still posted positive returns. These positive returns were due to impressive growth by the markets prior to the Asian financial crisis. Indeed, all the 11 countries posted positive returns over the entire period and after the crisis period. During the whole period, the Spanish stock market earned the highest average daily returns of 0.061 per cent, followed by Canada (0.060 per cent), France (0.051 per cent), Australia (0.049percent), Germany (0.046 per cent), Switzerland (0.045 per cent), United Kingdom (0.040 per cent), United States (0.039 per cent), Hong Kong (0.024 per cent), Japan (0.010 per cent), and Malaysia (0.008 per cent). Additionally, it is interesting to note that the Spanish market recorded the highest return of 0.341 per cent daily while the Malaysian market had the lowest daily return of -0.356 per cent during the crisis period.

During the period of crisis, the unconditional standard deviations of market returns are higher for all countries. This indicates that these markets are relatively more volatile during this critical period compared to the other periods under consideration. Additionally, most of the index returns tend to be negatively skewed. Furthermore, the index returns seem to exhibit excess kurtosis except for Spain (during pre-crisis), suggesting that the distribution of the index returns for all markets are leptokurtic, which means having a fatter tail than the normal distribution.

Table 4.2 Descriptive Statistics of the Malaysian and Developing Markets

Index returns (Per cent)				
Equity Markets	Mean	Standard	Skewness	Kurtosis
(a) Entire Period (July 1996 – June 2007)				
Malaysia	0.008	1.884	-1.725	82.339
China	0.013	2.034	-0.062	8.257
India	0.057	1.709	-0.326	7.182
Brazil	0.060	2.264	-0.086	8.908
Argentina	0.042	2.393	-1.363	25.823
Russia	0.077	3.212	-0.510	13.541
Mexico	0.076	1.815	-0.476	17.315
South Africa	0.039	1.628	-0.563	7.821
Chile	0.037	1.235	-0.284	8.108
Turkey	0.062	3.332	-0.170	9.321
Israel	0.047	1.622	-0.287	8.047
Average	0.047	t-value:-1.33E-05	P-value for T-test:1.0	
(b) Pre-Crisis (July 1996 – June 1997)				
Malaysia	-0.017	0.864	-0.448	5.154
China	0.116	1.486	-0.068	7.014
India	0.015	1.519	-0.125	6.945
Brazil	0.203	1.051	0.175	3.723
Argentina	0.099	1.310	-0.533	4.080
Russia	0.306	2.650	-0.131	5.721
Mexico	0.117	1.076	-0.058	3.249
South Africa	0.009	0.968	-0.100	4.038
Chile	0.034	0.798	0.635	4.090
Turkey	0.140	2.426	0.571	7.119
Israel	0.103	1.264	0.023	6.380
Average	0.102	t-value:-9.60E-06	P-value for T-test:1.0	
(c) Crisis (July 1997 – June 1998)				
Malaysia	-0.356	3.246	1.228	9.278
China	-0.131	3.408	-0.136	6.190
India	0.037	2.391	0.084	5.703
Brazil	0.027	3.060	-0.668	5.548
Argentina	0.108	2.571	-0.866	8.164
Russia	-0.167	4.871	-0.334	9.594
Mexico	0.138	2.877	-1.559	20.093
South Africa	0.028	2.498	-0.873	7.471
Chile	-0.004	1.984	-0.316	6.699
Turkey	0.271	3.741	-0.451	5.136
Israel	0.210	2.229	-0.264	7.681
Average	0.015	t-value:-9.60E-06	P-value for T-test:1.0	

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	(d) Post-Crisis (July 1998 – June 2007)			
Malaysia	0.048	1.752	-3.310	23.329
China	0.018	1.878	0.062	6.174
India	0.063	1.637	-0.468	7.011
Brazil	0.046	2.259	0.096	8.904
Argentina	0.026	2.466	-1.402	26.911
Russia	0.081	3.034	-0.531	13.378
Mexico	0.062	1.726	0.101	8.911
South Africa	0.044	1.566	-0.383	5.804
Chile	0.041	1.165	-0.242	6.196
Turkey	0.029	3.372	-0.157	9.803
Israel	0.022	1.577	-0.332	7.366
Average	0.044	t-value:-9.60E-06	P-value for T-test:1.0	

Source: Computed from the data

Table 4.2 presents descriptive statistics of the index returns for Malaysia and the ten top developing markets over the entire period, pre-crisis period, crisis period, and post-crisis period. Several points are notable from Table 4.2. The Malaysian market is distinct from the rest of counries in that it recorded a negative return over the period of pre-crisis and crisis period. The average equity market return of Malaysia fell drastically during the Asian financial crisis in 1997 but bounced back after the financial crisis as the Malaysian index recorded an average daily return of 0.048 per cent. It is interesting to note that during the pre-crisis period, all stock markets recorded positive average daily returns with the exception of the Malaysian market, which recorded a negative return of -0.017 per cent. During the Asian crisis, with the exception of the markets of Malaysia, China, Russia and Chile, the other markets still posted positive returns. In addition to the stock market of Malaysia, the markets of China, Russia, and Chile also recorded negative returns of -0.131 per cent, -0.167 per cent and -0.004 per cent, respectively, over the period of crisis, reflecting the stock market crash in 1997. These positive returns were due to impressive growth by the markets prior to the Asian financial crisis. Indeed, all the countries posted positive returns over the entire period and after the crisis period. During the entire period of 11 years, the Russian stock market earned the highest average daily returns of 0.077 per cent, followed by Mexico (0.076 per cent), Turkey (0.062percent), Brazil (0.060 per cent), India (0.057 per cent), Israel (0.047 per cent), Argentina (0.042 per cent), South Africa (0.039 per cent), Chile (0.037 per cent), China (0.013 per cent), and Malaysia (0.008 per cent). Additionally, it is interesting to note that Turkey's market recorded the highest return of 0.271 per cent daily followed by Israel (0.210 per cent), Mexico (0.138 per cent), Argentina (0.108 per cent), India (0.037 per cent), South Africa (0.028 per cent), Brazil (0.028 per cent), Chile (-0.004 per cent), China (-0.131 per cent), Russia (-0.167 per cent) while the Malaysian market has the lowest daily return of -0.356 per cent during the crisis period.

During the period of crisis, the unconditional standard deviations of market returns are higher for all countries, thus, indicating that these markets are relatively more volatile compared to the other periods under consideration. Additionally, most of the index returns tend to be negatively skewed. Furthermore, the index returns seem to exhibit excess kurtosis suggesting that the distribution of the index returns for all markets are leptokurtic, which means having a fatter tail than the normal distribution.

4.3 EMPIRICAL DATA ANALYSIS

4.3.1 Developed, developing countries and performance

Null Hypothesis 1a ($H_0$1a)

Developed countries exhibit no difference in return compared to developing countries during the pre crisis, crisis and post crisis.

As discussed earlier, in Tables 4.1 and 4.2, the findings show that, on average, the return from developing countries is higher than developed countries for all periods except during the crisis period. The results of return in developed and developing countries varies in all sub periods. Therefore, it allows the study to reject the null hypothesis of 1a.

Null Hypothesis 1b ($H_0$1b)

Developed countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis.

The results of the descriptive statistics of Malaysian and developed countries have been presented in Table 4.1. The average daily return for the pre crisis and post crisis period are 0.075 per cent and 0.021 per cent, respectively, and during the crisis period it is 0.163 per cent. In addition, the difference in average mean is significant in all sub periods. Therefore, this study rejects the null hypothesis 1b.

Null Hypothesis 1c ($H_0$1c)

Developing countries exhibit no difference in return during the pre and post financial crisis as compared to during the financial crisis.

The results of the descriptive statistics for Malaysia and the developing countries have been presented in Table 4.2. The average daily return for the pre crisis and post crisis period are 0.102 per cent and 0.044 per cent, respectively, and during the crisis period it is 0.015 per cent. In addition, the difference in average mean is significant. The average daily return during the pre crisis and post crisis exhibits a higher return than the crisis period. Therefore, this study rejects the null hypothesis 1c.

Table 4.3 Correlation of Index Returns between Malaysian and Developed Markets

(a) Entire Period (July 1996 – June 2007)

	MAL	USA	JPN	UK	FRN	HKG	GER	CAN	SWZ	AUS	SPN
MAL	1.000										
USA	-0.087*** [0.000]	1.000									
JPN	0.125*** [0.000]	0.195*** [0.000]	1.000								
UK	0.025 [0.174]	0.508*** [0.000]	0.312*** [0.000]	1.000							
FRN	0.012 [0.522]	0.511*** [0.000]	0.303*** [0.000]	0.800*** [0.000]	1.000						
HKG	0.231*** [0.000]	0.210*** [0.000]	0.399*** [0.000]	0.362*** [0.000]	0.330*** [0.000]	1.000					
GER	0.013 [0.474]	0.538*** [0.000]	0.274*** [0.000]	0.734*** [0.000]	0.834*** [0.000]	0.334*** [0.000]	1.000				
CAN	-0.001 [0.954]	0.692*** [0.000]	0.268*** [0.000]	0.531*** [0.000]	0.546*** [0.000]	0.269*** [0.000]	0.544*** [0.000]	1.000			
SWZ	0.019 [0.316]	0.458*** [0.000]	0.313*** [0.000]	0.746*** [0.000]	0.779*** [0.000]	0.294*** [0.000]	0.744*** [0.000]	0.478*** [0.000]	1.000		
AUS	0.126*** [0.000]	0.243*** [0.000]	0.492*** [0.000]	0.439*** [0.000]	0.407*** [0.000]	0.469*** [0.000]	0.382*** [0.000]	0.376*** [0.000]	0.411*** [0.000]	1.000	
SPN	-0.003 [0.877]	0.475*** [0.000]	0.273*** [0.000]	0.720 [0.000]	0.831*** [0.000]	0.300*** [0.000]	0.761*** [0.000]	0.505*** [0.000]	0.738*** [0.000]	0.397*** [0.000]	1.000

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(b) Pre-Crisis (July 1996 – June 1997)

	MAL	USA	JPN	UK	FRN	HKG	GER	CAN	SWZ	AUS	SPN
MAL	1.000										
USA	-0.028 [0.658]	1.000									
JPN	0.103* [0.097]	0.049 [0.433]	1.000								
UK	0.151** [0.015]	0.226*** [0.000]	0.201*** [0.001]	1.000							
FRN	0.031 [0.624]	0.241*** [0.000]	0.175*** [0.005]	0.490*** [0.000]	1.000						
HKG	0.253*** [0.000]	0.137** [0.027]	0.282*** [0.000]	0.186*** [0.003]	0.174*** [0.005]	1.000					
GER	0.276*** [0.000]	0.099 [0.112]	0.294*** [0.000]	0.404*** [0.000]	0.442*** [0.000]	0.397*** [0.000]	1.000				
CAN	0.122** [0.049]	0.697*** [0.000]	0.047 [0.453]	0.312*** [0.000]	0.283*** [0.000]	0.204*** [0.001]	0.211*** [0.001]	1.000			
SWZ	0.161*** [0.009]	0.074 [0.238]	0.248*** [0.000]	0.401*** [0.000]	0.477*** [0.000]	0.209*** [0.001]	0.541*** [0.000]	0.134** [0.030]	1.000		
AUS	0.276*** [0.000]	0.176*** [0.004]	0.110* [0.077]	0.356*** [0.000]	0.139** [0.025]	0.361*** [0.000]	0.389*** [0.000]	0.329*** [0.000]	0.209*** [0.001]	1.000	
SPN	0.107* [0.085]	0.277*** [0.000]	0.127** [0.041]	0.448*** [0.000]	0.546*** [0.000]	0.202*** [0.001]	0.438*** [0.000]	0.298*** [0.000]	0.454*** [0.000]	0.161*** [0.009]	1.000

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(c) Crisis (July 1997 – June 1998)

	MAL	USA	JPN	UK	FRN	HKG	GER	CAN	SWZ	AUS	SPN
MAL	1.000										
USA	-0.285*** [0.000]	1.000									
JPN	-0.094 [0.129]	0.590*** [0.000]	1.000								
UK	-0.248*** [0.000]	0.858*** [0.000]	0.682*** [0.000]	1.000							
FRN	-0.212*** [0.001]	0.808*** [0.000]	0.692*** [0.000]	0.890*** [0.000]	1.000						
HKG	0.173*** [0.005]	0.395*** [0.000]	0.495*** [0.000]	0.529*** [0.000]	0.533*** [0.000]	1.000					
GER	-0.200*** [0.001]	0.752*** [0.000]	0.681*** [0.000]	0.850*** [0.000]	0.868*** [0.000]	0.583*** [0.000]	1.000				
CAN	-0.226*** [0.000]	0.924*** [0.000]	0.644*** [0.000]	0.862*** [0.000]	0.843*** [0.000]	0.502*** [0.000]	0.814*** [0.000]	1.000			
SWZ	-0.229*** [0.000]	0.818*** [0.000]	0.671*** [0.000]	0.891*** [0.000]	0.905*** [0.000]	0.479*** [0.000]	0.888*** [0.000]	0.851*** [0.000]	1.000		
AUS	-0.086 [0.167]	0.698*** [0.000]	0.745*** [0.000]	0.788*** [0.000]	0.776*** [0.000]	0.622*** [0.000]	0.796*** [0.000]	0.789*** [0.000]	0.755*** [0.000]	1.000	
SPN	-0.241*** [0.000]	0.779*** [0.000]	0.653*** [0.000]	0.850*** [0.000]	0.910*** [0.000]	0.479*** [0.000]	0.830*** [0.000]	0.809*** [0.000]	0.872*** [0.000]	0.724*** [0.000]	1.000

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(d) Post-Crisis (July 1998 – June 2007)

	MAL	USA	JPN	UK	FRN	HKG	GER	CAN	SWZ	AUS	SPN
MAL	1.000										
USA	-0.014 [0.498]	1.000									
JPN	0.198*** [0.000]	0.076*** [0.000]	1.000								
UK	0.128*** [0.000]	0.392*** [0.000]	0.199*** [0.000]	1.000							
FRN	0.088*** [0.000]	0.431*** [0.000]	0.202*** [0.000]	0.786*** [0.000]	1.000						
HKG	0.258*** [0.000]	0.135*** [0.000]	0.375*** [0.000]	0.301*** [0.000]	0.268*** [0.000]	1.000					
GER	0.075*** [0.000]	0.496*** [0.000]	0.167*** [0.000]	0.716*** [0.000]	0.842*** [0.000]	0.250*** [0.000]	1.000				
CAN	0.071*** [0.001]	0.618*** [0.000]	0.173*** [0.000]	0.432*** [0.000]	0.474*** [0.000]	0.185*** [0.000]	0.485*** [0.000]	1.000			
SWZ	0.108*** [0.000]	0.348*** [0.000]	0.201*** [0.000]	0.710*** [0.000]	0.756*** [0.000]	0.221*** [0.000]	0.713*** [0.000]	0.374*** [0.000]	1.000		
AUS	0.202*** [0.000]	0.076*** [0.000]	0.431*** [0.000]	0.312*** [0.000]	0.305*** [0.000]	0.409*** [0.000]	0.257*** [0.000]	0.242*** [0.000]	0.295*** [0.000]	1.000	
SPN	0.078*** [0.000]	0.382*** [0.000]	0.169*** [0.000]	0.689*** [0.000]	0.822*** [0.000]	0.238*** [0.000]	0.757*** [0.000]	0.423*** [0.000]	0.707*** [0.000]	0.299*** [0.000]	1.000

Note: ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

The numbers in the [] are p value for the null hypotheses that the correlation coefficients are zero.

Note: MAL=Malaysia, USA=United States, JPN= Japan, UK = United Kingdom, FRN= France, HK= Hong Kong, GER= Germany, CAN=Canada, SWZ= Switzerland, AUS= Australia and SPN=Spain.

4.3.2 Developed, developing countries and correlation

The correlation coefficients of daily stock market return for the four sub-sample periods of the entire period, pre-crisis, crisis and post crisis periods of Malaysia and developed countries are shown in Table 4.3. The figures in parentheses indicate the p-values testing the null hypothesis. It is necessary to take a close look at these correlation coefficients because it can provide an important insight for the analysis of the short run relations between the movements of the stock markets, cointegration and Granger causality tests. The correlation coefficient for all periods are relatively low, in particular, the correlation between Malaysia and the United States is much lower. More specifically, the average correlation between Malaysia and the United States for all periods is -0.014 with the maximum and the minimum being -0.285. Between Malaysia and the other developed countries, Malaysia is recorded as having the highest correlation in stock return with Germany and Australia, 0.276 during the pre-crisis period, while the United States is shown to have the lowest correlated returns with Malaysia for all periods. The lowest correlation coefficients between Malaysia and the United States allow substantial gains from diversification across equity markets. In general, the correlation coefficients of the Malaysian stock returns are relatively lower than in the rest of the developed markets. Among the periods, during the financial crisis Malaysia is recorded as having negative correlation coefficients with all developed countries except for Hong Kong. In addition, during the entire period, pre-crisis period, crisis period and post-crisis period the highest correlated returns were found between France and Germany (0.834), France and Spain (0.546), United States and Canada (0.924), and France and Germany (0.842), respectively. This indicates that geographically and economically close markets, such as those mentioned above, exhibit high correlations of stock returns. The significant higher correlation coefficients among developed markets indicate that there are short-term co-movements among the markets, which suggests that the benefits of any short-term diversification are limited among developed countries. It is interesting to note that the stock markets in all developed countries that were not directly hit by the crisis also have high correlations.

Table 4.4 Correlation of Index Returns between Malaysia and Developing Markets

(a) Entire Period (July 1996 – June 2007)

	MAL	CHN	IND	BRA	ARG	RUS	MEX	SAF	CHI	TUR	ISR
MAL	1.000										
CHN	0.251*** [0.000]	1.000									
IND	0.120*** [0.000]	0.269*** [0.000]	1.000								
BRA	0.045** [0.029]	0.170*** [0.000]	0.114*** [0.000]	1.000							
ARG	0.047** [0.022]	0.086*** [0.000]	0.050** [0.017]	0.428*** [0.000]	1.000						
RUS	0.138*** [0.000]	0.164*** [0.000]	0.173*** [0.000]	0.246*** [0.000]	0.192*** [0.000]	1.000					
MEX	0.075*** [0.000]	0.184*** [0.000]	0.140*** [0.000]	0.596*** [0.000]	0.381*** [0.000]	0.266*** [0.000]	1.000				
SAF	0.173*** [0.000]	0.280*** [0.000]	0.216*** [0.000]	0.321*** [0.000]	0.199*** [0.000]	0.363*** [0.000]	0.360*** [0.000]	1.000			
CHI	0.069*** [0.001]	0.204*** [0.000]	0.145*** [0.000]	0.521*** [0.000]	0.327*** [0.000]	0.241*** [0.000]	0.488*** [0.000]	0.341*** [0.000]	1.000		
TUR	0.144*** [0.000]	0.181*** [0.000]	0.135*** [0.000]	0.227*** [0.000]	0.086*** [0.000]	0.273*** [0.000]	0.192*** [0.000]	0.268*** [0.000]	0.232*** [0.000]	1.000	
ISR	0.067*** [0.001]	0.171*** [0.000]	0.142*** [0.000]	0.281*** [0.000]	0.155*** [0.000]	0.242*** [0.000]	0.375*** [0.000]	0.308*** [0.000]	0.296*** [0.000]	0.199*** [0.000]	1.000

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(b) Pre-Crisis (July 1996 – June 1997)

	MAL	CHN	IND	BRA	ARG	RUS	MEX	SAF	CHI	TUR	ISR
MAL	1.000										
CHN	0.157**	1.000									
	[0.012]										
IND	0.035	-0.053	1.000								
	[0.576]	[0.398]									
BRA	0.035	-0.024	-0.014	1.000							
	[0.577]	[0.697]	[0.825]								
ARG	-0.038	-0.018	-0.039	0.462***	1.000						
	[0.541]	[0.772]	[0.533]	[0.000]							
RUS	0.111*	-0.016	0.006	0.102	0.065	1.000					
	[0.075]	[0.800]	[0.928]	[0.103]	[0.295]						
MEX	0.129**	0.015	0.022	0.322***	0.397***	0.054	1.000				
	[0.038]	[0.815]	[0.727]	[0.000]	[0.000]	[0.386]					
SAF	0.193***	0.170***	0.074	0.161**	0.155**	0.174***	0.181***	1.000			
	[0.002]	[0.006]	[0.237]	[0.010]	[0.013]	[0.005]	[0.003]				
CHI	0.130**	0.045	-0.069	0.318***	0.267***	0.062	0.288***	0.155**	1.000		
	[0.037]	[0.470]	[0.271]	[0.000]	[0.000]	[0.318]	[0.000]	[0.013]			
TUR	0.095	0.066	-0.072	-0.011	-0.040	0.013	0.075	0.000	-0.006	1.000	
	[0.127]	[0.288]	[0.251]	[0.866]	[0.522]	[0.830]	[0.230]	[0.994]	[0.927]		
ISR	0.083	0.053	-0.077	0.128**	0.177***	0.117*	0.150**	0.221***	0.161**	-0.025	1.000
	[0.181]	[0.396]	[0.217]	[0.040]	[0.004]	[0.061]	[0.016]	[0.000]	[0.010]	[0.695]	

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(c) Crisis (July 1997 – June 1998)

	MAL	CHN	IND	BRA	ARG	RUS	MEX	SAF	CHI	TUR	ISR
MAL	1.000										
CHN	0.120*	1.000									
	[0.053]										
IND	-0.142**	0.357***	1.000								
	[0.023]	[0.000]									
BRA	-0.080	0.170***	0.482***	1.000							
	[0.201]	[0.006]	[0.000]								
ARG	-0.111*	0.278***	0.556***	0.815***	1.000						
	[0.074]	[0.000]	[0.000]	[0.000]							
RUS	0.100	0.386***	0.394***	0.409***	0.417***	1.000					
	[0.107]	[0.000]	[0.000]	[0.000]	[0.000]						
MEX	-0.107*	0.210***	0.512***	0.778***	0.843***	0.334***	1.000				
	[0.087]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]					
SAF	-0.067	0.488***	0.608***	0.477***	0.501***	0.652***	0.435***	1.000			
	[0.283]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]				
CHI	-0.222***	0.395***	0.691***	0.634***	0.700***	0.480***	0.667***	0.694***	1.000		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]			
TUR	-0.161**	0.310***	0.548***	0.463***	0.487***	0.497***	0.440***	0.618***	0.590***	1.000	
	[0.010]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
ISR	-0.137**	0.453***	0.678***	0.496***	0.569***	0.580***	0.510***	0.772***	0.790***	0.647***	1.000
	[0.027]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	

continued on the next page

(d) Post-Crisis (July 1998 – June 2007)

	MAL	CHN	IND	BRA	ARG	RUS	MEX	SAF	CHI	TUR	ISR
MAL	1.000										
CHN	0.251***	1.000									
	[0.000]										
IND	-0.142**	0.357***	1.000								
	[0.023]	[0.000]									
BRA	0.045**	0.170***	0.114***	1.000							
	[0.029]	[0.000]	[0.000]								
ARG	0.047**	0.086***	0.050**	0.428***	1.000						
	[0.022]	[0.000]	[0.017]	[0.000]							
RUS	0.138***	0.164***	0.173***	0.246***	0.192***	1.000					
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]						
MEX	0.075***	0.184***	0.140***	0.596***	0.381***	0.266***	1.000				
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]					
SAF	0.173***	0.280***	0.216***	0.321***	0.199***	0.363***	0.360***	1.000			
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]				
CHI	0.069***	0.204***	0.145***	0.521***	0.327***	0.241***	0.488***	0.341***	1.000		
	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]			
TUR	0.144***	0.181***	0.135***	0.227***	0.086***	0.273***	0.192***	0.268***	0.000	1.000	
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.232]		
ISR	0.067***	0.000	0.142***	0.281***	0.155***	0.242***	0.375***	0.308***	0.296***	0.199***	1.000
	[0.001]	[0.171]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	

Note: ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.
The numbers in [] are the p value for the null hypotheses that the correlation coefficients are zero.
Note: MAL=Malaysia, CHN=China, IND= India, BRA = Brazil, ARG= Argentina, RUS= Russia, MEX= Mexico, SAF=South Africa, CHI= Chile, TUR= Turkey and ISR=Israel.

The correlation coefficients of daily stock market returns for the four sub-sample periods of entire period, pre-crisis, crisis and post crisis periods of Malaysian and developing countries are shown in Table 4.4. The figures in parentheses indicate the p-values testing the null hypothesis. It is necessary to take a close look at these correlation coefficients because it can provide an important insight into the analysis of the short-run relations between the movements of the stock markets, cointegration and Granger causality tests. The correlation coefficient for all periods are relatively low, in particular, the correlation between Malaysia and all developing countries. More specifically, between Malaysia and developing countries, Malaysia was recorded as having the highest correlation in stock return with China, 0.251, during the entire period and post-crisis period, while Malaysia is also shown to have the lowest correlated returns with Chile, -0.222, during the crisis period. Furthermore, the correlation coefficients of the Malaysian stock returns are relatively lower than in the rest of the developing markets ranging from -0.222 to 0.251. The lowest correlation coefficients between Malaysia and Chile allow substantial gains from diversification across equity markets. Among the periods, during the financial crisis Malaysia was recorded as having negative correlation coefficients with all developing countries except for China and Russia. In addition, during the entire period, pre-crisis period, crisis period and post-crisis period the highest correlated returns were found between Mexico and China (0.488), Brazil and Argentina (0.462), Argentina and Mexico (0.843), and Brazil and Mexico (0.596), respectively. Whereas, the lowest correlation coefficient according to the sub periods were found between Malaysia and Brazil (0.45), India and Israel (-0.077), Malaysia and Chile (-0.222) and Malaysia and India (-0.142), respectively. This indicates that geographically and economically close markets, such as those mentioned above, exhibit high correlations of stock returns.

The significant higher correlation coefficients among developing markets indicate that there are short-term co-movements among these markets, which suggests that the benefits of any short-term diversification are limited among those countries. It is interesting to note that stock markets in all developing countries that were not directly hit by the crisis also have high correlations.

Null Hypothesis 2a($H_0$2a)

There is no distinctive difference in correlation coefficient between developed and developing countries during the pre crisis, crisis and post crisis.

Table 4.3 and 4.4 present the correlation matrix between the Malaysian market and the developed markets and between the Malaysian market and developing markets. Between Malaysia and the developed countries, Malaysia was recorded as having the highest correlation in stock return with Germany and Australia, 0.276, during the pre-crisis period, while the United States is shown to have the lowest correlated returns with Malaysia for all periods. In addition, during the entire period, pre-crisis period, crisis period and post-crisis period the highest correlated returns were found between France and Germany (0.834), France and Spain (0.546), United States and Canada (0.924), and France and Germany (0.842), respectively. The significant higher correlation coefficients among developed markets indicate that there are short-term co-movements among the markets, which suggest that the benefits of any short-term diversification are limited among developed countries. In this case, the null hypothesis 2a can be rejected.

Table 4.5 Results of ADF and PP Unit Root Tests (stationarity tests) of individual MSCI series for Malaysia and Developed Countries

(a) Entire Period (July 1996 – June 2007)								
Country	Level							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	1.589	0	-2.445	27	1.717	28	-2.449
Japan	0	0.334	0	-1.812	18	0.372	17	-1.671
United Kingdom	0	1.678	0	-2.305	26	1.920	26	-2.249
France	0	1.856	0	-1.919	23	2.048	23	-1.841
Hong Kong	4	0.760	4	-2.224	16	0.754	13	-2.262
Germany	0	1.528	0	-1.688	10	1.604	9	-1.645
Canada	1	2.258	1	-1.987	24	2.362	23	-1.943
Switzerland	1	1.754	1	-2.003	24	1.883	24	-1.950
Australia	0	2.186	0	-1.682	10	2.234	8	-1.648
Spain	0	2.151	0	-1.967	0	2.151	1	-1.987
Malaysia	5	0.160	5	-2.062	15	0.163	15	-2.016

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First Difference

	ADF					PP		
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	-53.822***	0	-53.911***	25	-53.915***	28	-54.131***
Japan	0	-53.495***	0	-53.482***	18	-53.701***	18	-53.693***
United Kingdom	0	-53.839***	0	-53.895***	25	-54.192***	26	-54.393***
France	0	-52.226***	0	-52.284***	22	-52.364***	24	-52.507***
Hong Kong	3	-27.584***	3	-27.589***	15	-53.886***	15	-53.881***
Germany	0	-53.471***	0	-53.501***	9	-53.506***	10	-53.557***
Canada	0	-50.519***	0	-50.605***	23	-50.471***	26	-50.535***
Switzerland	0	-50.696***	0	-50.749***	24	-50.621***	26	-50.677***
Australia	3	-27.275***	3	-27.390***	8	-53.515***	10	-53.602***
Spain	0	-51.063***	0	-51.143***	2	-51.058***	3	-51.123***
Malaysia	4	-23.324***	4	-23.375***	16	-51.338***	17	-51.355***

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(b) Pre-Crisis (July 1996 – June 1997)

Level

	ADF				PP		
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend

	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites	0	2.065	0	-2.624	0	2.065	3	-2.737
Japan	0	-0.483	0	0.001	5	-0.453	4	-0.058
United	0	2.377	0	-2.587	6	2.402	2	-2.710
France	0	1.213	0	-3.208*	5	1.182	1	-3.282*
Hong Kong	0	1.399	0	-1.361	5	1.291	6	-1.542
Germany	1	2.070	0	-2.887	8	2.276	1	-2.655
Canada	1	1.631	1	-1.863	3	1.893	2	-1.673
Switzerland	0	1.937	0	-0.357	2	1.893	2	-0.366
Australia	0	0.939	0	-2.741	6	1.034	1	-2.749
Spain	1	2.089	1	-2.487	5	2.296	4	-2.410
Malaysia	0	-0.325	0	-0.896	4	-0.308	4	-0.990

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	First Difference							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	-14.460***	0	-14.671***	1	-14.461***	2	-14.663***
Japan	0	-15.288***	0	-15.509***	4	-15.305***	3	-15.504***
United Kingdom	0	-15.250***	0	-15.508***	4	-15.273***	6	-15.496***
France	1	-9.586***	1	-9.639***	5	-15.519***	6	-15.556***
Hong Kong	0	-14.921***	0	-14.990***	5	-14.968***	5	-15.020***
Germany	0	-19.162***	0	-19.406***	3	-19.137***	6	-19.791***
Canada	0	-12.590***	0	-12.713***	5	-12.403***	7	-12.515***
Switzerland	0	-15.799***	0	-16.305***	4	-15.850***	2	-16.311***
Australia	0	-16.292***	0	-16.308***	5	-16.327***	6	-16.371***
Spain	0	-13.349***	0	-13.664***	5	-13.283***	8	-13.473***
Malaysia	0	-14.619***	0	-14.636***	6	-14.558***	7	-14.566***

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(c) Crisis (July 1997 – June 1998)

	Level							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	2.241	0	-2.546	8	2.589	5	-2.545
Japan	0	0.210	0	-2.676	4	0.210	0	-2.676
United Kingdom	0	2.136	0	-2.182	10	2.570	8	-2.065
France	0	2.402	0	-3.556**	10	2.931	4	-3.807**
Hong Kong	3	-0.305	3	-3.093	6	-0.471	1	-2.775
Germany	0	2.345	0	-3.388*	9	2.791	4	-3.577**
Canada	0	1.809	0	-2.942	5	1.778	1	-2.997
Switzerland	0	2.250	0	-2.122	10	2.676	8	-2.078
Australia	0	0.794	0	-2.136	4	0.800	1	-2.105
Spain	0	2.361	0	-2.848	4	2.257	0	-2.848
Malaysia	0	-1.805	0	-1.866	2	-1.705*	3	-2.023

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	First Difference							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	-16.029***	0	-16.301***	5	-16.029***	7	-16.378***
Japan	0	-15.854***	0	-15.801***	4	-15.853***	5	-15.798***
United Kingdom	0	-16.033***	0	-16.312***	7	-16.034***	10	-16.637***
France	0	-15.264***	0	-15.557***	7	-15.244***	11	-15.901***
Hong Kong	2	-8.125***	2	-8.137***	0	-18.840***	1	-18.842***
Germany	0	-16.241***	0	-16.540***	5	-16.247***	8	-16.662***
Canada	0	-15.422***	0	-15.571***	4	-15.445***	6	-15.561***
Switzerland	0	-14.476***	0	-14.704***	10	-14.397***	13	-14.939***
Australia	0	-16.688***	0	-16.682***	2	-16.688***	3	-16.673***
Spain	0	-15.100***	0	-15.352***	2	-15.124***	5	-15.349***
Malaysia	0	-14.709***	0	-14.818***	2	-14.727***	1	-14.817***

Continued on the next page

(d) Post-Crisis (July 1998 – June 2007)

	Level							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
Unites States	0	0.085	0	-1.700	17	0.099	15	-1.532
Japan	0	0.317	0	-1.382	12	0.351	11	-1.267
United Kingdom	0	0.194	0	-1.531	8	0.229	8	-1.329
France	0	0.635	0	-1.367	12	0.721	12	-1.168
Hong	1	0.762	1	-1.787	8	0.877	6	-1.746
Germany	0	0.277	0	-1.066	6	0.285	5	-1.041
Canada	0	1.439	1	-1.605	12	1.421	11	-1.521
Switzerla	0	0.418	0	-1.964	11	0.434	12	-1.917
Australia	0	1.815	0	-1.696	7	1.841	7	-1.673
Spain	0	0.710	0	-1.606	11	0.723	11	-1.581
Malaysia	18	1.543	18	-2.031	3	1.231	5	-2.089

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	First Difference							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
United States	0	-48.939***	0	-48.928***	17	-49.148***	17	-49.146***
Japan	0	-48.843***	0	-48.830***	12	-49.015***	12	-49.006***
United Kingdom	2	-31.173***	2	-31.246***	8	-49.141***	9	-49.235***
France	0	-47.327***	0	-47.348***	12	-47.606***	13	-47.685***
Hong	0	-45.105***	0	-45.100***	8	-45.018***	9	-45.004***
Germany	0	-47.800***	0	-47.855***	5	-47.798***	3	-47.852***
Canada	0	-45.629***	0	-45.680***	13	-45.561***	14	-45.608***
Switzerla	0	-46.361***	0	-46.408***	12	-46.341***	14	-46.409***
Australia	0	-47.822***	0	-47.929***	8	-47.819***	5	-47.930***
Spain	0	-46.563***	0	-46.617***	11	-46.529***	10	-46.591***
Malaysia	17	-12.865***	17	-12.966***	3	-47.404***	2	-47.396***

Note: ***, **,* denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. The lag lengths included in the models are based on the Akaike Information Criteria (AIC). The test of ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) are based on two models (1) Without constant and trend; and (2) with constant and trend.

4.3.3 Developed, developing and integration

According to Gujarati (1995), to get reliable and robust results for any conventional regression analysis, the data to be analysed should be stationary. Therefore, to test for stationarity, the ADF and PP tests are performed based on two models (1) without constant and trend; and (2) with constant and trend. We use the SC for the optimum lag order in the ADF test(Appendix A-I). Table 4.5 reports the ADF and PP tests statistics that examine the presence of unit roots (non-stationary) for the log levels of the series and present the test statistics for their first differences.

As may be noted, the study finds that all log MSCI indices contain a unit root. This implies that the null hypothesis of the presence of a unit root at level cannot be rejected even at the 10% significance level in all cases. As shown in Table 4.5, the log MSCI indices are found to be non-stationary at level; the first differences for entire models are taken. Therefore, the same tests are applied to the first differences of the log MSCI indices. However, the results show that all the indices become stationary after differencing once. The results indicate that all log MSCI indices for all countries are stationary in first difference, suggesting the MSCI indices are integrated of order 1 or they are $I(1)$. In particular, the evidence from the PP tests with and without the time trend strongly supports the stationarity of the MSCI indices when they are first difference. Therefore, as required for cointegration we can proceed to the cointegration analysis with these indices because they are all integrated in the same order. For our present analysis, this serves as a prerequisite for evaluating the long-run relationship and short-run dynamic for our empirical models. Accordingly, these results provide justification for us to proceed and evaluate the possible Johansen-

Juselius cointegration test between these markets and provide the trace and maximal eigenvalue test statistic and 5% critical values in Tables 4.7 and 4.8.

Table 4.6 Results of ADF and PP Unit Root Tests (stationarity tests) of individual MSCI series for Malaysia and developing countries

(a) Entire Period (July 1996 – June 2007)								
Country	Level							
	ADF				PP			
	Lag Length	No Trend	Lag Length	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	1	0.227	1	-0.609	19	0.238	19	-0.542
India	1	1.651	1	-1.398	13	1.651	12	-1.390
Brazil	1	1.215	1	-1.201	15	1.296	15	-1.107
Argentina	0	0.852	0	-0.879	12	0.836	12	-0.909
Russia	1	1.075	1	-2.155	4	1.111	2	-2.105
Mexico	1	2.048	1	-2.096	7	2.128	5	-2.032
South	1	1.090	1	-1.850	16	1.143	15	-1.768
Malaysia	5	0.160	5	-2.062	15	0.163	15	-2.016
Chile	1	1.356	1	-1.060	13	1.297	13	-1.150
Turkey	0	0.850	0	-1.938	9	0.815	8	-2.011
Israel	0	1.412	0	-2.047	7	1.335	7	-2.121

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	First Difference							
		ADF				PP		
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	0	-48.476***	0	-48.505***	21	-	22	-48.398***
India	0	-49.221***	0	-49.280***	14	-	16	-49.356***
Brazil	0	-48.433***	0	-48.461***	18	-	19	-48.328***
Argentina	0	-52.979***	0	-52.987***	12	-	12	-52.991***
Russia	0	-50.130***	0	-50.141***	6	-	6	-50.165***
Mexico	0	-50.087***	0	-50.153***	8	-	9	-50.082***
South	0	-49.948***	0	-49.974***	17	-	18	-49.908***
Malaysia	4	-23.324***	4	-23.375***	16	-	17	-51.355***
Chile	0	-45.336***	0	-45.398***	9	-	8	-45.776***
Turkey	0	-51.060***	0	-51.058***	10	-	11	-51.040***
Israel	0	-51.017***	0	-51.046***	8	-	9	-51.047***

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(b) Pre-Crisis (July 1996 – June 1997)

Level

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	1	0.825	1	-3.346*	2	1.008	3	-2.840
India	1	0.125	1	-2.009	1	0.124	1	-1.866
Brazil	0	3.142	0	-1.679	5	3.239	6	-1.547
Argentina	1	1.052	1	-4.313	8	1.260	8	-4.005***
Russia	0	1.886	1	-3.451**	4	1.627	5	-2.816
Mexico	1	1.382	1	-2.540	5	1.589	4	-2.211
South	0	0.145	0	-2.184	7	0.142	7	-2.208
Malaysia	0	-0.399	0	-0.764	4	-0.377	4	-0.866
Chile	1	0.490	1	-1.081	2	0.601	1	-0.772
Turkey	0	0.910	0	-2.218	4	0.854	5	-2.362
Israel	0	1.301	0	-3.058	6	1.124	6	-3.257*

First Difference

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	0	-10.944***	0	-10.964***	8	-10.670***	9	-10.606***
India	0	-13.388***	0	-13.554***	3	-13.347***	5	-13.438***
Brazil	0	-14.467***	0	-15.125***	1	-14.471***	9	-15.285***
Argentina	0	-13.669***	0	-13.774***	10	-13.493***	12	-13.640***
Russia	0	-12.713***	0	-12.956***	7	-12.956***	8	-12.798***
Mexico	0	-13.076***	0	-13.232***	8	-12.991***	10	-13.050***
South	0	-14.611***	0	-14.667***	9	-14.555***	10	-14.609***
Malaysia	0	-14.640***	0	-14.681***	5	-14.606***	6	-14.625***
Chile	0	-12.367***	0	-12.601***	2	-12.300***	5	-12.404***
Turkey	0	-14.688***	0	-14.701***	4	-14.695***	3	-14.687***
Israel	0	-14.077***	0	-14.153***	5	-14.139***	5	-14.186***

Continued on the next page

(c) Crisis (July 1997 – June 1998)

Level

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	0	-0.649	0	-3.130	1	-0.661	3	-3.167*
India	0	0.212	0	-2.324	6	0.206	3	-2.586
Brazil	0	0.112	0	-2.569	2	0.109	2	-2.675
Argentina	0	0.640	0	-2.341	1	0.654	1	-2.317
Russia	0	-0.575	0	-2.241	6	-0.624	4	-2.173
Mexico	0	0.726	0	-2.298	1	0.768	2	-2.199
South	0	0.148	0	-1.812	12	0.196	8	-1.633
Malaysia	0	-1.805*	0	-1.866	2	-1.705*	3	-2.023
Chile	0	-0.055	0	-2.760	4	-0.054	1	-2.837
Turkey	0	1.095	1	-2.085	3	0.962	4	-2.085
Israel	0	1.479	0	-2.902	5	1.453	1	-2.909

First Difference

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	0	-	0	-	2	-16.712***	1	-16.750***
India	0	-	0	-	7	-14.760***	8	-14.722***
Brazil	0	-	0	-	2	-15.549***	2	-15.501***
Argentina	0	-	0	-	0	-16.556***	2	-16.604***
Russia	0	-	0	-	4	-17.449***	6	-17.746***
Mexico	0	-	0	-	2	-17.665***	1	-17.806***
South	0	-9.496***	0	-9.655***	11	-16.600***	13	-16.897***
Malaysia	0	-	0	-	2	-14.727***	1	-14.817***
Chile	0	-	0	-	5	-15.248***	5	-15.238***
Turkey	0	-	0	-	1	-13.882***	0	-13.928***
Israel	0	-	0	-	3	-16.225***	4	-16.295***

Continued on the next page

(d) Post-Crisis (July 1998 – June 2007)

Level

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	1	0.315	1	-1.166	2	0.390	4	-1.016
India	1	1.748	1	-1.176	5	1.724	5	-1.197
Brazil	1	0.842	1	-1.834	8	0.901	9	-1.742
Argentina	0	0.438	0	-1.032	16	0.414	15	-1.072
Russia	1	1.105	1	-3.847**	3	1.136	6	-3.869**
Mexico	1	1.548	1	-2.069	5	1.635	6	-1.962
South	1	1.160	1	-2.296	4	1.181	4	-2.283
Malaysia	18	1.543	18	-2.031	3	1.231	5	-2.089
Chile	1	1.417	1	-1.377	20	1.231	20	-1.581
Turkey	0	0.315	0	-1.811	7	0.305	6	-1.856
Israel	0	0.607	0	-1.691	4	0.567	5	-1.686

First Difference

	ADF				PP			
	Lag	No Trend	Lag	Trend	Bandwidth	No Trend	Bandwidth	Trend
China	0	-	0	-	5	-42.378***	7	-42.382***
India	0	-	0	-	7	-44.667***	9	-44.715***
Brazil	0	-	0	-	11	-43.013***	13	-43.066***
Argentina	0	-	0	-	16	-47.933***	15	-47.960***
Russia	0	-	0	-	2	-44.136***	3	-44.122***
Mexico	0	-	0	-	3	-43.311***	0	-43.450***
South	0	-	0	-	1	-44.191***	2	-44.238***
Malaysia	17	-	17	-	3	-47.404***	2	-47.396***
Chile	0	-	0	-	18	-40.990***	18	-40.919***
Turkey	0	-	0	-	8	-46.847***	8	-46.849***
Israel	0	-	0	-	3	-45.782***	2	-45.768***

Note: ***, **,* denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. The lag lengths included in the models are based on the Akaike Information Criteria (AIC). The test of ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) are based on two models (1) Without constant and trend; and (2) with constant and trend.

To test for stationarity, the ADF and PP tests are performed based on two models: (1) without constant and trend; and (2) with constant and trend. We use the SC for the optimum lag order in the ADF test. Table 4.6 reports the ADF and PP tests statistics that examine the presence of unit roots (non-stationary) for the log levels of the series and presents the test statistics for their first differences. The series are Malaysia and developing countries.

As may be noted, the study finds that all log MSCI indices contain a unit root except a few cases. This implies that the null hypothesis of the presence of a unit root at level cannot be rejected even at the 1% significance level except in a few cases. As shown in Table 4.6, the log MSCI indices are found to be non-stationary at level; the first differences for entire models are taken. Therefore, the same tests are applied to the first differences of the log MSCI indices. However, the results show that all the indices become stationary after differencing once. The results indicate that all log MSCI indices for all countries are stationary in first difference, suggesting the MSCI indices are integrated of order 1 or they are $I(1)$. In particular, the evidence from the PP tests with and without the time trend strongly supports the stationarity of the MSCI indices when they are first difference. Therefore, as required for cointegration we can proceed to the cointegration analysis with these indices because they are all integrated in the same order. For our present analysis, this serves as a prerequisite for evaluating the long-run relationship and short-run dynamic for our empirical models. Accordingly, these results provide justification for us to proceed and evaluate the possible Johansen-Juselius cointegration test between these markets and provide the trace and maximal eigenvalue test statistic and 5% critical values in Tables 4.7 and 4.8.

Table 4.7 Cointegration Tests (Malaysia and developed countries)

Johansen-Juselius Test

The model: MAL, USA, JPN, UK, FRN, HKG, GER, CAN, SWZ, AUS, SPN

	Entire Period (July 1996 – June 2007) Model 1		Pre-Crisis (July1996 – June 1997) Model 2		Crisis (July1997June1998) Model 3		Post-Crisis July 1998 – June 2007) Model 4		
	Lag =2		Lag =1		Lag = 1		Lag =2		
Null hypothesis	TS	MES	TS	MES	TS	MES	TS	MES	Results
None	335.408**	74.268**	317.188**	71.123**	287.221**	60.84	364.519**	90.832**	There are a total of 13
At most 1	261.140**	58.212	246.065**	51.204	226.376	50.62	273.687**	63.738	cointegrating vectors. In
At most 2	202.928**	45.120	194.861	44.926	175.753	37.10	209.949**	48.714	each sub period sample there
At most 3	157.808	38.856	149.935	36.048	138.649	32.32	161.235**	40.249	is cointegrating vector. Four
At most 4	118.952	36.844	113.886	29.838	106.321	25.56	120.986	35.440	cointegrating vectors in
At most 5	82.108	32.019	84.049	25.521	80.756	23.04	85.546	27.981	entire period, three
At most 6	50.089	22.586	58.527	21.954	57.712	21.40	57.565	21.474	cointegrating vectors in pre-
At most 7	27.502	12.829	36.573	18.173	36.306	18.81	36.091	19.729	crisis period, one
At most 8	14.673	8.701	18.400	12.458	17.493	10.74	16.363	11.582	cointegrating vector in crisis
At most 9	5.973	5.356	5.942	5.162	6.749	6.666	4.781	4.534	period and five cointegrating
At most 10	0.616	0.616	0.780	0.780	0.083	0.083	0.246	0.246	vectors in post crisis period.

Note:

** denotes significance at the 5 per cent level.

The optimal lag length incorporated in the model based on the Akaike Information Criteria (AIC).

TS and MES refer to Trace Statistic and Max-Eigen Statistic, respectively.

Note: MAL=Malaysia, CHN=China, IND= India, BRA = Brazil, ARG= Argentina, RUS= Russia, MEX= Mexico, SAF=South Africa,CHI= Chile, TUR= Turkey and ISR=Israel.

Accordingly, having established that each of the series is stationary at first difference, we proceed to examine whether a long-run equilibrium relationship exists between Malaysia and the developed countries market. We proceed to the Johansen-Juselius cointegration test and provide the trace and maximal eigenvalue test statistics and 5% critical values in Table 4.7. We conduct the tests using 1 lag lengths for the model based on the SC, which we find sufficient to whiten the noise process. As may be observed from the trace tests in Table 4.7, the model indicates a cointegrating vector at the 5 per cent significance level in all periods under consideration. This indicates that during all sample periods, the stock markets of developed countries and the Malaysian market shared long-run equilibrium. Meanwhile, the Maximal eigenvalue statistics also indicate that there is a co-movement among the markets during all the periods except the crisis period. Both statistics indicate the presence of cointegration or long-run relation among the markets. Thus, the presence of cointegration among the developed markets and the markets of the developed markets and the Malaysian market rejects the non-causality between them and suggests that at least one of the markets reacts to deviations from the long-run relationship. Whether the markets correct for the disequilibrium remains to be investigated. This means that the market is not informationally efficient in the long-run. Additionally, the dynamic interactions among these markets need to be established to assess the informational efficiency of the stock market in the short-run. These issues we address next using Granger causality, variance decomposition and an impulse response. One general conclusion that can be drawn from this finding is that the developed stock markets are moving towards a greater integration either among themselves or with the Malaysian market.

As shown in Table 4.7, the impact of the crisis on the Malaysian stock market integration is evident. Three cointegrating vectors exist in the pre-crisis period, one in the crisis period, while five cointegrating vectors exist in the post-crisis period. The results suggest that the long-run relationship among the markets under consideration were altered by the crisis and were actually strengthened. This is similar to the case of Asia, where long-run relationships were found to be strengthened after a stock market crisis (Arshanapalli et al., 1995; Yang et al., 2003). This finding is also in line with many previous findings that documented that the world capital markets are becoming increasingly integrated and that co-movements among them have been increasing (Billio and Pelizon, 2003; Westermann, 2004; Chelley-Steely, 2004).

The finding of linkages between Malaysia and the markets in developed countries can also be interpreted from a portfolio diversification perspective. The long-run relationship between the Malaysian and the developed equity markets implies that no potential long-run gain exists in risk reduction from diversifying in the Malaysian market and equity markets in any of these developed markets. Thus, our findings further imply that there is limited room to gain benefit from international investment diversification in the developed stock markets.

In sum, the results from the Johansen test are robust and consistent in suggesting that the Malaysian equity market and the equity markets in the developed markets are cointegrated during the entire period as well as pre-crisis, crisis and post-crisis periods. These results are similar with Arshanapalli and Doukas (1993), who found evidence of pairwise cointegration between the US and France, and the US and UK for the period from January 1980 to May 1990 as well as for the post-crash period (from November 1987 to May 1990), and between the US and Germany for the post-crash period.

Table 4.8 Cointegration Test (Malaysia and developing countries)

	Johansen-Juselius Test								
The model: MAL, CHN,IND, BRA,ARG,RUS,MEX,SAF,CHI,TUR,ISR									
	Entire Period (July 1996 – June 2007) Model 5 Lag =1		Pre-Crisis (July1996 – June 1997) Model 6 Lag =1		Crisis (July1997June1998) Model 7 Lag = 1		Post-Crisis July 1998 – June 2007) Model 8 Lag =1		
Null hypothesis	TS	MES	TS	MES	TS	MES	TS	MES	Results
None	284.114	81.065**	284.890	54.346	337.763**	76.698**	302.600**	75.500**	There are a total of 7 cointegrating vectors. In each sub period sample there is cointegrating vector except pre-crisis period. One cointegrating vector in entire period, no cointegrating vectors in pre-crisis period, four cointegrating vectors in crisis period and two cointegrating vectors in post period.
At most 1	203.049	44.950	230.544	51.428	261.065**	62.507	227.100	57.589	
At most 2	158.099	40.012	179.117	38.662	198.558**	50.179	169.511	43.678	
At most 3	118.086	28.482	140.455	35.126	148.379	35.038	125.832	33.188	
At most 4	89.605	26.991	105.329	27.356	113.341	34.212	92.644	31.406	
At most 5	62.614	20.576	77.973	24.077	79.128	29.115	61.238	21.519	
At most 6	42.038	16.311	53.896	18.014	50.013	21.632	39.719	15.901	
At most 7	25.727	12.655	35.882	15.395	28.381	13.444	23.818	9.642	
At most 8	13.071	7.576	20.486	12.713	14.936	8.555	14.176	9.030	
At most 9	5.496	5.330	7.773	7.493	6.382	6.379	5.146	5.132	
At most 10	0.166	0.166	0.280	0.280	0.003	0.003	0.014	0.014	

Note:
** denotes significance at the 5 per cent level.
The optimal lag length incorporated in the model based on the Akaike Information Criteria (AIC).
TS and MES refer to Trace Statistic and Max-Eigen Statistic, respectively. Note: MAL=Malaysia, CHN=China, IND= India, BRA = Brazil, ARG= Argentina, RUS= Russia, MEX= Mexico, SAF=South Africa,CHI= Chile, TUR= Turkey and ISR=Israel

Accordingly, having established that each of the series is stationary at first difference, we proceed to examine whether a long-run equilibrium relationship exists between Malaysia and the developing countries market. We proceed to the Johansen-Juselius cointegration test and provide the trace and maximal eigenvalue test statistics and 5% critical values in Table 4.8. We conduct the tests using various lag lengths for the model based on the SC, which we find sufficient to whiten the noise process. As may be observed from trace tests in Table 4.8, the model indicates a cointegrating vector at the 5 per cent significance level in all periods under consideration except for the pre-crisis period. This indicates that during all sample periods, except the entire period and pre-crisis period, the stock markets of developing countries and the Malaysian market shared long-run equilibrium. Meanwhile, the Maximal eigenvalue statistics also indicate that there is a co-movement among the markets during all the periods except the pre-crisis period. Both statistics indicate the presence of cointegration or a long-run relation among the markets. Thus, the presence of cointegration among the developing markets and the markets of the developing markets and the Malaysian market rejects the non-causality among them and suggests that at least one of the markets reacts to deviations from the long-run relationship. Whether the markets correct for the disequilibrium remains to be investigated. This means that the market is not informationally efficient in the long-run. Additionally, the dynamic interactions among these markets need to be established to assess the informational efficiency of the stock market in the short-run. These issues we address next using Granger causality, variance decomposition and an impulse response. One general conclusion that can be drawn from this finding is that the developing stock markets are moving towards a greater integration either among themselves or with the Malaysian market during the crisis period.

As shown in Table 4.8, the impact of the crisis on the Malaysian stock market integration is evident (Appendix N-Q). Cointegrating vectors do not exist in the pre-crisis period, four exist in the crisis period, while two cointegrating vectors exist in the post-crisis period. The results suggest that the long-run relationship among the markets under consideration were altered by the crisis and were actually weakened. This stands in sharp contrast to the case of Asia, where long-run relationships were found to be strengthened after a stock market crisis (Chowdhary, 1994; Arshanapalli et al., 1995; Yang et al., 2003, Sheng and Tu, 2000; Majid et al., 2008). This finding is also in contrast with many previous findings that documented that world capital markets have been increasingly integrated and that co-movements among them have been rising (Billio and Pelizon, 2003; Westermann, 2004; Chelley-Steely, 2004). However, our study is in line with Wang et al. (2003) who found that both long-run relationships and short-run causal linkages between the markets investigated were weakened after the crisis. The empirical studies came to rather diverse conclusions as the authors used different sampling data, and analysed different countries within a different time period. Furthermore, generally, the studies did not apply the same empirical methodology. Thus, yielding mix conclusions. Our findings further imply that there is room to gain benefit from international investment diversification in the developing stocks markets.

To conclude, in this study on twenty-one stock markets, including developed and developing countries, we found that the cointegrating vectors in the developed markets were more than those in the developing countries, suggesting an increasing degree of integration in the developed countries compared to the developing countries. In addition, we did not find any cointegrating vectors in the developing countries during the crisis period, suggesting that there is maximal benefit of diversification.

Null Hypothesis 3a($H_0$3a)

There is no integration between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis.

The results from Tables 4.5 and 4.6 indicate that for ADF and Phillip-Perron, the unit root tests are at log levels, except a few cases in table 4.6. This means that the null hypothesis of the presence of the unit root cannot be rejected even at the 10 per cent significance level. However, both ADF and PP consistently suggest that all data are stationary at first differentiated, indicating that all the variables are I (1). This indicates that integration between the Malaysian financial market exists with the developed and developing financial markets during pre crisis, crisis and post crisis. In addition, the study intends to look at the cointegration between the Malaysian financial market with developed and developing financial markets during the pre crisis, crisis and post crisis. The results, as presented in Tables 4.7 and 4.8, show that, as predicted, there is cointegration between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis. In table 4.7, there are a total of 13 cointegrating vectors. In each sub period sample there is a cointegrating vector. Four cointegrating vectors in the entire period, three cointegrating vectors in the pre-crisis period, one cointegrating vector in the crisis period and five cointegrating vectors in the post crisis period. Meanwhile, in Table 4.8, there are a total of seven cointegrating vectors. In each sub period sample there is a cointegrating vector except the pre crisis period. One cointegrating vector in the entire period, no cointegrating vectors in the pre-crisis period, four cointegrating vectors in the crisis period and two cointegrating vectors in the post crisis period.

Especially for cointegrated cases, we employ Error Correction Models (ECMs), and for the non cointegrated series, the Error Correction Term (ECT) is omitted in the regression. Based on Tables 4.9 and 4.10, some general conclusions on the causality can be derived; the Malaysian stock market seems to have unidirectional and bidirectional causality with the developed and developing financial markets during the pre crisis, crisis and post crisis.

Table 4.9 The Malaysian market and developed countries: Error Correction Terms

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<u>Model 1: The Malaysian market ECM(OVERALL)</u>

MAL = 0.131 Δ US*** -0.058 Δ JPN** -0.141 Δ UK***+ 0.048 Δ FRN+ 0.036 Δ HK+ 0.076 Δ GER*

(3.172) (-2.105) (-2.700) (0. 815) (1.381) (1. 721)

+ 0.128 Δ CAN*** -0.111 Δ SWZ** -0.111 Δ AUS***+ 0.041 Δ SPN + 0.0004 ECT_{t-1} + 2.29E-05

(3.208) (-2.247) (-2.951) (0.902) (1.097) (0.066)

$R^2 = 0.032$ DW = 2. 006 LM =0.944 HET=2.457***

<u>Model 2: The Malaysian market ECM(PRECRISIS)</u>

Δ MAL = 0. 026 Δ US-0.020 Δ JPN+0. 153 Δ UK*-0.092 Δ FRN-0.001 Δ HK-0.040 Δ GER

(0.300) (-0. 408) (1.701) (-1.218) (-0.015) (-0.489)

+0.192 Δ CAN*+0.024 Δ SWZ-0.092 Δ AUS-0.018 Δ SPN - 0.106 ECT_{t-1} ***+0. 000

(+1.966) (+0.297) (-1.330) (-0.262) (-3. 918) (-0.776)

$R^2 = 0.161$ DW = 2. 019 LM = 0.869 HET=1.460

Model 3: The Malaysian market ECM(CRISIS)

Δ MAL = 0.297 Δ US-0.076 Δ JPN+0.450 Δ UK-0.588 Δ FRN+0.169 Δ HK*+0..203 Δ GER
(0.997) (-0.554) (1.618) (-1.974) (1.837) (0.849)
-0.226 Δ CAN-0. 372 Δ SWZ-0.131 Δ AUS+0.135 Δ SPN +0.002 ECT_{t-1} -0.003
(-0.685) (-1.284) (-0.641) (0.597) (0.611) (-1.442)
$R^2 = 0.068$ DW = 2. 014 LM = 0.228 HET=1.885**

Model 4: The Malaysian market ECM(POSTCRISIS)

Δ MAL = 0.156 Δ US***-0.043 Δ JPN-0.206 Δ UK***+0.145 Δ FRN**-0.003 Δ HK+0.030 Δ GER
(3.726) (-1.500) (-3.780) (2.274) (-0.116) (0.648)
+0.153 Δ CAN***-0.056 Δ SWZ-0.101 Δ AUS**+0.044 Δ SPN - 0. 004 ECT_{t-1} ***+0. 001
(3.979) (-1.101) (-2.579) (0.927) (-3.420) (1.200)
$R^2 = 0.055$ DW = 2. 012 LM = 2.110 HET=4.676***

Table 4.10 The Malaysian market and developing countries: Error Correction Terms

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Model 5: The Malaysian market ECM(OVERALL)

ΔMAL = 0.001ΔCHN -0.021ΔIND +0.009ΔBRA-0.013ΔARG+ 0.004ΔRUS+0.155ΔMEX***-

(0.014) (-0.959) (0.426) (-0.737) (0.319) (5.802)

0.014ΔSAF -0.029ΔCHI -0.001ΔTUR- 0.046ΔISR + 0.001 ECT_{t-1}+ 7.29E-06

(-0.538) (-0.772) (-0.067) (-1.815) (1.602) (0.021)

$R^2 = 0.020$ DW = 2. 002 LM =0.180 HET=3.924***

Model 6: The Malaysian market ECM(PRECRISIS)

ΔMAL = 0.001ΔCHN*** -0.047ΔIND +0.125ΔBRA**-0.024ΔARG-0.021ΔRUS+

(2.749) (-1.352) (2.153) (-0.508) (-1.037)

0.130ΔMEX**- 0.101ΔSAF* +0.012ΔCHI +0.012ΔTUR- 0.025ΔISR -0.030*** ECT_{t-1}-0.001

(2.357) (-1.744) (0.175) (0.544) (-0.590) (-3.648) (-1.148)

$R^2 = 0.129$ DW =1.979 LM =0.159 HET=1.902**

Model 7: The Malaysian market ECM(CRISIS)

Δ MAL = 0.046 Δ CHN -0.044 Δ IND -0.060 Δ BRA+0.157 Δ ARG+ 0.045 Δ RUS+ 0.107 Δ MEX+

(0.617) (-0.339) (-0.482) (0.900) (0.760) (0.744)

0.065 Δ SAF -0.003 Δ CHI -0.008 Δ TUR- 0.446 Δ ISR** -0.003 ECT_{t-1} -0.003

(0.435) (-0.013) (-0.103) (-2.348) (-0.324) (-1.308)

$R^2 = 0.056$ DW = 2.068 LM =7.045*** HET=1.049

Model 8: The Malaysian market ECM(POSTCRISIS)

Δ MAL = -0.016 Δ CHN +0.007 Δ IND -0.001 Δ BRA-0.015 Δ ARG+ 0.002 Δ RUS+

(-0.739) (0.296) (-0.046) (-0.895) (0.115)

0.152 Δ MEX***+ 0.004 Δ SAF +0.007 Δ CHI +0.004 Δ TUR- 0.002 Δ ISR + 0.001 ECT_{t-1} + 0.001

(5.403) (0.131) (0.190) (0.339) (-0.085) (1.300) (1.051)

$R^2 = 0.023$ DW = 2.000 LM =0.001 HET=4.251***

For each of the equations above (model 1 to model 8), if the error correction terms are found to be negative and significant, they further substantiate the presence of cointegration among the Malaysian, developed and developing markets, as established in the system earlier. The estimated coefficients for the error correction terms in models 2, and 4, as exhibited in table 4.9, are 0.106 and 0. 004, respectively, suggesting that the last period of disequilibrium is corrected by 0.4 - 10.6 percent on the following day. Table 4.10 shows that the estimated coefficient for the error correction terms for models 6 and 7 are 0.030 and 0.003, respectively, suggesting that the last period disequilibrium is corrected by 3.0 and 0.3 percent on the following day. The general performance of the models seems to be satisfactory with the expected hypothesized signs of the coefficients for the independent variables (Appendix R-Y). Although the values of the R-squared are relatively low, they are still regarded as acceptable, given that the estimates are based on first differentiated values. The low values of R-squared are similar with the findings of Majid et al. (2009), Majid et al. (2008), and Yusof and Majid (2006). The above equations further substantiate the presence of cointegration among the Malaysian and developed and developing countries. Therefore, the null hypotheses 3a can be rejected.

Table 4.11 Bivariate Granger Causality Tests (Malaysia and Developed Countries)

	Entire Period (July 1996 – June 2007)		Pre-Crisis (July1996 – June 1997)		Crisis (July1997June1998)		Post-Crisis July 1998 – June 2007)	
	Lag:2		Lag:1		Lag:1		Lag:2	
Null Hypothesis	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability
LUSA does not Granger Cause LMAL	19.912***	0.000	0.016	0.898	0.019	0.892	35.163***	0.000
LMAL does not Granger Cause LUSA	0.499	0.607	3.807*	0.052	4.197**	0.042	3.847**	0.022
LJPN does not Granger Cause LMAL	3.853**	0.021	1.564	0.212	5.723**	0.018	1.521	0.219
LMAL does not Granger Cause LJPN	0.795	0.452	17.347***	0.000	1.297	0.256	5.111***	0.006
LUK does not Granger Cause LMAL	0.858	0.424	0.110	0.741	0.002	0.966	1.811	0.164
LMAL does not Granger Cause LUK	3.621**	0.027	2.141	0.145	4.019**	0.046	0.488	0.614
LFRN does not Granger Cause LMAL	3.749**	0.024	0.110	0.740	0.806	0.370	12.407***	0.000
LMAL does not Granger Cause LFRN	3.281**	0.038	0.282	0.596	2.055	0.153	1.085	0.338
LHKG does not Granger Cause LMAL	3.749**	0.024	1.953	0.164	5.824**	0.017	3.605**	0.027
LMAL does not Granger Cause LHKG	0.412	0.663	9.587***	0.002	0.964	0.327	1.518	0.219
LGER does not Granger Cause LMAL	5.462***	0.004	1.728	0.190	0.454	0.501	13.216***	0.000
LMAL does not Granger Cause LGER	1.539	0.215	0.757	0.385	3.048*	0.082	1.535	0.216
LCAN does not Granger Cause LMAL	17.002***	0.000	0.449	0.503	0.209	0.648	31.960***	0.000
LMAL does not Granger Cause LCAN	1.618	0.199	6.673**	0.010	1.788	0.182	7.908***	0.000
LSWZ does not Granger Cause LMAL	0.873	0.418	1.799	0.181	0.058	0.810	3.490**	0.031
LMAL does not Granger Cause LSWZ	3.104**	0.045	1.280	0.259	3.733*	0.054	0.912	0.402
LAUS does not Granger Cause LMAL	5.591***	0.004	0.063	0.802	1.636	0.202	4.198**	0.015
LMAL does not Granger Cause LAUS	0.252	0.777	2.379	0.124	4.747**	0.030	0.725	0.484
LSPN does not Granger Cause LMAL	3.759**	0.023	0.322	0.571	0.244	0.622	10.597***	0.000
LMAL does not Granger Cause LSPN	0.332	0.718	2.418	0.121	2.394	0.123	1.065	0.345
LJPN does not Granger Cause LUSA	1.171	0.310	0.107	0.744	5.493**	0.020	2.601*	0.074

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LUSA does not Granger Cause LJPN	88.476***	0.000	2.182	0.141	0.431	0.512	111.169***	0.000
LUK does not Granger Cause LUSA	2.979*	0.051	7.942***	0.005	0.047	0.829	2.390*	0.092
LUSA does not Granger Cause LUK	114.781***	0.000	4.648**	0.032	4.052**	0.045	135.194***	0.000
LFRN does not Granger Cause LUSA	0.656	0.519	0.074	0.786	1.199	0.275	1.037	0.355
LUSA does not Granger Cause LFRN	113.434***	0.000	20.390***	0.000	0.042	0.839	121.054***	0.000
LHKG does not Granger Cause LUSA	1.988	0.137	0.030	0.862	2.057	0.153	3.051**	0.048
LUSA does not Granger Cause LHKG	125.013***	0.000	6.248**	0.013	4.512**	0.035	172.405***	0.000
LGER does not Granger Cause LUSA	0.415	0.660	0.105	0.746	0.200	0.655	1.517	0.220
LUSA does not Granger Cause LGER	85.173***	0.000	11.670***	0.001	1.272	0.261	60.970***	0.000
LCAN does not Granger Cause LUSA	0.071	0.932	0.149	0.700	0.937	0.334	0.111	0.895
LUSA does not Granger Cause LCAN	9.796***	0.000	1.109	0.293	3.088*	0.080	12.745***	0.000
LSWZ does not Granger Cause LUSA	3.837**	0.022	0.419	0.518	1.297	0.256	4.254**	0.014
LUSA does not Granger Cause LSWZ	61.420***	0.000	3.349*	0.068	1.465	0.227	65.524***	0.000
LAUS does not Granger Cause LUSA	0.505	0.604	0.425	0.515	3.262*	0.072	0.430	0.651
LUSA does not Granger Cause LAUS	229.847***	0.000	15.536***	0.000	3.828*	0.052	295.159***	0.000
LSPN does not Granger Cause LUSA	2.114	0.121	2.435	0.120	1.016	0.315	2.194	0.112
LUSA does not Granger Cause LSPN	61.128***	0.000	3.942**	0.048	0.495	0.482	61.249***	0.000
LUK does not Granger Cause LJPN	51.104***	0.000	1.021	0.313	0.317	0.574	73.689***	0.000
LJPN does not Granger Cause LUK	2.335*	0.097	0.011	0.918	4.591**	0.033	2.623*	0.073
LFRN does not Granger Cause LJPN	71.359***	0.000	0.571	0.451	0.041	0.841	98.964***	0.000
LJPN does not Granger Cause LFRN	3.865**	0.021	0.406	0.525	6.398**	0.012	3.616**	0.027
LHKG does not Granger Cause LJPN	7.777***	0.000	0.350	0.554	0.218	0.641	15.288***	0.000
LJPN does not Granger Cause LHKG	3.023**	0.049	1.007	0.317	2.891*	0.090	2.269	0.104
LGER does not Granger Cause LJPN	71.944***	0.000	3.983**	0.047	0.065	0.799	101.031***	0.000
LJPN does not Granger Cause LGER	1.406	0.245	1.086	0.298	6.597**	0.011	2.854*	0.058
LCAN does not Granger Cause LJPN	75.279***	0.000	0.353	0.553	0.149	0.699	92.038***	0.000
LJPN does not Granger Cause LCAN	2.348*	0.096	0.261	0.610	3.746*	0.054	0.551	0.577
LSWZ does not Granger Cause LJPN	42.327***	0.000	8.435***	0.004	0.284	0.595	56.259***	0.000
LJPN does not Granger Cause LSWZ	2.740*	0.065	2.734	0.100	5.071**	0.025	1.765	0.172
LAUS does not Granger Cause LJPN	1.591	0.204	0.254	0.615	0.858	0.355	3.086**	0.046

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LJPN does not Granger Cause LAUS	1.948	0.143	0.016	0.901	2.167	0.142	1.727	0.178
LSPN does not Granger Cause LJPN	48.255***	0.000	1.037	0.309	0.097	0.755	62.555***	0.000
LJPN does not Granger Cause LSPN	3.070**	0.047	0.126	0.723	5.536**	0.019	1.599	0.202
LFRN does not Granger Cause LUK	3.070**	0.047	0.002	0.963	0.622	0.431	2.151	0.117
LUK does not Granger Cause LFRN	2.539*	0.079	8.757***	0.003	0.245	0.621	0.313	0.732
LHKG does not Granger Cause LUK	1.259	0.284	0.016	0.899	1.116	0.292	1.928	0.146
LUK does not Granger Cause LHKG	24.197***	0.000	3.662*	0.057	5.340**	0.022	47.591***	0.000
LGER does not Granger Cause LUK	6.053***	0.002	1.325	0.251	0.011	0.917	11.674***	0.000
LUK does not Granger Cause LGER	3.926**	0.020	1.720	0.191	0.049	0.826	5.166***	0.006
LCAN does not Granger Cause LUK	44.647***	0.000	0.342	0.559	0.083	0.774	45.924***	0.000
LUK does not Granger Cause LCAN	0.592	0.554	4.121**	0.043	2.418	0.121	0.089	0.915
LSWZ does not Granger Cause LUK	7.721***	0.001	0.488	0.485	1.755	0.186	9.835***	0.000
LUK does not Granger Cause LSWZ	0.132	0.876	0.745	0.389	0.000	0.985	0.274	0.760
LAUS does not Granger Cause LUK	1.361	0.257	0.108	0.743	2.038	0.155	2.559*	0.078
LUK does not Granger Cause LAUS	80.864***	0.000	12.742***	0.000	2.831*	0.094	111.888***	0.000
LSPN does not Granger Cause LUK	4.447**	0.012	1.263	0.262	1.055	0.305	5.508***	0.004
LUK does not Granger Cause LSPN	0.866	0.421	3.928**	0.049	0.006	0.939	1.464	0.232
LHKG does not Granger Cause LFRN	1.774	0.170	3.056*	0.082	1.714	0.192	4.286**	0.014
LFRN does not Granger Cause LHKG	25.228***	0.000	1.269	0.261	7.106***	0.008	41.536***	0.000
LGER does not Granger Cause LFRN	8.531***	0.000	1.120	0.291	2.325	0.129	20.690***	0.000
LFRN does not Granger Cause LGER	4.532**	0.011	1.883	0.171	13.700***	0.000	2.149	0.117
LCAN does not Granger Cause LFRN	41.911***	0.000	11.368***	0.001	0.252	0.616	39.230***	0.000
LFRN does not Granger Cause LCAN	1.316	0.268	0.050	0.823	2.629	0.106	1.512	0.221
LSWZ does not Granger Cause LFRN	5.071***	0.006	0.412	0.522	0.038	0.845	3.650**	0.026
LFRN does not Granger Cause LSWZ	1.041	0.353	0.668	0.414	0.214	0.644	0.008	0.992
LAUS does not Granger Cause LFRN	5.320***	0.005	4.401**	0.037	2.579	0.110	4.732***	0.009
LFRN does not Granger Cause LAUS	109.742***	0.000	4.894**	0.028	1.113	0.292	143.850***	0.000
LSPN does not Granger Cause LFRN	4.772***	0.009	2.673	0.103	0.659	0.418	2.538*	0.079
LFRN does not Granger Cause LSPN	3.746**	0.024	0.505	0.478	0.014	0.906	1.645	0.193
LGER does not Granger Cause LHKG	24.336***	0.000	1.678	0.196	7.436***	0.007	56.360***	0.000

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LHKG does not Granger Cause LGER	1.271	0.281	0.002	0.961	2.929*	0.088	5.184***	0.006
LCAN does not Granger Cause LHKG	81.859***	0.000	5.803**	0.017	6.622**	0.011	105.230***	0.000
LHKG does not Granger Cause LCAN	4.947***	0.007	0.459	0.499	0.858	0.355	2.023	0.133
LSWZ does not Granger Cause LHKG	13.644***	0.000	3.830*	0.051	5.171**	0.024	27.922***	0.000
LHKG does not Granger Cause LSWZ	2.329*	0.098	0.010	0.919	1.428	0.233	0.978	0.376
LAUS does not Granger Cause LHKG	1.290	0.275	4.491**	0.035	4.683**	0.031	1.698	0.183
LHKG does not Granger Cause LAUS	1.171	0.310	2.320	0.129	0.223	0.637	9.897***	0.000
LSPN does not Granger Cause LHKG	23.562***	0.000	2.618	0.107	5.640**	0.018	37.323***	0.000
LHKG does not Granger Cause LSPN	0.834	0.435	0.508	0.477	1.006	0.317	1.245	0.288
LCAN does not Granger Cause LGER	35.193***	0.000	2.969*	0.086	0.057	0.812	22.631***	0.000
LGER does not Granger Cause LCAN	0.579	0.561	0.001	0.982	0.583	0.446	1.962	0.141
LSWZ does not Granger Cause LGER	6.870***	0.001	0.877	0.350	1.007	0.317	3.659**	0.026
LGER does not Granger Cause LSWZ	1.604	0.201	1.189	0.277	0.504	0.478	5.968***	0.003
LAUS does not Granger Cause LGER	2.191	0.112	0.074	0.785	2.415	0.121	3.173**	0.042
LGER does not Granger Cause LAUS	102.152***	0.000	5.577**	0.019	0.860	0.355	155.553***	0.000
LSPN does not Granger Cause LGER	9.080***	0.000	1.918	0.167	6.468**	0.012	4.632**	0.010
LGER does not Granger Cause LSPN	2.975*	0.051	1.900	0.169	1.824	0.178	9.338***	0.000
LSWZ does not Granger Cause LCAN	2.405*	0.090	0.827	0.364	3.367*	0.068	5.108***	0.006
LCAN does not Granger Cause LSWZ	13.636***	0.000	0.779	0.378	0.076	0.783	13.934***	0.000
LAUS does not Granger Cause LCAN	4.866***	0.008	0.265	0.607	1.028	0.312	2.857*	0.058
LCAN does not Granger Cause LAUS	196.781***	0.000	9.397***	0.002	1.780	0.183	228.629***	0.000
LSPN does not Granger Cause LCAN	0.498	0.608	1.029	0.311	3.674*	0.056	1.503	0.223
LCAN does not Granger Cause LSPN	25.466***	0.000	1.248	0.265	0.066	0.797	23.121***	0.000
LAUS does not Granger Cause LSWZ	3.509**	0.030	0.017	0.895	2.133	0.145	5.136***	0.006
LSWZ does not Granger Cause LAUS	66.350***	0.000	4.232**	0.041	2.389	0.123	84.025***	0.000
LSPN does not Granger Cause LSWZ	1.217	0.296	1.619	0.204	0.566	0.453	3.335**	0.036
LSWZ does not Granger Cause LSPN	0.877	0.416	0.294	0.588	0.002	0.966	1.204	0.300
LSPN does not Granger Cause LAUS	89.805***	0.000	6.226**	0.013	1.515	0.220	109.264***	0.000
LAUS does not Granger Cause LSPN	2.109	0.122	1.279	0.259	1.348	0.247	3.817**	0.022

Note: ***, ** and *denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

To get a better understanding of the direction of the correlation, this study performs Granger causality tests. Table 4.11 summarizes the results of the bivariate Granger causality based on the standard *F* test framework. During the entire period, as can be seen, there is a “developed markets Granger cause Malaysia market” pattern and it is a unidirectional causality. The markets of the United States, Japan, the United Kingdom, Hong Kong, Germany, Canada, Switzerland and Australia have a unidirectional relation with the Malaysian market. Furthermore, at the same time, the Malaysian market is having bidirectional causality with the French market. Meanwhile, this study finds that during the pre-crisis period, only the United States, Japan, Hong Kong and Canada exhibit unidirectional causality with the Malaysian market and others have no causalities with the Malaysian market. Similar to the finding from the entire period, the United States, Japan, the United Kingdom, Hong Kong, Germany, Switzerland and Australia have a unidirectional relation with the Malaysian market in the crisis period. In short, in this period we find that there are no causalities running between Malaysia and France, Malaysia and Canada, and Malaysia and Spain. However, during the post crisis, Malaysia has bidirectional causality with the United States and Canada and unidirectional causality is found between Malaysia and Japan, France and Malaysia, Hong Kong and Malaysia, Germany and Malaysia, Switzerland and Malaysia, Australia and Malaysia, and Spain and Malaysia. Meanwhile, Malaysia is found to have no relative causality with the United Kingdom during this period. Nevertheless, the results are found to be mixed between the developed markets, unidirectional, bidirectional and no causalities between them are documented.

In this study, we found that developed countries (larger economies) are in the higher degree Granger cause developing (smaller economies) countries. The United States and Japan markets are, for example, significantly Granger causing the Malaysian market during all the sub periods. Hence, the highly significant Granger cause from the US and Japan to Malaysia can be explained by the time zone factor and the "leading" market factor. The overall highly United States Granger-causality of all the other markets were documented in several previous papers studying different geographic areas (Eun and Shim 1989, Choudhary 1994, Sheng and Tu 2000; Yang et al., 2003; Ibrahim 2006). They discovered that the United States is not only dominant in the ASEAN region, but is the most influential market in the world. In addition, Cheung and Mak (1992) also showed that the United States stock market led almost all of the other markets. Meanwhile, according to Janakiramanan and Lamba (1998), other markets have little, if any influence on the United States market. It is evident that the US market is the most influential "leading" market in the world, regardless of the time zone factor. However, if no significant Granger causality is displayed while a high degree of correlation is found, this may indicate that the markets are interdependent. In this study for example, during the post crisis period, between the France and United Kingdom, there is no significant Granger causality, nevertheless, there is a high degree of correlation, 0.786. If no Granger causality can be found while a low degree of correlation exists this may indicate that the markets are independent of each other. In this study, during the post-crisis period, between the United Kingdom and Malaysia, there is a low correlation of 0.128.

Table 4.12 Bivariate Granger Causality Tests
(Malaysia and Developing countries)

	Entire Period (July 1996 – June 2007)		Pre-Crisis (July1996 – June 1997)		Crisis (July1997June1998)		Post-Crisis July 1998 – June 2007)	
	Lag:1		Lag:1		Lag:1		Lag:1	
Null Hypothesis	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability
LCHN does not Granger Cause LMAL	0.788*	0.375	2.400	0.123	0.071	0.790	2.004	0.157
LMAL does not Granger Cause LCHN	3.749	0.053	0.132	0.717	8.367***	0.004	0.848	0.357
LIND does not Granger Cause LMAL	3.188*	0.074	6.206**	0.013	0.096	0.758	3.450*	0.063
LMAL does not Granger Cause LIND	1.229	0.268	0.022	0.882	0.000	0.999	1.131	0.288
LBRA does not Granger Cause LMAL	0.656	0.418	2.345	0.127	1.383	0.241	1.822	0.177
LMAL does not Granger Cause LBRA	5.747**	0.017	0.008	0.928	0.214	0.644	4.908**	0.027
LARG does not Granger Cause LMAL	0.512	0.475	0.563	0.454	1.442	0.231	1.567	0.211
LMAL does not Granger Cause LARG	1.061	0.303	0.053	0.818	1.676	0.197	1.013	0.314
LRUS does not Granger Cause LMAL	0.859	0.354	1.821	0.178	0.929	0.336	3.309*	0.069
LMAL does not Granger Cause LRUS	6.809***	0.009	0.022	0.882	4.694**	0.031	3.129*	0.077
LMEX does not Granger Cause LMAL	4.724**	0.030	0.811	0.369	0.598	0.440	7.625***	0.006
LMAL does not Granger Cause LMEX	0.890	0.346	1.773	0.184	1.339	0.248	0.126	0.723
LSAF does not Granger Cause LMAL	2.637	0.105	6.346**	0.012	0.004	0.948	4.006**	0.046
LMAL does not Granger Cause LSAF	0.913	0.339	0.051	0.821	0.082	0.774	0.308	0.579
LCHI does not Granger Cause LMAL	3.322*	0.069	2.288	0.132	1.146	0.285	5.048**	0.025
LMAL does not Granger Cause LCHI	1.321	0.251	1.048	0.307	1.274	0.260	0.297	0.586
LTUR does not Granger Cause LMAL	0.756	0.385	2.496	0.115	0.030	0.863	1.269	0.260
LMAL does not Granger Cause LTUR	1.729	0.189	1.829	0.178	2.517	0.114	2.993*	0.084
LISR does not Granger Cause LMAL	0.664	0.415	0.710	0.400	3.007*	0.084	0.010	0.921
LMAL does not Granger Cause LISR	2.363	0.124	0.031	0.860	5.007**	0.026	6.425**	0.011
LIND does not Granger Cause LCHN	0.883	0.347	1.838	0.176	6.613**	0.011	5.152**	0.023

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LCHN does not Granger Cause LIND	0.720	0.396	10.068***	0.002	0.026	0.873	0.971	0.325
LBRA does not Granger Cause LCHN	1.458	0.227	3.180*	0.076	3.924**	0.049	4.873**	0.027
LCHN does not Granger Cause LBRA	1.786	0.182	0.895	0.345	0.102	0.750	0.583	0.445
LARG does not Granger Cause LCHN	0.831	0.362	8.342***	0.004	6.003**	0.015	4.926**	0.027
LCHN does not Granger Cause LARG	4.774**	0.029	0.879	0.349	0.001	0.980	5.993**	0.014
LRUS does not Granger Cause LCHN	1.251	0.263	0.582	0.446	0.873	0.351	3.585*	0.058
LCHN does not Granger Cause LRUS	0.003	0.959	7.250***	0.008	7.769***	0.006	0.030	0.863
LMEX does not Granger Cause LCHN	0.869	0.351	2.026	0.156	4.989**	0.026	6.007**	0.014
LCHN does not Granger Cause LMEX	1.281	0.258	1.487	0.224	0.034	0.854	0.101	0.751
LSAF does not Granger Cause LCHN	1.422	0.233	0.019	0.891	13.628***	0.000	5.379**	0.021
LCHN does not Granger Cause LSAF	0.027	0.870	1.945	0.164	0.108	0.743	0.006	0.941
LCHI does not Granger Cause LCHN	2.171	0.141	0.444	0.506	5.059**	0.025	6.843***	0.009
LCHN does not Granger Cause LCHI	0.121	0.728	6.452**	0.012	4.794**	0.030	0.012	0.913
LTUR does not Granger Cause LCHN	0.006	0.937	1.047	0.307	12.668***	0.000	2.030	0.154
LCHN does not Granger Cause LTUR	2.756*	0.097	2.131	0.146	0.013	0.908	2.281	0.131
LISR does not Granger Cause LCHN	0.647	0.421	0.681	0.410	21.006***	0.000	0.122	0.727
LCHN does not Granger Cause LISR	3.300*	0.069	5.867**	0.016	1.622	0.204	3.608*	0.058
LBRA does not Granger Cause LIND	3.528*	0.061	8.623***	0.004	6.968***	0.009	2.878*	0.090
LIND does not Granger Cause LBRA	4.472**	0.035	0.006	0.939	0.336	0.563	16.313***	0.000
LARG does not Granger Cause LIND	0.298	0.585	6.474**	0.012	2.619	0.107	0.166	0.683
LIND does not Granger Cause LARG	2.808*	0.094	0.620	0.432	0.753	0.386	7.052***	0.008
LRUS does not Granger Cause LIND	4.206**	0.040	9.459***	0.002	1.610	0.206	1.846	0.174
LIND does not Granger Cause LRUS	0.469	0.494	1.238	0.267	3.928**	0.049	1.066	0.302
LMEX does not Granger Cause LIND	8.069***	0.005	7.153***	0.008	4.743**	0.030	7.502***	0.006
LIND does not Granger Cause LMEX	4.392**	0.036	0.370	0.543	1.287	0.258	3.536*	0.060
LSAF does not Granger Cause LIND	10.424***	0.001	0.324	0.570	0.051	0.822	21.746***	0.000
LIND does not Granger Cause LSAF	2.213	0.137	4.562**	0.034	3.873*	0.050	0.656	0.418
LCHI does not Granger Cause LIND	10.582***	0.001	2.463	0.118	0.406	0.525	16.687***	0.000
LIND does not Granger Cause LCHI	0.948	0.330	5.526**	0.020	2.663	0.104	1.440	0.230
LTUR does not Granger Cause LIND	1.254	0.263	6.350**	0.012	0.698	0.404	0.921	0.337

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LIND does not Granger Cause LTUR	5.954**	0.015	0.845	0.359	0.275	0.601	7.866***	0.005
LISR does not Granger Cause LIND	0.000	0.999	9.305***	0.003	0.111	0.739	0.192	0.661
LIND does not Granger Cause LISR	4.726**	0.030	2.525	0.113	0.893	0.346	6.018**	0.014
LARG does not Granger Cause LBRA	0.967	0.326	8.197***	0.005	1.493	0.223	0.637	0.425
LBRA does not Granger Cause LARG	1.004	0.316	0.706	0.402	0.982	0.323	1.334	0.248
LRUS does not Granger Cause LBRA	2.618	0.106	3.293*	0.071	0.033	0.856	3.469*	0.063
LBRA does not Granger Cause LRUS	0.176	0.675	11.756***	0.001	0.002	0.961	0.199	0.656
LMEX does not Granger Cause LBRA	1.023	0.312	3.819*	0.052	1.824	0.178	8.542***	0.004
LBRA does not Granger Cause LMEX	0.222	0.638	2.891*	0.090	1.795	0.182	0.147	0.701
LSAF does not Granger Cause LBRA	9.255***	0.002	0.917	0.339	0.464	0.496	14.656***	0.000
LBRA does not Granger Cause LSAF	0.493	0.483	7.097***	0.008	5.041**	0.026	0.033	0.856
LCHI does not Granger Cause LBRA	14.841***	0.000	0.210	0.647	0.032	0.858	17.959***	0.000
LBRA does not Granger Cause LCHI	0.464	0.496	7.299***	0.007	0.457	0.500	1.653	0.199
LTUR does not Granger Cause LBRA	0.596	0.440	1.578	0.210	0.044	0.835	3.074*	0.080
LBRA does not Granger Cause LTUR	6.409**	0.011	2.178	0.141	1.541	0.216	4.147**	0.042
LISR does not Granger Cause LBRA	0.123	0.725	15.064***	0.000	0.011	0.916	0.539	0.463
LBRA does not Granger Cause LISR	3.364*	0.067	0.052	0.820	0.021	0.884	3.443*	0.064
LRUS does not Granger Cause LARG	0.715	0.398	2.171	0.142	0.326	0.568	1.068	0.302
LARG does not Granger Cause LRUS	0.031	0.860	10.305***	0.002	0.840	0.360	0.218	0.641
LMEX does not Granger Cause LARG	0.142	0.707	2.199	0.139	6.550**	0.011	1.389	0.239
LARG does not Granger Cause LMEX	0.804	0.370	1.072	0.301	1.269	0.261	0.519	0.471
LSAF does not Granger Cause LARG	3.461*	0.063	3.175*	0.076	2.000	0.159	5.674**	0.017
LARG does not Granger Cause LSAF	0.000	0.993	6.407**	0.012	5.178**	0.024	0.084	0.772
LCHI does not Granger Cause LARG	3.085*	0.079	3.701*	0.056	0.366	0.546	4.336**	0.037
LARG does not Granger Cause LCHI	0.006	0.938	10.074***	0.002	0.600	0.439	0.018	0.893
LTUR does not Granger Cause LARG	1.102	0.294	1.297	0.256	0.241	0.624	3.783*	0.052
LARG does not Granger Cause LTUR	5.476**	0.019	6.485**	0.012	1.882	0.171	3.894**	0.049
LISR does not Granger Cause LARG	0.235	0.628	11.861***	0.001	0.145	0.704	0.106	0.745
LARG does not Granger Cause LISR	4.789**	0.029	2.113	0.147	0.167	0.683	5.197**	0.023
LMEX does not Granger Cause LRUS	3.356*	0.067	15.436***	0.000	0.388	0.534	9.647***	0.002

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LRUS does not Granger Cause LMEX	0.662	0.416	1.866	0.173	0.215	0.643	0.029	0.865
LSAF does not Granger Cause LRUS	1.140	0.286	4.865**	0.028	8.075***	0.005	3.490*	0.062
LRUS does not Granger Cause LSAF	2.010	0.156	8.279***	0.004	0.379	0.539	0.223	0.637
LCHI does not Granger Cause LRUS	1.186	0.276	0.257	0.613	0.256	0.614	1.269	0.260
LRUS does not Granger Cause LCHI	1.520	0.218	7.323***	0.007	3.056*	0.082	0.939	0.333
LTUR does not Granger Cause LRUS	0.349	0.555	0.175	0.676	5.552**	0.019	0.079	0.778
LRUS does not Granger Cause LTUR	2.739*	0.098	6.385**	0.012	0.000	0.995	1.637	0.201
LISR does not Granger Cause LRUS	0.862	0.353	13.381***	0.000	10.064***	0.002	0.261	0.609
LRUS does not Granger Cause LISR	3.232*	0.072	0.455	0.501	2.913*	0.089	2.676	0.102
LSAF does not Granger Cause LMEX	1.128	0.288	4.025**	0.046	3.193*	0.075	1.877	0.171
LMEX does not Granger Cause LSAF	5.309**	0.021	11.911***	0.001	6.803**	0.010	6.548**	0.011
LCHI does not Granger Cause LMEX	2.137	0.144	0.061	0.806	0.143	0.706	0.994	0.319
LMEX does not Granger Cause LCHI	1.304	0.254	9.019***	0.003	0.291	0.590	3.513*	0.061
LTUR does not Granger Cause LMEX	0.033	0.857	0.025	0.874	0.005	0.947	0.000	0.997
LMEX does not Granger Cause LTUR	4.541**	0.033	6.515**	0.011	8.965***	0.003	5.405**	0.020
LISR does not Granger Cause LMEX	0.911	0.340	2.877*	0.091	0.801	0.372	0.246	0.620
LMEX does not Granger Cause LISR	3.537*	0.060	3.117*	0.079	1.463	0.228	2.777*	0.096
LCHI does not Granger Cause LSAF	5.047**	0.025	2.544	0.112	0.344	0.558	1.858	0.173
LSAF does not Granger Cause LCHI	3.966**	0.047	1.767	0.185	6.222**	0.013	8.100***	0.005
LTUR does not Granger Cause LSAF	0.027	0.870	7.200***	0.008	0.130	0.719	0.205	0.651
LSAF does not Granger Cause LTUR	5.840**	0.016	1.988	0.160	0.841	0.360	6.411**	0.011
LISR does not Granger Cause LSAF	0.105	0.746	8.866***	0.003	0.746	0.389	0.639	0.424
LISR does not Granger Cause LSAF	3.014*	0.083	9.592***	0.002	1.246	0.265	4.282**	0.039
LTUR does not Granger Cause LCHI	0.741	0.389	6.249**	0.013	1.827	0.178	0.632	0.427
LCHI does not Granger Cause LTUR	9.779***	0.002	0.796	0.373	0.058	0.809	9.258***	0.002
LISR does not Granger Cause LCHI	0.888	0.346	10.497***	0.001	5.195**	0.024	2.464	0.117
LCHI does not Granger Cause LISR	5.028**	0.025	4.382**	0.037	1.361	0.244	6.947***	0.009
LISR does not Granger Cause LTUR	0.413	0.521	13.277***	0.000	0.050	0.824	1.360	0.244
LTUR does not Granger Cause LISR	9.381***	0.002	0.031	0.861	0.260	0.611	12.016***	0.001

Note:***, ** and *denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

Table 4.12 summarizes the results of the bivariate Granger causality based on the standard *F* test framework. During the entire period, we find that there are unidirectional causalities running between China and Malaysia, India and Malaysia, Brazil and Malaysia, Russia and Malaysia, Mexico and Malaysia, and Chile and Malaysia. The markets of Argentina, South Africa, Turkey and Israel have no relation with the Malaysian market. Furthermore, at the same time, the Malaysian market has no bidirectional causality with any markets. Meanwhile, this study found that during the pre-crisis period, only India and South Africa exhibit unidirectional causality with the Malaysian market and others have no causality with the Malaysian market. In contrast to the finding from the pre-crisis period, China and Russia have a unidirectional relation with the Malaysian market in the crisis period. In short, in the crisis period we find that there is only one bidirectional relationship running between Malaysia and Israel and no Granger cause with India, Brazil, Argentina, Mexico, South Africa, Chile and Turkey. This suggests that, at this time period, there is a benefit of diversifying in these countries. However, during the post crisis, Malaysia is having bidirectional causality with Russia and unidirectional causality is found between India and Malaysia, Brazil and Malaysia, Mexico and Malaysia, South Africa and Malaysia, Chile and Malaysia, Turkey and Malaysia, and Israel and Malaysia. Meanwhile, Malaysia is found to have relatively no causality with China and Argentina during this period. Nevertheless, the results are found to be mixed between the developing markets, unidirectional, bidirectional and no causalities between them are documented.

In addition, the Argentinean market is found to have relatively no causality with the Malaysian market for all time periods. Whereas, the Indian market, for example, significantly Granger caused the Malaysian market during all the sub periods except the crisis period. Hence, the highly significant Granger cause from India to Malaysia can be explained by the external trade factor. This finding is consistent with the finding of Masih and Masih (1999), who discovered that higher intra-regional stock dependency among the Asian markets is perhaps due partly to the growing share of intra regional trade and investment. Based on the Bank Negara Report (1997-2009) in figure 4.1, the external total trade by Malaysian in India has increased significantly.

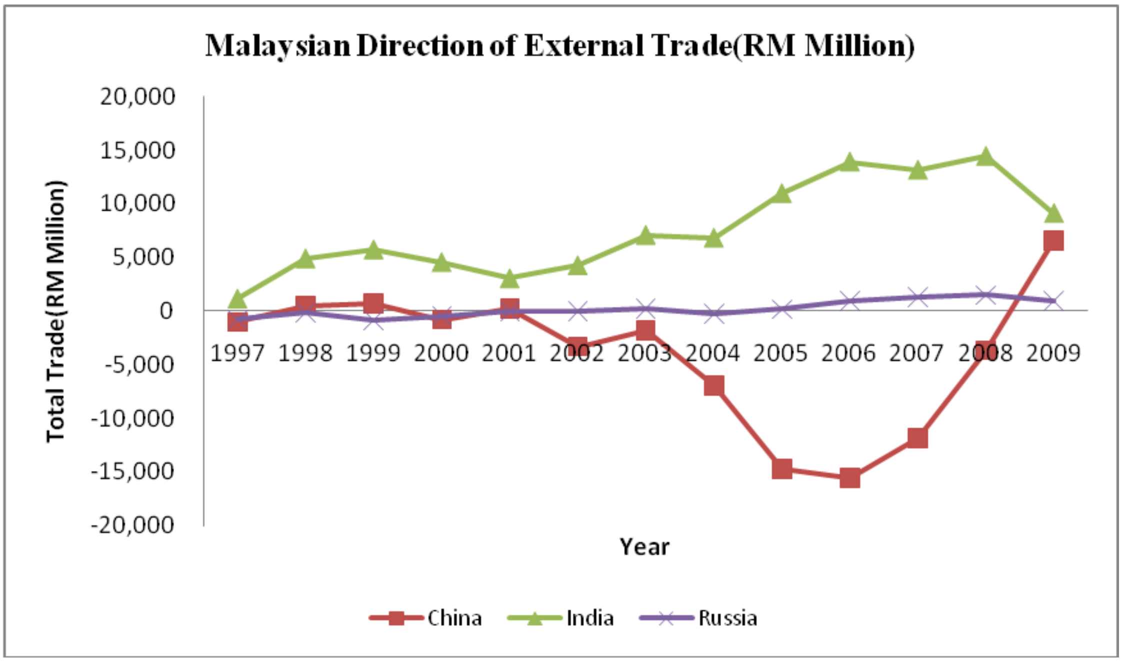

Figure 4.1 Malaysian Directional of External Trade (RM Million)

Source: Bank Negara Quarterly Statistical Bulletin (Various issues-1996 to 2010)

Apart from trade bilateral dependencies, according to Janakiraanan and Asjeet (1998); Bracker et al. (1999); and Pretorius (2002); the geographic distance between different stock markets can also be an important factor contributing to a greater extent of market integration. For instance, Janakiraanan and Asjeet (1998) provide empirical evidence that the geographically and economically close countries, such as Australia-New Zealand and Malaysia-Singapore, should exhibit higher levels of market integration. In the case of the Malaysian and Indian markets, the greater integration during all the periods of analysis except the crisis period could also be due to the geographic distance as compared to the Argentinean stock market. In addition, if no significant Granger causality is displayed while a high degree of correlation is found, this may indicate that the markets are interdependent. In this study, for example, during the post crisis period, between Malaysia and China, there is no significant Granger causality, nevertheless, there is a high degree of correlation, 0.251. If no Granger causality can be found while a low degree of correlation exists this may indicate that the markets are independent of each other. In this study, during the crisis period, between Malaysia and Argentina, there is a low correlation of -0.111.

Null Hypothesis 3b($H_0$3b)

There is no short-run dynamic relationship between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis periods.

This section builds upon the previous cointegration test to precisely estimate the dynamic interactions between the Malaysian market and the developed and developing countries. Based on Tables 4.11 and 4.12, some general conclusions on the pairwise Granger causality can be derived: unidirectional and bidirectional exists between the Malaysian financial market with developed and developing financial markets during the pre crisis, crisis and post crisis periods. Therefore, the null hypothesis of 3b can be rejected.

Table 4.13 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developed markets (Overall period)

Dependent Variables	Independent Variables [F-statistics]										(t-statistic)	Diagnostic Tests		
	Δ MAL	Δ US	Δ JPN	Δ UK	Δ FRN	Δ HK	Δ GER	Δ CAN	Δ SWZ	Δ AUS	Δ SPN	ECT $_{t-1}$	LM	HETER	RESET
Δ MAL(1)		0.131***	-0.058**	-0.141***	0.048	0.036	0.076*	0.128***	-0.111**	-0.111***	0.041	0.0004	0.944	2.457***	18.461***
		[0.002]	[0.035]	[0.007]	[0.415]	[0.168]	[0.085]	[0.001]	[0.025]	[0.003]	[0.367]	(1.097)	[0.331]	[0.004]	[0.000]
Δ US(1)	0.526***		-0.021	-0.033	-0.005	-0.025	-0.033	0.014	0.097***	-0.013	0.020	-0.020***	1.005	8.313***	5.79E-07
	[0.008]		[0.240]	[0.346]	[0.905]	[0.141]	[0.253]	[0.598]	[0.003]	[0.603]	[0.502]	(-4.152)	[0.316]	[0.000]	[0.999]
Δ JPN(1)	0.038**	0.156***		-0.006	0.131***	0.001	0.065*	0.104***	-0.018	-0.116***	-0.026	0.0004	14.426***	4.107***	1.592
	[0.011]	[0.000]		[0.879]	[0.004]	[0.941]	[0.057]	[0.001]	[0.629]	[0.000]	[0.461]	(0.476)	[0.000]	[0.000]	[0.207]
Δ UK(1)	-0.008	0.289***	-0.045**		-0.051	-0.008	-0.030	0.043*	0.088***	-0.020	0.016	-0.014**	39.754***	3.967***	4.341**
	[0.519]	[0.000]	[0.011]		[0.169]	[0.638]	[0.270]	[0.084]	[0.005]	[0.404]	[0.579]	(-2.226)	[0.000]	[0.000]	[0.037]
Δ FRN(1)	-0.006	0.337***	-0.047**	-0.095**		-0.001	0.029	0.048*	0.073**	-0.057**	-0.038	-0.004	30.961***	6.101***	0.566
	[0.650]	[0.000]	[0.018]	[0.012]		[0.956]	[0.367]	[0.096]	[0.040]	[0.034]	[0.250]	(-0.935)	[0.000]	[0.000]	[0.452]
Δ HK(1)	0.053***	0.335***	-0.085***	0.027	0.021		-0.050	0.125***	-0.050	-0.066**	0.041	-0.002	4.584**	7.322***	3.028*
	[0.001]	[0.000]	[0.000]	[0.534]	[0.671]		[0.177]	[0.000]	[0.225]	[0.034]	[0.274]	(-1.582)	[0.032]	[0.000]	[0.082]
Δ GER(1)	0.004	0.328***	-0.041*	-0.115***	0.021	0.007		0.060*	0.101**	-0.058*	0.076**	-0.003	46.842***	5.242***	4.685**
	[0.781]	[0.000]	[0.070]	[0.007]	[0.658]	[0.731]		[0.065]	[0.012]	[0.055]	[0.039]	-0.746	[0.000]	[0.000]	[0.031]
Δ CAN(1)	0.029**	0.134***	-0.030	-0.114***	0.078*	-0.029	-0.069**		0.111***	-0.017	0.003	0.0004	4.724**	4.070***	1.092
	[0.029]	[0.000]	[0.120]	[0.002]	[0.059]	[0.103]	[0.024]		[0.001]	[0.526]	[0.936]	(0.441)	[0.030]	[0.000]	[0.296]
Δ SWZ(1)	-0.006	0.271***	-0.028	-0.063*	-0.051	-0.018	-0.009	-0.017		-0.020	0.015	-0.0003	33.955***	4.812***	4.205**
	[0.633]	[0.000]	[0.127]	[0.068]	[0.186]	[0.294]	[0.746]	[0.504]		[0.415]	[0.603]	(-0.248)	[0.000]	[0.000]	[0.040]
Δ AUS(1)	0.025**	0.237***	-0.025	-0.021	0.080**	-0.029*	0.007	0.154***	-0.016		0.032	-0.002	26.475***	5.057***	3.493*
	[0.031]	[0.000]	[0.125]	[0.495]	[0.022]	[0.055]	[0.797]	[0.000]	[0.583]		[0.237]	[-1.019]	[0.000]	[0.000]	[0.062]
Δ SPN(1)	0.015	0.278***	-0.053**	-0.125***	-0.117**	-0.012	0.023	0.057*	0.055	0.003		-0.001	28.131***	6.680***	0.753
	[0.307]	[0.000]	[0.012]	[0.002]	[0.010]	[0.534]	[0.483]	[0.059]	[0.141]	[0.927]		(-1.315)	[0.000]	[0.000]	[0.386]

Table 4.14 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developed markets (pre-crisis period)

Dependent Variables	Independent Variables												Diagnostic Tests		
	[F-statistics]											(t-statistic)			
	Δ MAL	Δ US	Δ JPN	Δ UK	Δ FRN	Δ HK	Δ GER	Δ CAN	Δ SWZ	Δ AUS	Δ SPN	ECT_{t-1}	LM	HETER	RESET
Δ MAL(1)		0.026 [0.765]	-0.020 [0.687]	0.153* [0.090]	-0.092 [0.225]	-0.001 [0.988]	-0.040 [0.625]	0.192* [0.050]	0.024 [0.767]	-0.092 [0.185]	-0.018 [0.794]	-0.106*** (-3.918)	0.869 [0.352]	1.460 [0.140]	2.299 [0.131]
Δ US(1)	0.023 [0.735]		0.042 [0.409]	0.019 [0.842]	0.061 [0.447]	-0.113* [0.054]	-0.124 [0.151]	0.090 [0.385]	0.028 [0.743]	-0.036 [0.619]	0.144** [0.048]	0.037 (1.557)	0.022 [0.882]	1.132 [0.335]	0.681 [0.410]
Δ JPN(1)	-0.118 [0.175]	0.155 [0.179]		0.126 [0.294]	-0.123 [0.223]	0.019 [0.798]	0.041 [0.704]	0.066 [0.614]	-0.030 [0.778]	-0.159* [0.087]	-0.015 [0.869]	-0.013*** (-3.573)	0.161 0.689	1.419 0.157	3.258 0.072
Δ UK(1)	-0.067 [0.233]	0.123 [0.100]	0.050 [0.234]		-0.071 [0.273]	-0.047 [0.328]	-0.010 [0.883]	-0.038 [0.654]	-0.042 [0.544]	0.000 [0.994]	0.164*** [0.006]	-0.038** (-2.438)	0.186 0.666	0.746 0.705	0.702 0.403
Δ FRN(1)	-0.115 [0.103]	0.077 [0.413]	-0.009 [0.871]	-0.046 [0.633]		-0.035 [0.557]	-0.093 [0.292]	0.024 [0.823]	-0.059 [0.490]	0.103 [0.168]	0.034 [0.643]	0.002** (2.578)	0.316 0.575	0.989 0.460	0.522 0.471
Δ HK(1)	0.080 [0.285]	0.171* [0.086]	-0.092* [0.099]	0.241** [0.021]	-0.016 [0.851]		-0.245*** [0.009]	0.275** [0.015]	0.100 [0.272]	-0.076 [0.342]	-0.013 [0.864]	-0.018*** (-4.392)	0.686 0.408	1.755 0.056	0.866 0.353
Δ GER(1)	0.047 [0.407]	0.242*** [0.002]	0.023 [0.593]	0.013 [0.870]	0.004 [0.948]	-0.096** [0.048]		0.168* [0.050]	0.099 [0.153]	-0.110* [0.070]	0.132** [0.028]	-0.004*** (-3.891)	0.524 0.470	1.579 0.098	0.539 0.464
Δ CAN(1)	0.006 [0.919]	-0.035 [0.664]	0.027 [0.546]	-0.088 [0.294]	0.128* [0.069]	-0.036 [0.480]	-0.121 [0.111]		0.043 [0.563]	-0.117* [0.070]	0.051 [0.425]	0.017 (1.323)	0.013 0.911	0.657 0.792	0.460 0.498
Δ SWZ(1)	0.073 [0.236]	0.036 [0.658]	0.039 [0.399]	-0.043 [0.610]	-0.028 [0.692]	-0.086 [0.102]	-0.080 [0.302]	-0.038 [-0.411]		-0.020 [0.760]	0.105 [0.106]	-0.091*** (-6.213)	0.001 0.973	2.012 0.024	0.321 0.571
Δ AUS(1)	0.074 [0.245]	0.229*** [0.008]	0.078 [0.102]	0.066 [0.456]	-0.087 [0.243]	-0.030 [0.580]	-0.174** [0.031]	0.203** [0.036]	0.168** [0.032]		0.170** [0.012]	0.005* (0.675)	0.050 0.823	0.769 0.682	6.396 0.012
Δ SPN(1)	0.062 [0.388]	0.090 [0.350]	-0.010 [0.855]	-0.106 [0.288]	-0.117 [0.163]	-0.019 [0.761]	-0.060 [0.511]	0.175 [0.108]	-0.093 [0.293]	-0.004 [0.963]		-0.021*** (-2.885)	1.793 0.182	1.059 0.396	0.103 0.748

Table 4.15 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developed markets (crisis period)

Dependent Variables	Independent Variables												Diagnostic Tests		
	[F-statistics]											(t-statistic)			
	Δ MAL	Δ US	Δ JPN	Δ UK	Δ FRN	Δ HK	Δ GER	Δ CAN	Δ SWZ	Δ AUS	Δ SPN	ECT $_{t-1}$	LM	HETER	RESET
Δ MAL(1)		0.297	-0.076	0.450	-0.588*	0.169*	0.203	-0.226	-0.372	-0.131	0.135	0.002	0.228	1.885**	9.692***
		[0.320]	[0.580]	[0.107]	[0.050]	[0.067]	[0.397]	[0.494]	[0.200]	[0.522]	[0.551]	(0.611)	[0.633]	[0.037]	[0.002]
Δ US(1)	-0.072		-0.044	0.063	0.191	-0.135**	-0.114	0.514**	0.100	-0.105	-0.093	0.120	3.623*	1.691*	1.639
	0.100		0.608	0.718	0.306	0.020	0.449	0.013	0.583	0.413	0.513	1.613	[0.058]	[0.069]	[0.202]
Δ JPN(1)	-0.040	-0.003		-0.034	-0.035	-0.010	-0.003	0.243	0.081	-0.336**	0.010	-0.003*	2.636	1.682*	0.154
	[-0.787]	[0.990]		[0.865]	[0.869]	[0.884]	[0.985]	[0.308]	[0.699]	[0.023]	[0.950]	(-1.812)	[0.106]	[0.071]	[0.696]
Δ UK(1)	-0.077*	-0.243	0.018		0.028	-0.088	-0.085	0.634***	0.014	-0.203	0.025	0.019**	0.648	1.437	0.842
	[0.079]	[0.193]	[0.829]		[0.883]	[0.129]	[0.570]	[0.002]	[0.937]	[0.112]	[0.860]	(2.223)	[0.209]	[0.150]	[0.360]
Δ FRN(1)	-0.057	-0.033	0.010	-0.105		-0.117**	-0.064	0.528**	0.065	-0.219*	-0.094	0.134**	0.013	1.229	0.034
	[0.200]	[0.863]	[0.903]	[0.550]		[0.046]	[0.670]	[0.012]	[0.723]	[0.091]	[0.511]	(2.349)	[0.911]	[0.263]	[0.854]
Δ HK(1)	-0.049	0.338	-0.099	-0.456*	0.230		-0.245	0.459	-0.090	-0.145	0.012	0.023**	0.173	1.249	6.833**
	[0.455]	[0.228]	[0.441]	[0.082]	[0.411]		[0.277]	[0.139]	[0.740]	[0.449]	[0.956]	(2.591)	[0.678]	[0.250]	[0.010]
Δ GER(1)	-0.067	0.113	-0.011	-0.323*	0.185	-0.083		0.441**	0.131	-0.243*	0.098	-0.152	1.305	1.207	0.585
	[0.144]	[0.559]	[0.903]	[0.075]	[0.341]	[0.168]		[0.041]	[0.488]	[0.068]	[0.507]	(0.006)	[0.254]	[0.279]	[0.445]
Δ CAN(1)	-0.075*	-0.365**	0.009	-0.047	0.167	-0.155***	-0.068		0.045	-0.139	-0.100	-0.168***	2.626	1.486	3.757*
	[0.073]	[0.042]	[0.914]	[0.778]	[0.348]	[0.005]	[0.637]		[0.794]	[0.255]	[0.463]	(-3.048)	[0.106]	[0.130]	[0.054]
Δ SWZ(1)	-0.079*	-0.149	-0.018	-0.136	0.032	-0.106*	-0.065	0.493**		-0.174	0.011	-0.055	0.004	0.938	0.244
	[0.070]	[0.418]	[0.833]	[0.429]	[0.862]	[0.064]	[0.663]	[0.016]		[0.169]	[0.936]	0.000	[0.948]	[0.510]	[0.622]
Δ AUS(1)	-0.059	0.010	0.013	-0.218	0.099	-0.082	-0.049	0.481**	-0.021		-0.063	-0.021***	0.240	1.435	0.409
	[0.180]	[0.956]	[0.878]	[0.207]	[0.593]	[0.155]	[0.742]	[0.020]	[0.906]		[0.656]	(-3.377)	[0.624]	[0.151]	[0.523]
Δ SPN(1)	-0.052	-0.104	-0.046	-0.137	0.150	-0.149**	0.063	0.587***	-0.149	-0.083		-0.068***	0.780	1.422	0.045
	[0.274]	[0.606]	[0.617]	[0.467]	[0.458]	[0.018]	[0.699]	[0.009]	[0.448]	[0.548]		(-4.181)	[0.378]	[0.156]	[0.831]

Table 4.16 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developed markets (post crisis period)

Dependent Variables	Independent Variables [F-statistics]											(t-statistic)	Diagnostic Tests		
	Δ MAL	Δ US	Δ JPN	Δ UK	Δ FRN	Δ HK	Δ GER	Δ CAN	Δ SWZ	Δ AUS	Δ SPN	ECT_{t-1}	LM	HETER	RESET
Δ MAL(1)		0.156*** [0.000]	-0.043 [0.134]	-0.206*** [0.000]	0.145** [0.023]	-0.003 [0.908]	0.030 [0.517]	0.153*** [0.000]	-0.056 [0.271]	-0.101** [0.010]	0.044 [0.354]	-0.004*** (-3.420)	2.110 [0.147]	4.676*** [0.000]	21.940*** [0.000]
Δ US(1)	0.034** [0.014]		-0.035* [0.072]	-0.036 [0.322]	-0.043 [0.310]	0.032* [0.097]	0.010 [0.738]	-0.006 [0.809]	0.097*** [0.004]	-0.010 [0.714]	0.012 [0.691]	0.455 (-0.747)	0.720 [0.396]	11.618*** [0.000]	0.101 [0.751]
Δ JPN(1)	0.046*** [0.005]	0.185*** [0.000]		0.004 [0.916]	0.158*** [0.001]	0.035 [0.119]	0.063* [0.080]	0.109*** [0.000]	-0.004 [0.926]	-0.054* [0.074]	-0.047 [0.198]	-0.001 (-0.989)	0.706 [0.401]	3.194*** [0.000]	3.985** [0.046]
Δ UK(1)	0.005 [0.686]	0.335*** [0.000]	-0.061*** [0.001]		-0.089** [0.025]	0.036** [0.049]	-0.004 [0.887]	0.034 [0.149]	0.117*** [0.000]	0.014 [0.569]	-0.017 [0.567]	-0.018 (-2.247)	33.819*** [0.000]	5.055*** [0.000]	7.596*** [0.006]
Δ FRN(1)	0.006 [0.694]	0.362*** [0.000]	-0.058*** [0.007]	-0.095** [0.020]		0.061*** [0.005]	0.076** [0.030]	0.038 [0.182]	0.096** [0.011]	-0.033 [0.259]	-0.050 [0.156]	-0.009 (0.285)	28.981*** [0.000]	6.327*** [0.000]	2.903* [0.089]
Δ HK(1)	0.042** [0.010]	0.351*** [0.000]	-0.066*** [0.003]	0.103** [0.014]	-0.088* [0.072]		0.034 [0.348]	0.119*** [0.000]	-0.018 [0.644]	-0.010 [0.744]	0.029 [0.427]	0.000 (-0.421)	1.226 [0.268]	4.145*** [0.000]	2.240 [0.135]
Δ GER(1)	0.020 [0.266]	0.320*** [0.000]	-0.053** [0.033]	-0.092* [0.052]	-0.031 [0.570]	0.066*** [0.009]		0.046 [0.167]	0.101** [0.022]	-0.022 [0.522]	0.041 [0.315]	0.001 (0.506)	36.637*** [0.000]	6.024*** [0.000]	7.436*** [0.006]
Δ CAN(1)	0.057*** [0.000]	0.149*** [0.000]	-0.047** [0.023]	-0.089** [0.023]	0.015 [0.738]	0.030 [0.157]	-0.024 [0.475]		0.121*** [0.001]	-0.009 [0.738]	-0.005 [0.879]	-0.026*** (-5.105)	1.220 [0.270]	6.258*** [0.000]	1.652 [0.199]
Δ SWZ(1)	0.012 [0.399]	0.283*** [0.000]	-0.038** [0.044]	-0.036 [0.310]	-0.088** [0.035]	0.025 [0.189]	0.038 [0.220]	-0.033 [0.191]		0.003 [0.894]	-0.015 [0.630]	0.000 (0.234)	30.978*** [0.000]	7.201*** [0.000]	7.816*** [0.005]
Δ AUS(1)	0.016 [0.181]	0.270*** [0.000]	-0.028* [0.078]	0.024 [0.421]	0.064* [0.073]	0.016 [0.330]	0.022 [0.395]	0.150*** [0.000]	0.000 [0.995]		0.020 [0.446]	-0.003 (-0.837)	15.192*** [0.000]	4.681*** [0.000]	5.845** [0.016]
Δ SPN(1)	0.026 [0.119]	0.277*** [0.000]	-0.056** [0.014]	-0.111*** [0.009]	-0.178*** [0.000]	0.042* [0.067]	0.073** [0.044]	0.043 [0.146]	0.090** [0.023]	0.012 [0.687]		0.000 (0.132)	20.470*** [0.000]	5.596*** [0.000]	3.303* [0.069]

Note: *Significance at the 10 per cent level, **significance at the 5 per cent level, ***significance at the 1 per cent level. Figures in the parentheses and square brackets represent t-statistic and probabilities for F-statistic, respectively.

Having provided at least an insight into bivariate causality between the Malaysian and the developed markets in the analysis, we now proceed to the multivariate analysis. The existence of cointegration among the stock markets of developed markets and Malaysian rejects non-causality among them. This implies that at least one of the markets reacted to deviations from the long-run relationship. The Vector Error Correction models allow us to distinguish between the short-run and long forms of causality among developed markets and the Malaysian market. When the variables are cointegrated, in the short-run, deviations from this equilibrium will feed back on the changes in the dependent variable in order to force movements towards long-run equilibrium. If the dependent variable is driven directly by this long-run equilibrium error, then it is responding to this feedback. Otherwise, it is only responding to short-term shocks to the stochastic environment.

The results from VECM provide information on both short and long relationships among the markets during the overall, pre-crisis, crisis and post crisis periods and these are reported in Tables 4.13, 4.14, 4.15, and 4.16, respectively. The summarized results based on the VECM formulations described earlier are presented in table 4.13. For model 1, we note that at least one channel of Granger causality is active, either in the short-run through the joint test of lagged differences or statistically significant error correction terms. The interpretation arising from this finding is that when there is a deviation from equilibrium cointegrating relationship as measured by the ECTs, it is mainly the changes in these variables that adjust to clear the disequilibrium.

During the overall period (Table 4.13), there seems to be a bidirectional relationship running from the US and Malaysian stock markets, Japan and Malaysia, Canada and Malaysia, Australia and Malaysia, Switzerland and the US, France and Japan, Germany and Japan, Canada and the UK, Switzerland and the UK, Canada and France, Australia and France, Australia and Hong Kong and Canada and Germany. From this model, we identified that the Malaysian market is found to be the only market affected by the US, Japan, Canada and Australia. Unlike the Malaysian market, which is independent from France, Hong Kong, and Spain, there seems to be bidirectional causalities running from Malaysia and the US, Malaysia and Japan, Malaysia and Canada and Malaysia and Australia. Meanwhile, France and Japan, Germany and Japan, Canada and the UK, Switzerland and the UK, Canada and France, Australia and France, Australia and Hong Kong and Canada and Germany were found to have bidirectional Granger causality relationships. For the US market, only Malaysia and Switzerland are found to Granger cause this market. While Japan is independent from the UK, Hong Kong, Switzerland and Spain. All the developed markets, as well as Malaysia, are Granger caused by the US market. Another interesting point is that with the exception of ECTs for the Malaysia, Japan, France, Hong Kong, Germany, Canada, Switzerland, Australia and Spain equations, the US and the UK ECTs in the system are significant, implying that the burden of short term adjustment to long term equilibrium relationships are borne by these significant ECTs stock markets. However, although the ECTs are significant in the US and UK equations, according to Masih and Masih (1999), one cannot assume that these markets are non-causal since the short-run channels are still active.

Furthermore, during the pre-crisis (Table 4.14), the model possesses at least one active channel of causality, either the short-run through joint test of lagged differences or a statistically significant ECT. A number of general conclusions can be drawn pertaining to the short-run causal influences: the Malaysian market is independent from both the US and Japanese stocks markets; all markets except Hong Kong, Germany and Australia are totally independent of the US market; all markets except Hong Kong are also independent of the Japanese market; there are bidirectional relationships between Hong Kong and the US, Germany and Hong Kong, Australia and Germany, and Australia and Canada; apart from France, Switzerland and Spain have, to some extent, no Granger causal relations with all stock markets; all other developed markets are, however, affected by significant short-run causal influences of other developed markets. Another interesting point is that with the exception of ECTs for the US and Canada equations, all the markets in the system are significant, implying that the burden of short-term adjustment to long-term equilibrium relationships are borne by these significant ECTs stock markets.

Meanwhile, a number of general findings of the short-run causal influences during the crisis period (Table 4.15), which can be summarized here are: the Malaysian stock market is independent of both the US and Japanese stock markets but has a number of causal linkages with the France and Hong Kong stock markets; all markets are independent of the US and Japanese market except the Canada market, which is affected by the US market. There is a one-bidirectional relationship in the model, which is between Canada and the US markets; the ECTs of all markets are significant except for the markets of Malaysia, the US and Germany. There are unidirectional relationships among the developed markets and the Malaysian market.

Unlike the crisis period, where there is only one bidirectional relationship, there seems to be many bidirectional relationships between Malaysia and the developed markets during the post crisis period (table 4.16). From these models, we identified that the Malaysian market is found to be affected by the US, UK, France, Canada and Australia. Unlike the Malaysian market, which is independent from Japan, Hong Kong, Germany, Switzerland and Spain, there seems to be bidirectional causalities running from the US and Malaysia and Canada and Malaysia. Meanwhile, among the developed markets, bidirectional causalities running from Japan and the US, Hong Kong and the US, Switzerland and the US, France and Japan, Germany and Japan, Canada and Japan, Australia and Japan, France and the UK, Hong Kong and the UK, Hong Kong and France, and Switzerland and France. Another interesting finding is that the ECTs for the equations of Malaysia and Canada are statistically significant while the other markets are insignificant.

Taking into account all periods, pre crisis, crisis and post crisis, some of the general findings of the short-run and long-run causal influences that can be summarized here are: the Malaysian market was independent of the US and Japan markets during the pre crisis and crisis period but dependent on the US during the post crisis period. There were less bidirectional relationships between Malaysia and the developed markets during the pre crisis and crisis period compared to the post crisis period. During the pre crisis period France, Switzerland and Spain were very independent from the other markets. The ECTs for the equations of the Malaysian markets were statistically significant during the pre crisis and post crisis. Whereas, the ECTs of many developed market equations were significant during the pre crisis and crisis periods.

The overall performance of our estimated models seems to be acceptable. Almost all the ECTs' coefficients were found with the expected negative signs, implying that in the long-run, the stock markets have a tendency to return to their equilibrium relationships. Although the R^2 values are relatively low, they are still regarded as acceptable given that the estimates are based on first difference values. These low R^2 findings are similar to Majid et al. (2009), Majid et al. (2008), and Yusof and Majid (2006).

In conclusion, based on the earlier diagnostic test, we can conclude that the performances of our estimated models are satisfactory enough to provide information pertaining to the issue of market integration between Malaysia and the developed markets.

Table 4.17 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developing markets (Overall period)

Dependent Variables	Independent Variables [F-statistics]											(t-statistic)	Diagnostic Tests		
	Δ MAL	Δ CHN	Δ IND	Δ BRA	Δ ARG	Δ RUS	Δ MEX	Δ SAF	Δ CHI	Δ TUR	Δ ISR	ECT_{t-1}	LM	HETER	RESET
Δ MAL(1)		0.001 [0.989]	-0.021 [0.338]	0.009 [0.670]	-0.013 [0.461]	0.004 [0.750]	0.155*** [0.000]	-0.014 [0.591]	-0.029 [0.440]	-0.001 [0.946]	-0.046* [0.070]	0.001 (1.602)	0.180 [0.671]	3.924*** [0.000]	11.635*** [0.001]
Δ CHN(1)	0.065*** [0.001]		-0.061*** [0.009]	0.042* [0.067]	0.001 [0.415]	0.019 [0.143]	0.231*** [0.000]	-0.012 [0.666]	0.007 [0.863]	-0.029** [0.017]	-0.038 [0.153]	-0.001 (-0.928)	1.081 [0.299]	3.432*** [0.000]	5.072** [0.024]
Δ IND(1)	0.016 [0.364]	-0.068*** [0.000]		0.080*** [0.000]	15 -0.001 [0.966]	-0.006 [0.588]	0.053** [0.028]	0.012 [0.609]	-0.016 [0.626]	-0.002 [0.808]	0.063*** [0.006]	-0.014*** (-4.744)	0.029 [0.864]	5.847*** [0.000]	0.656 [0.418]
Δ BRA(1)	-0.023 [0.316]	-0.007 [0.771]	0.019 [0.474]		1 0.022 [0.288]	0.009 [0.533]	0.009 [0.787]	-0.048 [0.136]	-0.020 [0.650]	-0.010 [0.457]	-0.035 [0.244]	-0.010*** (-3.465)	6.145** [0.013]	5.660*** [0.000]	0.094 [0.759]
Δ ARG(1)	0.004 [0.867]	-0.035 [0.147]	0.010 [0.727]	0.048* [0.079]		0.022 [0.167]	0.071** [0.039]	-0.058* [0.089]	-0.018 [0.702]	0.011 [0.472]	-0.036 [0.265]	-0.001 (-0.887)	0.147 [0.701]	1.213 [0.267]	0.162 [0.687]
Δ RUS(1)	0.034 [0.285]	-0.131*** [0.000]	-0.008 [0.833]	0.119*** [0.001]	0.083*** [0.004]		0.231*** [0.000]	-0.130*** [0.004]	0.112* [0.072]	-0.027 [0.158]	-0.083** [0.048]	-0.002*** (-3.413)	5.586** [0.018]	16.878*** [0.000]	3.227* [0.073]
Δ MEX(1)	-0.002 [0.931]	-0.032* [0.080]	0.004 [0.862]	0.027 [0.187]	0.027 [0.107]	0.006 [0.625]		-0.059** [0.024]	0.012 [0.743]	0.006 [0.559]	-0.027 [0.275]	-0.003 (-1.183)	0.929 [0.335]	7.150*** [0.000]	4.214** [0.040]
Δ SAF(1)	-0.009 [0.589]	-0.044*** [0.006]	-0.013 [0.495]	0.062*** [0.001]	0.044*** [0.002]	-0.009 [0.362]	0.21*** [0.000]		0.001 [0.978]	0.001 [0.884]	-0.043** [0.038]	0.001 (0.432)	0.082 [0.775]	10.519*** [0.000]	7.131*** [0.008]
Δ CHI(1)	-0.017 [0.165]	-0.013 [0.310]	-0.005 [0.704]	0.013 [0.342]	0.027** [0.015]	0.004 [0.640]	2 0.054*** [0.002]	-0.044** [0.010]		0.002 [0.790]	-0.030* [0.067]	0.001** (-2.460)	0.815 [0.367]	2.550*** [0.002]	0.009 [0.923]
Δ TUR(1)	-0.014 [0.688]	-0.049 [0.146]	-0.007 [0.855]	0.089** [0.018]	0.013 [0.663]	-0.017 [0.451]	0.185*** [0.000]	-0.076 [0.105]	0.053 [0.421]		0.123*** [0.005]	0.001 (1.013)	0.001 [0.981]	4.143*** [0.000]	2.755* [0.097]
Δ ISR(1)	0.001 [0.935]	-0.050*** [0.002]	0.020 [0.291]	0.033* [0.071]	0.019 [0.201]	-0.009 [0.372]	0.152*** [0.000]	-0.058** [0.011]	0.001 [0.966]	0.003 [0.737]		0.001 (1.498)	2.062 [0.151]	4.424*** [0.000]	1.930 [0.165]

Table 4.18 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developing markets (pre-crisis period)

Dependent Variables	Independent Variables												Diagnostic Tests		
	[F-statistics]											(t-statistic)			
	Δ M	Δ CHN	Δ IND	Δ BRA	Δ ARG	Δ RUS	Δ MEX	Δ SAF	Δ CHI	Δ TUR	Δ ISR	ECT $_{t-1}$	LM	HETER	RESET
Δ MAL(1)		0.101*** [0.006]	-0.047 [0.178]	0.125** [0.032]	-0.024 0.612	-0.021 [0.301]	0.130** [0.019]	-0.101* [0.082]	0.012 [0.861]	0.012 [0.587]	-0.025 [0.556]	-0.030*** (-3.648)	0.159 [0.690]	1.902** [0.035]	0.264 [0.608]
Δ CHN(1)	0.060 [0.558]		0.012 [0.832]	0.208** [0.029]	0.029 [0.714]	0.004 [0.912]	0.115 [0.206]	-0.138 [0.147]	0.147 [0.207]	-0.044 [0.222]	-0.207*** [0.004]	-0.019* (-1.886)	0.210 [0.648]	0.637 [0.810]	10.055*** [0.002]
Δ IND(1)	-0.014 [0.906]	-0.050 [0.457]		0.132 [0.213]	-0.05 [0.557]	0.013 [0.713]	-0.165 [0.102]	-0.022 [0.836]	-0.060 [0.643]	0.041 [0.310]	0.152* [0.053]	0.002 (0.724)	0.090 [0.765]	0.962 [0.486]	1.467 [0.227]
Δ BRA(1)	-0.076 [0.334]	-0.055 [0.231]	0.022 [0.606]		0.024 [0.692]	-0.019 [0.450]	0.141** [0.043]	0.023 [0.754]	-0.075 [0.400]	0.010 [0.720]	0.080 [0.139]	-0.024* (-1.802)	0.833 [0.362]	0.738 [0.714]	0.173 [0.678]
Δ ARG(1)	-0.018 [0.856]	-0.085 [0.136]	0.005 [0.925]	-0.235*** [0.009]		-0.012 [0.687]	0.118 [0.168]	0.020 [0.822]	-0.07 [0.507]	0.034 [0.314]	0.098 [0.141]	0.008 (1.442)	0.419 [0.518]	1.571 [0.101]	0.201 [0.654]
Δ RUS(1)	0.087 [0.643]	-0.177 [0.105]	-0.061 [0.551]	0.325* [0.061]	0.146 [0.311]		0.028 [0.864]	-0.173 [0.318]	-0.007 [0.972]	0.059 [0.366]	0.208 [0.106]	-0.093*** (-4.375)	4.361** [0.038]	1.171 [0.305]	4.607** [0.033]
Δ MEX(1)	0.017 [0.836]	-0.041 [0.387]	0.017 [0.701]	-0.062 [0.405]	0.040 [0.518]	-0.020 [0.434]		-0.037 [0.624]	-0.012 [0.896]	0.034 [0.234]	0.016 [0.777]	-0.006 (-0.867)	1.024 [0.313]	0.627 [0.819]	0.201 [0.655]
Δ SAF(1)	0.002 [0.982]	0.054 [0.19]	0.005 [0.905]	0.134** [0.043]	0.042 [0.449]	-0.012 [0.600]	0.154** [0.015]		0.015 [0.853]	0.025 [0.321]	0.002 [0.971]	0.002 (1.322)	0.001 [0.976]	1.333 [0.200]	3.124* [0.078]
Δ CHI(1)	-0.008 [0.886]	-0.010 [0.777]	0.030 [0.340]	0.120** [0.025]	0.036 [0.420]	-0.013 [0.496]	0.008 [0.88]	0.044 [0.409]		0.033 [0.107]	0.016 [0.687]	-0.011 (-1.620)	2.516 [0.114]	2.365*** [0.007]	0.438 [0.509]
Δ TUR(1)	0.179 [0.325]	-0.013 [0.905]	-0.092 [0.357]	-0.330** [0.049]	-0.146 [0.295]	0.028 [0.624]	0.321** [0.045]	-0.179 [0.285]	0.261 [0.204]		0.152 [0.223]	-0.009** (-2.193)	0.196 [0.659]	3.426*** [0.000]	0.018 [0.894]
Δ ISR(1)	-0.050 [0.592]	0.115** [0.037]	0.027 [0.606]	0.094 [0.279]	-0.025 [0.726]	-0.025 [0.408]	0.244*** [0.003]	-0.137 [0.116]	0.042 [0.697]	-0.056* [0.090]		0.009 (1.199)	0.872 [0.351]	1.203 [0.282]	3.044* [0.082]

Table 4.19 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developing markets (crisis period)

Dependent Variables	Independent Variables												Diagnostic Tests		
	[F-statistics]											(t-statistic)			
	Δ MAL	Δ CHN	Δ IND	Δ BRA	Δ ARG	Δ RUS	Δ MEX	Δ SAF	Δ CHI	Δ TUR	Δ ISR	ECT_{t-1}	LM	HETER	RESET
Δ MAL(1)		0.046 [0.538]	-0.044 [0.735]	-0.060 [0.630]	0.157 [0.369]	0.045 [0.448]	0.107 [0.458]	0.065 [0.664]	-0.003 [0.990]	-0.008 [0.918]	-0.446** [0.020]	-0.003 (-0.324)	7.045*** [0.009]	1.049 [0.405]	1.086 [0.298]
Δ CHN(1)	0.044 [0.523]		-0.072 [0.576]	0.010 [0.935]	-0.390** [0.027]	0.175*** [0.003]	0.480*** [0.001]	-0.128 [0.395]	0.070 [0.740]	0.060 [0.432]	-0.344* [0.072]	0.054** (2.118)	0.103 [0.749]	1.667* [0.075]	0.127 [0.722]
Δ IND(1)	-0.107** [0.027]	-0.126** [0.018]		0.179** [0.043]	-0.351*** [0.005]	0.037 [0.377]	0.060 [0.556]	0.011 [0.921]	-0.032 [0.831]	0.053 [0.330]	0.028 [0.834]	0.077*** (2.675)	0.638 [0.425]	1.755* [0.056]	0.159 [0.691]
Δ BRA(1)	-0.116* [0.066]	-0.089 [0.199]	0.143 [0.231]		0.033 [0.840]	0.053 [0.327]	-0.252* [0.058]	-0.210 [0.132]	-0.083 [0.670]	0.010 [0.891]	0.009 [0.958]	0.094** (2.465)	5.554** [0.019]	1.775* [0.053]	0.235 [0.628]
Δ ARG(1)	-0.057 [0.260]	-0.121** [0.031]	0.105 [0.275]	0.135 [0.145]		0.087** [0.048]	-0.181* [0.092]	-0.254** [0.024]	0.102 [0.515]	0.044 [0.445]	0.002 [0.989]	-0.043*** (-4.759)	3.492* [0.063]	2.187** [0.013]	0.425 [0.515]
Δ RUS(1)	-0.054 [0.510]	-0.319*** [0.001]	-0.068 [0.659]	0.018 [0.904]	0.075 [0.720]		0.532*** [0.002]	-0.267 [0.139]	0.276 [0.273]	0.068 [0.462]	-0.216 [0.345]	-0.209*** (-5.958)	0.650 [0.421]	1.457 [0.141]	3.023* [0.083]
Δ MEX(1)	-0.072 [0.206]	-0.167*** [0.008]	0.089 [0.410]	0.116 [0.263]	-0.051 [0.728]	0.064 [0.194]		-0.211* [0.093]	0.095 [0.587]	0.068 [0.284]	0.023 [0.886]	0.061*** (4.698)	4.822** [0.029]	3.228*** [0.000]	0.003 [0.960]
Δ SAF(1)	-0.068 [0.143]	-0.164*** [0.002]	-0.110 [0.210]	0.006 [0.944]	-0.011 [0.929]	-0.013 [0.754]	0.269*** [0.006]		-0.176 [0.219]	0.075 [0.152]	-0.072 [0.581]	-0.102*** (-4.682)	0.092 [0.762]	2.719*** [0.002]	6.450** [0.012]
Δ CHI(1)	-0.061 [0.109]	-0.155*** [0.000]	0.010 [0.891]	0.049 [0.479]	-0.174* [0.077]	0.068** [0.041]	0.008 [0.921]	-0.097 [0.251]		0.033 [0.439]	0.002 [0.981]	-0.088*** (-5.505)	1.272 [0.261]	1.853** [0.041]	0.052 [0.820]
Δ TUR(1)	-0.163** [0.030]	-0.177** [0.032]	0.003 [0.983]	0.210 [0.124]	-0.108 [0.572]	0.055 [0.395]	0.107 [0.496]	-0.118 [0.475]	-0.290 [0.208]		0.206 [0.324]	0.036*** (3.152)	0.587 [0.444]	1.813** [0.047]	2.188 [0.140]
Δ ISR(1)	-0.023 [0.582]	-0.130*** [0.006]	-0.080 [0.317]	0.023 [0.761]	-0.039 [0.720]	0.001 [0.977]	0.215** [0.017]	-0.092 [0.329]	0.067 [0.611]	0.099** [0.039]		-0.102*** (-3.459)	0.286 [0.594]	1.475 [0.134]	1.475 [0.134]

Table 4.20 Multivariate Vector Error Correction Model (VECM) causality analysis between Malaysia and the developing markets (post crisis period)

Dependent Variables	Independent Variables [F-statistics]											(t-statistic)	Diagnostic Tests		
	Δ MAL	Δ CHN	Δ IND	Δ BRA	Δ ARG	Δ RUS	Δ MEX	Δ SAF	Δ CHI	Δ TUR	Δ ISR	ECT_{t-1}	LM	HETER	RESET
Δ MAL(1)		-0.016 [0.460]	0.007 [0.768]	-0.001 [0.964]	-0.015 [0.371]	0.002 [0.908]	0.152*** [0.000]	0.004 [0.896]	0.007 [0.849]	0.004 [0.735]	-0.002 [0.933]	0.001 (1.300)	0.001 [0.986]	4.251*** [0.000]	2.466 [0.117]
Δ CHN(1)	0.047** [0.037]		-0.039 [0.109]	0.029 [0.194]	0.031* [0.071]	0.006 [0.662]	0.197*** [0.000]	0.032 [0.258]	0.055 [0.171]	- 0.033*** [0.006]	0.031 [0.243]	-0.001 (-0.932)	15.109*** [0.000]	6.293*** [0.000]	3.893** [0.049]
Δ IND(1)	0.055*** [0.005]	-0.053*** [0.006]		0.065*** [0.001]	0.015 [0.334]	-0.009 [0.436]	0.081*** [0.002]	0.014 [0.562]	0.008 [0.829]	-0.013 [0.227]	0.075*** [0.001]	-0.021*** (-5.641)	0.363 [0.547]	10.751*** [0.000]	0.004 [0.951]
Δ BRA(1)	0.004 [0.885]	0.022 [0.427]	0.006 [0.846]		0.022 [0.296]	0.015 [0.370]	0.029 [0.429]	-0.024 [0.504]	0.015 [0.769]	-0.016 [0.284]	-0.031 [0.345]	-0.004** (-1.980)	4.998** [0.026]	5.681*** [0.000]	1.074 [0.300]
Δ ARG(1)	0.026 [0.389]	-0.015 [0.624]	0.001 [0.998]	0.044 [0.157]		0.028 [0.131]	0.081** [0.042]	-0.034 [0.380]	-0.008 [0.887]	0.003 [0.868]	-0.034 [0.342]	-0.002 (-1.428)	0.322 [0.571]	1.357 [0.180]	0.012 [0.914]
Δ RUS(1)	0.096** [0.010]	-0.092** [0.011]	-0.036 [0.371]	0.105*** [0.005]	0.071** [0.012]		0.080* [0.096]	-0.042 [0.365]	0.134** [0.043]	-0.045** [0.024]	-0.027 [0.536]	0.001** (2.003)	4.769** [0.029]	10.287*** [0.000]	0.429 [0.512]
Δ MEX(1)	0.018 [0.408]	0.001 [1.000]	-0.005 [0.830]	0.014 [0.527]	0.032* [0.050]	0.013 [0.336]		-0.038 [0.154]	0.028 [0.456]	-0.005 [0.632]	-0.016 [0.519]	-0.001 (-0.875)	0.923 [0.337]	5.631*** [0.000]	0.230 [0.632]
Δ SAF(1)	0.013 [0.489]	-0.024 [0.185]	-0.004 [0.842]	0.055*** [0.003]	0.045*** [0.002]	0.001 [0.917]	0.187 [0.917]		0.050 [0.132]	0.050 [0.358]	0.050 [0.408]	-0.002 (-0.690)	1.044 [0.307]	7.801*** [0.000]	0.140 [0.708]
Δ CHI(1)	-0.008 [0.549]	0.025* [0.069]	-0.010 [0.506]	-0.001 [0.934]	0.034*** [0.002]	0.004 [0.638]	0.055*** [0.003]	-0.033* [0.065]		-0.004 [0.555]	-0.014 [0.388]	-0.001** (-2.560)	0.135 [0.714]	3.935*** [0.000]	1.301 [0.254]
Δ TUR(1)	0.028 [0.496]	-0.019 [0.644]	0.002 [0.956]	0.079* [0.056]	0.022 [0.487]	-0.022 [0.393]	0.164*** [0.002]	-0.051 [0.327]	0.111 [0.132]		0.145*** [0.003]	0.001 (-0.215)	1.765 [0.184]	6.122*** [0.000]	0.689 [0.407]
Δ ISR(1)	0.018 [0.345]	-0.042** [0.026]	0.027 [0.194]	0.030 [0.123]	0.018 [0.236]	-0.003 [0.774]	0.113*** [0.000]	-0.040 [0.100]	0.010 [0.770]	-0.005 [0.661]		-0.002** (-2.520)	2.258 [0.133]	5.143*** [0.000]	2.000 [0.158]

Having provided an insight into short-run and long-run causality between Malaysia and the developed markets in the analysis, we now proceed to the multivariate analysis of the Malaysian market and the developing markets. Similar to the analysis of Malaysia and the developed markets, the existence of cointegration between the stock markets of the developing markets and the Malaysian market rejects non-causality among them. This implies that at least one of the markets reacted to deviations from the long-run relationship. The results from the VECM provide information on both short and long relationships among the markets during the overall, pre-crisis, crisis and post crisis periods and these are reported in Tables 4.17, 4.18, 4.19, and 4.20, respectively. We note that at least one channel of Granger causality is active, either in the short-run through joint test of lagged differences or statistically significant error correction terms. The interpretation arising from this finding is that when there is a deviation from equilibrium cointegrating relationship, as measured by the ECTs, it is mainly the changes in these variables that adjust to clear the disequilibrium.

During the overall period (Table 4.17), there seems to be a bidirectional relationship running from India and China, Mexico and China, South Africa and Argentina, South Africa and Mexico and Israel and South Africa. From this model, we identified that the Malaysian market is found to be the only market affected by Mexico and Israel. The Malaysian market is independent from China, India, Brazil, Argentina, Russia, South Africa, Chile and Turkey. There seems to be no bidirectional causalities running from Malaysia with other developing markets. For the China market, only Malaysia, India, Brazil, Mexico and Turkey are found to Granger cause this market. Moreover, India is independent from Malaysia, Argentina, Russia, South Africa, Chile and Turkey. Furthermore, all developing markets, including Malaysia, are not Granger caused by the Russian markets. Another interesting point is that with the exception of the ECTs for the Malaysia, China, Argentina, Mexico, South Africa, Turkey and Israel equations, India, Brazil, Russia and Chile, the

ECTs in the system are significant, implying that the burden of short-term adjustment to long-term equilibrium relationships are borne by these significant ECTs stock markets. However, although the ECTs are significant in the India, Brazil, Russia and Chile equations, according to Masih and Masih (1999), one cannot assume that these markets are non-causal since the short-run channels are still active.

Furthermore, during the pre-crisis (Table 4.18), the model possesses at least one active channel of causality, either the short-run through joint test of lagged differences or a statistically significant ECT. A number of general conclusions can be drawn pertaining to the short-run causal influences: the Malaysian market is independent of the markets of India, Argentina, Russia, Chile, Turkey and Israel. Furthermore, all developing markets are not Granger caused by the markets of Malaysia, India, Argentina, Russia or the Chile. The Mexican market is independent from all developing markets. Only one bidirectional relationships exists, which is between Israel and China. Another interesting point is that with the exception of ECTs for the India, Argentina, Mexico, South Africa, Chile and Israel equations, all markets in the system are significant, implying that the burden of short-term adjustment to long-term equilibrium relationships are borne by these significant ECTs stock markets.

Meanwhile, there are a number of general findings of the short-run causal influences during the crisis period (Table 4.19) that can be summarized here: the Malaysian stock market is independent of all markets but has unidirectional causal linkages with Israel. Furthermore, none of the developing markets are Granger caused by the Indian or Chilean markets. There are bidirectional relationships in the model, which are between Argentina and China, Russia and China, Mexico and China, Israel and China and South Africa and China. The ECTs of all markets are significant except for the Malaysian market. There are unidirectional relationships between the developing markets.

Unlike in the crisis period there are a couple of bidirectional relationships and there only seems to be one bidirectional relationship between the developing markets during the post crisis period (Table 4.20), which is between Mexico and Argentina. From these models, we identified that the Malaysian market is only affected by Mexico. Another interesting finding is that the ECTs for the equations of India, Brazil, Russia, Chile and Israel are statistically significant while all the other markets are insignificant.

Taking into account all periods, pre crisis, crisis and post crisis, there are some general findings of the short-run and long-run causal influences that can be summarized here are: the Malaysian market is independent of the Indian, Argentinean, Russian, Chilean and Turkish markets during all periods. There are no bidirectional relationships between the Malaysian markets and other developing countries for all periods under investigation. The ECTs for the equations of the Malaysian markets are statistically insignificant during the overall period, crisis and post crisis. However, the ECTs of many developing market equations were significant during the crisis period. During the overall crisis period and post crisis period the Brazilian market was very independent from the rest of the markets. During the pre crisis period, the markets of China, India, Brazil, Argentina, Russia, Mexico and Chile were very independent as the markets have only one unidirectional relationship compared to the post crisis period.

The overall performance of our estimated models seems to be acceptable. Almost all ECTs' coefficients are found with the expected negative signs, implying that in the long-run, stock markets have a tendency to return to their equilibrium relationships. Although the R^2 values are relatively low, they are still regarded as acceptable given that the estimates are based on first difference values. These low R^2 findings are similar to Majid et al. (2009), Majid et al. (2008), and Yusof and Majid (2006).

In conclusion, based on the earlier diagnostic test, we can conclude that the performance of our estimated models is satisfactory for providing information pertaining to the issue of market integration among the developed markets and Malaysian markets.

Null Hypothesis 3c($H_0$3c)

There is no long-run dynamic relationship between the Malaysian financial market and the developed and developing financial markets during the pre crisis, crisis and post crisis periods.

After diagnosing the results based on Tables 4.13 – 4.20, it was found that there is a long-run dynamic relationship between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis periods. Therefore, the null hypotheses 3c can be rejected.

Table 4.21 Variance Decomposition of Malaysian and Developed Markets.

Sub Period: Overall											
Model 1: USA,JPN,UK,FRN,HKG,GER,CAN, SWZ,AUS,SPN,MAL											
Period	DLUSA	DLJPN	DLUK	DLFRN	DLHKG	DLGER	DLCAN	DLSWZ	DLAUS	DLSPN	DLMAL
1	0.772	1.234	0.040	0.021	3.981	0.013	0.114	0.013	0.008	0.114	93.689
2	1.935	1.482	0.238	0.193	3.958	0.098	0.405	0.196	0.260	0.129	91.106
3	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.045
4	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
5	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
6	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
7	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
8	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
9	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044
10	1.983	1.482	0.240	0.193	3.955	0.105	0.405	0.201	0.261	0.130	91.044

Table 4.22 Variance Decomposition of Malaysian and Developed Markets

Sub Period: Pre Crisis											
Model 1: USA,JPN,UK,FRN,HKG,GER,CAN, SWZ,AUS,SPN,MAL											
Period	DLUSA	DLJPN	DLUK	DLFRN	DLHKG	DLGER	DLCAN	DLSWZ	DLAUS	DLSPN	DLMAL
1	0.329	0.163	1.595	0.346	1.512	2.420	1.442	0.221	0.846	0.028	91.099
2	6.443	0.149	1.658	0.892	1.522	2.200	3.538	0.270	1.014	0.070	82.245
3	6.598	0.159	1.649	1.002	1.541	2.209	3.702	0.278	1.096	0.090	81.675
4	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.090	81.652
5	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.091	81.650
6	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.092	81.650
7	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.092	81.650
8	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.092	81.650
9	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.092	81.650
10	6.597	0.160	1.658	1.008	1.541	2.209	3.706	0.284	1.096	0.092	81.650

Table 4.23 Variance Decomposition of Malaysian and Developed Markets

Sub Period: Crisis											
Model 1: USA,JPN,UK,FRN,HKG,GER,CAN, SWZ,AUS,SPN,MAL											
Period	DLUSA	DLJPN	DLUK	DLFRN	DLHKG	DLGER	DLCAN	DLSWZ	DLAUS	DLSPN	DLMAL
1	6.918	0.686	0.288	0.072	11.992	0.212	0.151	0.194	0.533	0.446	78.510
2	6.739	1.121	0.343	2.324	13.177	0.198	0.645	0.600	0.636	0.575	73.640
3	6.870	1.124	0.342	2.334	13.179	0.216	0.644	0.641	0.666	0.590	73.394
4	6.868	1.124	0.346	2.337	13.180	0.216	0.645	0.647	0.670	0.592	73.376
5	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375
6	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375
7	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375
8	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375
9	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375
10	6.868	1.124	0.346	2.337	13.179	0.216	0.645	0.647	0.670	0.592	73.375

Table 4.24 Variance Decomposition of Malaysian and Developed Markets

Sub Period: Post Crisis											
Model 1: USA,JPN,UK,FRN,HKG,GER,CAN, SWZ,AUS,SPN,MAL											
Period	DLUSA	DLJPN	DLUK	DLFRN	DLHKG	DLGER	DLCAN	DLSWZ	DLAUS	DLSPN	DLMAL
1	0.020	2.235	0.585	0.079	2.911	0.001	0.176	0.212	0.129	0.019	93.632
2	2.834	2.232	0.672	0.969	2.768	0.014	0.746	0.239	0.279	0.049	89.196
3	2.878	2.230	0.676	0.969	2.773	0.016	0.751	0.250	0.279	0.049	89.129
4	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
5	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
6	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
7	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
8	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
9	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128
10	2.879	2.230	0.676	0.969	2.773	0.016	0.751	0.251	0.279	0.049	89.128

Accordingly, our objective is also to examine the relative strength of each variable in explaining the changes in the dependent variable. Here, we implement an unrestricted VAR model. From the model, we generate variance decomposition (VDCs) and impulse response functions (IRFs) to capture the relative importance of various shocks and their influences on our variable of interest. The ordering that we have chosen is US, JPN, UK, FRN, HKG, GER, CAN, SWZ, AUS, SPN, MAL. This is based on the economy and market capitalization of each country. For robustness checks, we reverse the order. Finally, we employ the generalized impulses, which depend on the VAR ordering.

Tables 4.21, 4.22, 4.23 and 4.24 provide variance decomposition for the horizon of 1-10 days for the overall period, pre-crisis period, crisis period and post crisis period, respectively. As may be noted from these variance decompositions, we can then conclude that the variations in the Malaysian market responded more to shocks in the US, Japan and Hong Kong during the overall period, crisis period and post crisis period accounting for about 1-13 per cent of the Malaysian market forecast error variance after 10 days. This finding implies that the opportunities of gaining abnormal profit through investment diversification in the crisis and post crisis periods in these markets would diminish as the markets moved towards a greater integration. However, in the pre-crisis period the variations in the Malaysian market responded more to shocks in the US, UK and Germany accounting for about 1.6-6.5 per cent of the Malaysian market forecast error variance after 10 days.

Our study seems to be consistent with Daly (2003). Daly (2003) asserts that there is little evidence of integration of south-East Asian stock markets, namely, Indonesia, Malaysia, the Philippines, Singapore, Thailand with the advanced stock markets of

Australia, Germany and the US for the period of 1990 to 2001, which covers the periods both before and after the 1997 financial crisis. However, they reveal that whilst there is some evidence of long-run integration between the South-East Asian markets, the level of integration appears to be slightly stronger in the post crisis period. The evidence of Daly (2003), to some extent, is in line with our finding. As the Malaysian stock market goes to a greater integration, especially with the US and Japan, this implies that the two markets simultaneously adjust to new information, thereby eliminating any opportunities of gaining abnormal profits associated with lagged information processing. Our findings are also similar to Cha and Sekyung (2000).

Furthermore, Sheng and Tu (2000) provide another dimension in examining the existence of cointegration relationships amongst the national stock indices of the US, Japan, Singapore, Australia, Korea, Taiwan, Malaysia, the Philippines, Thailand, Indonesia and China. By employing the variance decomposition technique, the study found that the degree of exogeneity for all countries indices has been reduced, implying that no countries were exogenous to the financial crisis. Finally, based on the Granger causality test, the US market was observed to still influence the Malaysian stock market (around 4 per cent) during the period of crisis, reflecting that the US market has a persistent dominant role.

Table 4.25 Variance Decomposition of Malaysian and Developing Markets

Sub period: overall											
Order 1: CHN,IND,BRA,ARG,RUS,MEX,SAF,MAL,CHI,TUR,ISR											
Period	DLCHN	DLIND	DLBRA	DLARG	DLRUS	DLMEX	DLSAF	DLMAL	DLCHI	DLTUR	DLISR
1	3.609	0.000	0.028	0.000	0.682	0.003	0.044	95.634	0.000	0.000	0.000
2	3.564	0.004	0.511	0.003	0.680	1.012	0.068	94.019	0.028	0.000	0.110
3	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.000	0.112
4	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
5	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
6	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
7	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
8	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
9	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112
10	3.565	0.004	0.512	0.004	0.680	1.012	0.071	94.012	0.029	0.001	0.112

Table 4.26 Variance Decomposition of Malaysian and Developing Markets

Sub period: Pre crisis											
Order 1: CHN,IND,BRA,ARG,RUS,MEX,SAF,MAL,CHI,TUR,ISR											
Period	DLCHN	DLIND	DLBRA	DLARG	DLRUS	DLMEX	DLSAF	DLMAL	DLCHI	DLTUR	DLISR
1	0.679	0.514	0.087	0.278	0.782	1.473	1.109	95.077	0.000	0.000	0.000
2	2.091	1.372	2.268	0.311	0.905	2.722	1.696	88.348	0.001	0.271	0.014
3	2.159	1.401	2.257	0.380	0.929	2.944	1.711	87.914	0.002	0.271	0.033
4	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.887	0.002	0.272	0.039
5	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040
6	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040
7	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040
8	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040
9	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040
10	2.164	1.402	2.259	0.385	0.931	2.950	1.711	87.885	0.002	0.272	0.040

Table 4.27 Variance Decomposition of Malaysia and Developing Markets

Sub period: Crisis											
Order 1: CHN,IND,BRA,ARG,RUS,MEX,SAF,MAL,CHI,TUR,ISR											
Period	DLCHN	DLIND	DLBRA	DLARG	DLRUS	DLMEX	DLSAF	DLMAL	DLCHI	DLTUR	DLISR
1	0.545	2.999	0.087	0.665	1.256	0.004	1.893	92.549	0.000	0.000	0.000
2	0.519	3.623	0.331	1.096	1.264	0.154	2.081	88.150	0.480	0.123	2.178
3	0.517	3.639	0.472	1.165	1.283	0.272	2.114	87.718	0.479	0.159	2.181
4	0.523	3.638	0.472	1.165	1.283	0.282	2.115	87.696	0.479	0.165	2.181
5	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.694	0.479	0.165	2.182
6	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.693	0.479	0.165	2.182
7	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.693	0.479	0.165	2.182
8	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.693	0.479	0.165	2.182
9	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.693	0.479	0.165	2.182
10	0.524	3.638	0.472	1.165	1.283	0.283	2.115	87.693	0.479	0.165	2.182

Table 4.28 Variance Decomposition of Malaysian and Developing Markets

Sub period: post Crisis											
Order 1: CHN,IND,BRA,ARG,RUS,MEX,SAF,MAL,CHI,TUR,ISR											
	DLCHN	DLIND	DLBRA	DLARG	DLRUS	DLMEX	DLSAF	DLMAL	DLCHI	DLTUR	DLISR
1	5.130	0.210	0.000	0.054	0.812	0.019	0.489	93.286	0.000	0.000	0.000
2	5.036	0.244	0.645	0.054	0.844	1.402	0.481	91.283	0.005	0.006	0.000
3	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
4	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
5	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
6	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
7	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
8	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
9	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000
10	5.034	0.244	0.663	0.062	0.844	1.411	0.483	91.247	0.006	0.006	0.000

Tables 4.25 - 4.28 provide variance decomposition for the horizon of 1-10 days of overall period, pre-crisis period, crisis period and post crisis period, respectively, for Malaysia and the developing markets. The ordering that we have chosen are China, India, Brazil, Argentina, Russia, Mexico, South Africa, Malaysia, Chile, Turkey and Israel. Similar to the above analysis, this order is based on the economy and market capitalization of each country. It is compelling to note that the findings on the variations in the Malaysian market response to shocks in the developing markets are mixed. During the overall period and post crisis period, China, Russia and Mexico account for about 0.68-5.0 per cent of the Malaysian market forecast error variance after 10 days. Whereas, during the pre-crisis period, the variations in the Malaysian market response to shocks in Mexico, Brazil and China account for about 2.0-2.9 per cent of the Malaysian market forecast error variance after 10 days. Furthermore in the crisis period, Russia, South Africa and India respond to the Malaysian market by about 1.2 – 3.6 per cent. As may be noted from these variance decompositions, we can then conclude that variations in the Malaysian market respond more to shocks in India during the crisis period and China during the post crisis period. This finding implies that the opportunities of gaining abnormal profit through investment diversification in the crisis and post crisis period in these markets are going to diminish as the markets are becoming more integrated.

Null Hypothesis 3d($H_0$3d)

There was no difference in the strength of the linkages between the Malaysian stock market and the developed and developing countries during the pre crisis, crisis and post crisis periods.

In addition, the study intends to look at the relative strength of each variable in explaining the changes in the dependent variable. The results, as presented in Tables 4.21-4.28, show that there is a difference in the strength of the linkages between the Malaysian stock market with the developed and developing countries during the pre crisis, crisis and post crisis periods, thus, the null hypothesis 3d can be rejected.

We further generate the impulse response functions (IRFs) to complement our analysis based on the variance decomposition described above. Impulse Response Functions (IRFs) are one of the useful tools of the VAR approach for examining the interaction between the variables in this study. They reflect how individual variables respond to shocks from other variables in the system. When graphically presented, the IRFs give a visual representation of the behaviour of variables in the response to shocks.

Figures 4.2 to 4.5 and 4.6 to 4.9 show the estimated impulse response between the Malaysian and the developed markets and the Malaysian and developing markets, respectively. Responses are shown over ten days on the horizontal axis. The vertical axis provides the scale of the response of each individual market in the same units of measure used for the variables. The graphs provide a visual representation of responses, where an increasing graph shows positive responses and a decreasing graph reflects negative responses.

We further generate the impulse response functions (IRS) to observe our analysis based on the variance decompositions described above. In general, the overall results seem to be consistent with our earlier findings. Accordingly, we present our results based on the order as we used in variance decomposition. Generally, for both the Cholesky and generalized impulse orderings, our findings from Figures 4.1 to 4.4 and 4.5 to 4.8 appear to reaffirm our previous findings.

Figure 4.2, gives the impulse responses of the Malaysian market from each of the ten developed markets during the overall period. The Malaysian market responded positively to its own shocks. Initially, the Malaysian market responded negatively, but in the long-term responded positively to the UK, Switzerland and Australia. Hong Kong was consistently positive, while the US and Japan response fluctuated but were positive in the long-term. The Malaysian market responded positively to the markets of France, Germany, Canada and Spain. We found the lag was generally between 2-3 days for the Malaysian market to shocks in all developed markets, which gradually subsided after a period of between 4 to 5 days.

Figure 4.3, reflects the impulse responses of the Malaysian market from each of the ten developed markets during the pre crisis period with the positive response to the Malaysian market itself. The Malaysian market initially responded negatively to the markets of France and Spain, however, the long-term response was positive, although relatively small. The Malaysian market responded to both markets positively up to period two, however, responses from period two were negative and gradually subsided after a period of between 4-5 days. The Malaysian market initially responded positively to the US, Japan, UK, Hong Kong, Germany, Canada and Switzerland shocks, however, gradually subsiding after the period of between 2-3 days. The Malaysian market responded positively to the Australian market up to period two, however, responses from period two to four were negative and subsided after period four.

The responses of the Malaysian market to the developed markets shocks during crisis period are shown in Figure 4.4. The Malaysian market responded positively to its own innovations. There was a negative response by the Malaysian market to the US and Germany shocks for periods one to four, and gradually subsiding after period four. The Malaysian market only responded positively to the Hong Kong market and subsided after period three. The Malaysian market responses fluctuated to Japan, France, Canada, Switzerland and Australia; on average, the response was negative over the short period. The Malaysian market initially responded negatively to the markets of the UK and Spain, however, the long-term responses were positive, although relatively small and gradually subsided after a period of between 2-3 days.

Figure 4.5 shows the response of the Malaysian market to innovations from the developed market for the post crisis period. The Malaysian market shocks resulted in positive responses from itself. Overall, the Malaysian market responded positively to all the developed markets with the exception of the Australian market, to which the Malaysian market responded negatively for the first two periods. Meanwhile, there was only a slight response of the Malaysian market to the shocks of Germany, Switzerland and Spain.

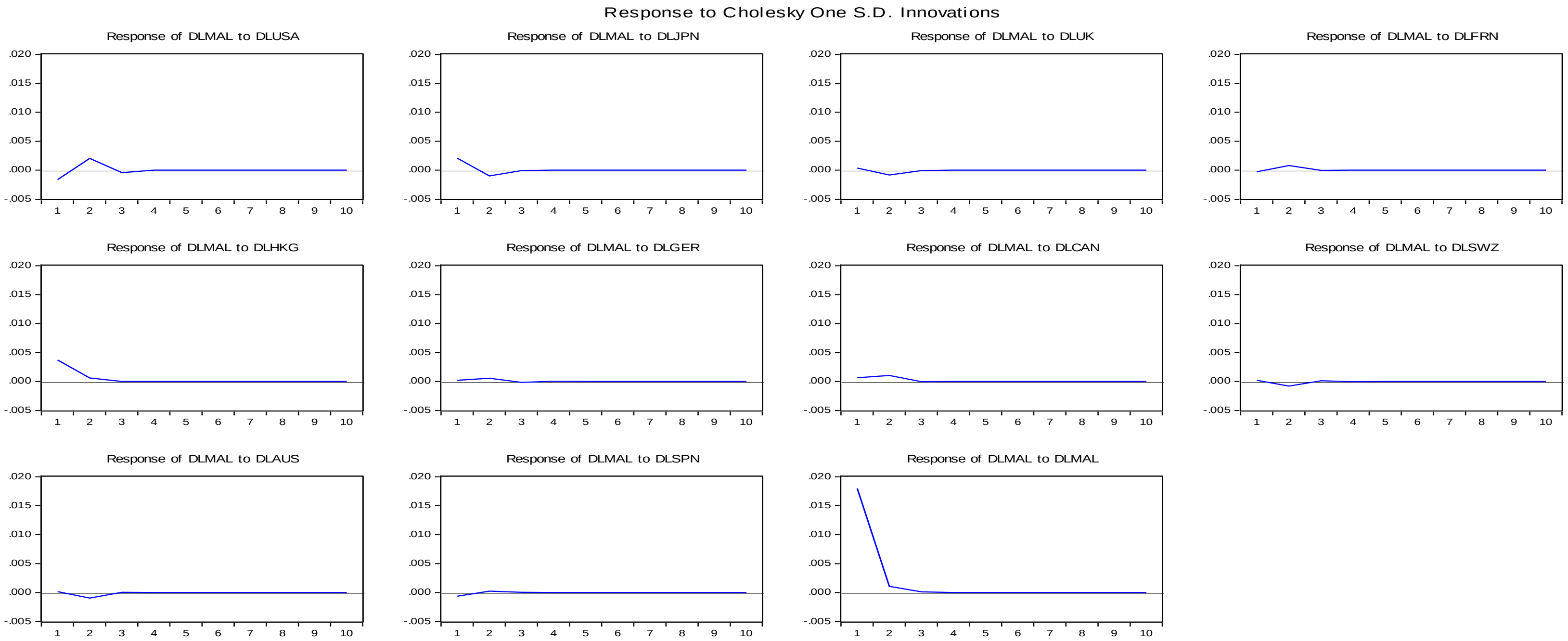

Figure 4.2 Response to Cholesky: Malaysian and developed markets
Sub period: Overall

(Order: US, Japan, UK, France, Hong Kong, Germany, Canada, Switzerland, Australia, Spain, Malaysia)

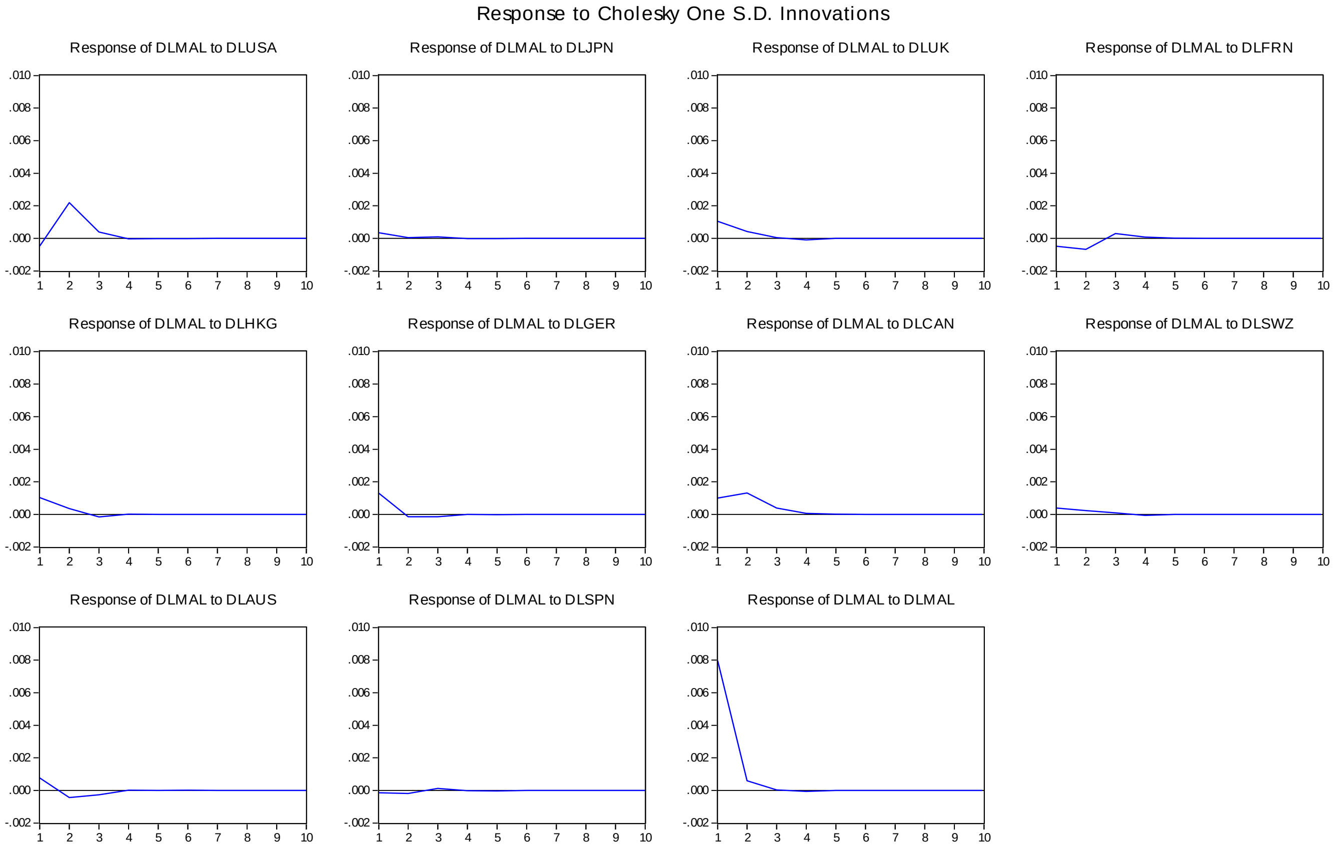

Figure 4.3 Response to Cholesky: Malaysian and developed markets

Sub period: Pre-crisis

(Order: US, Japan, UK, France, Hong Kong, Germany, Canada, Switzerland, Australia, Spain, Malaysia)

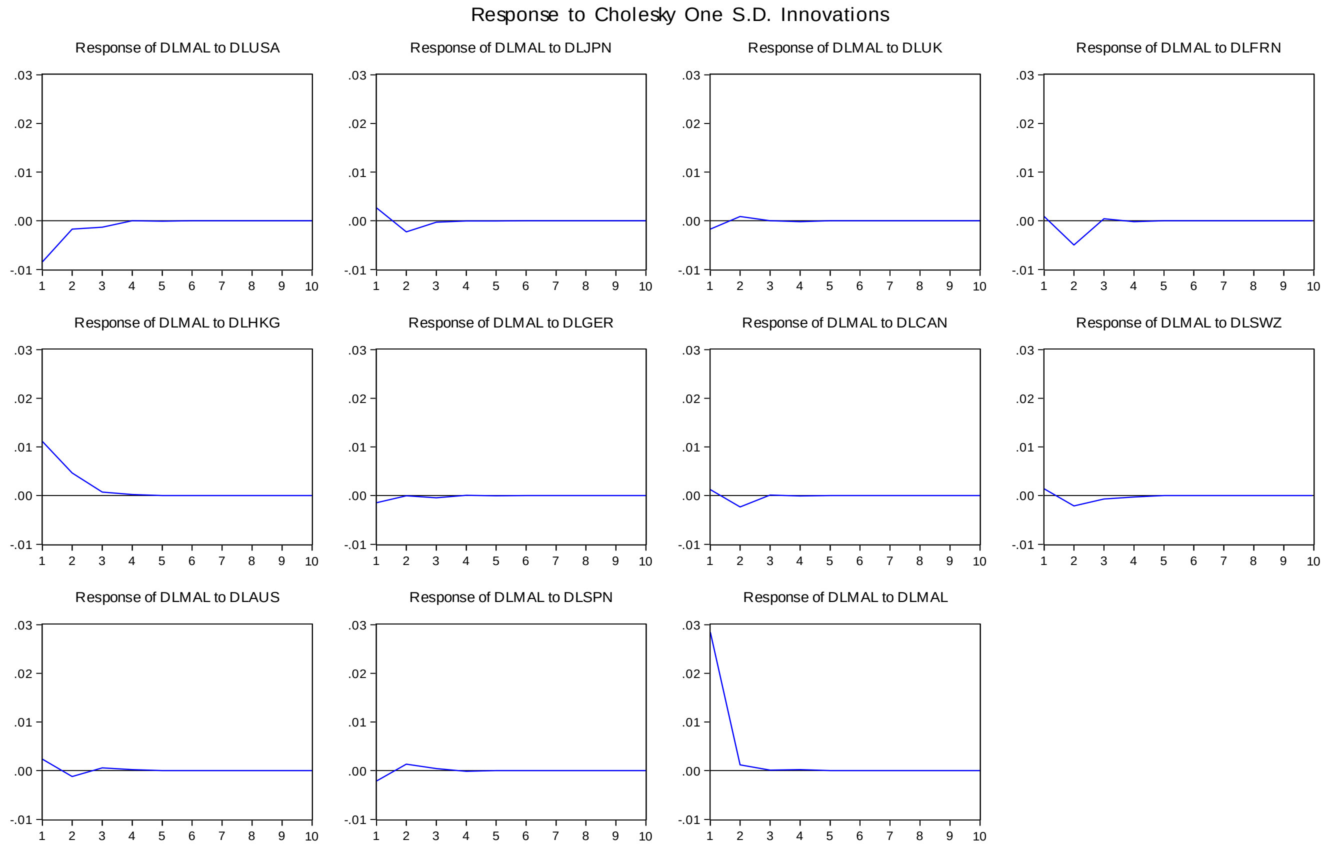

Figure 4.4 Response to Cholesky: Malaysia and developed markets

Sub period: crisis

(Order: US, Japan, UK, France, Hong Kong, Germany, Canada, Switzerland, Australia, Spain, Malaysia)

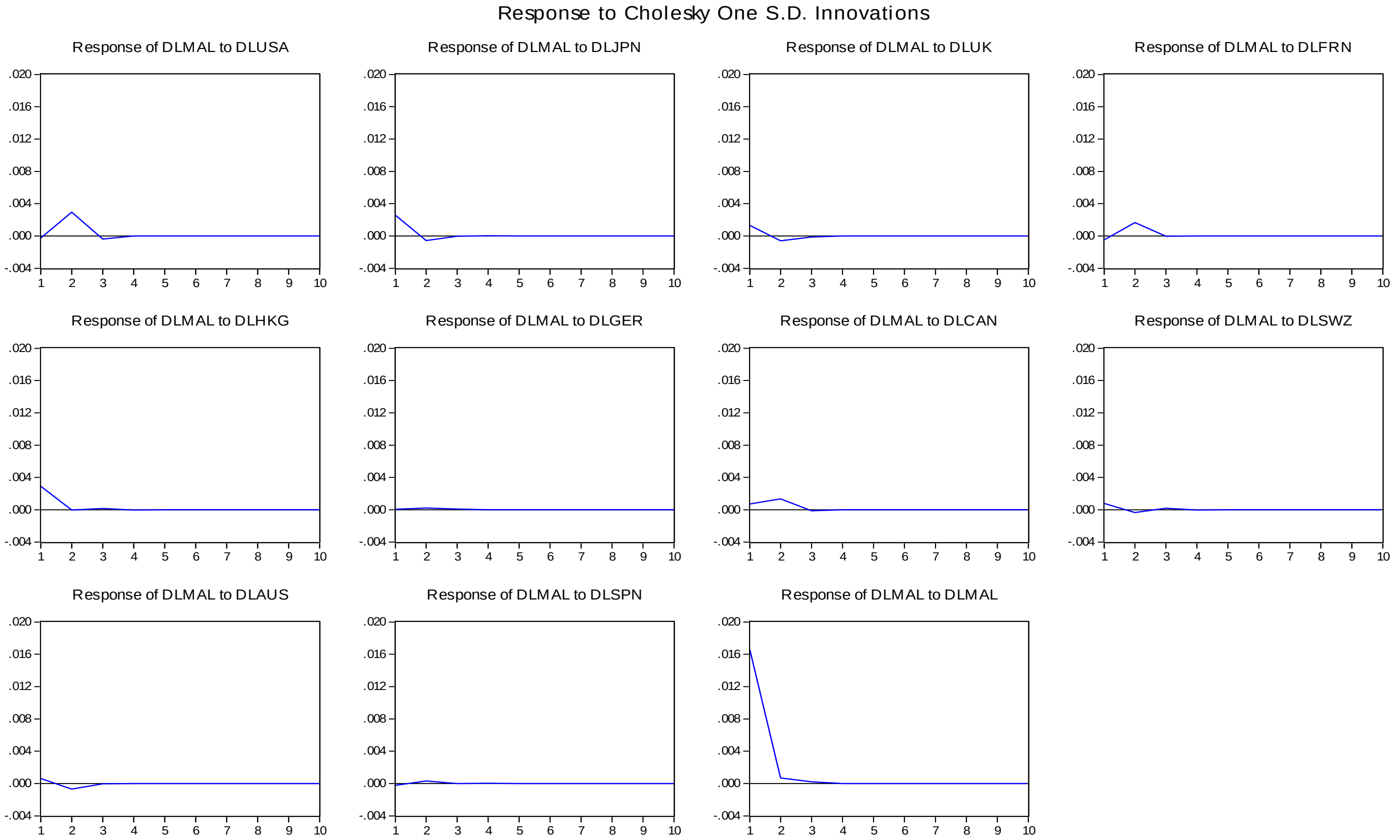

Figure 4.5 Response to Cholesky: Malaysia and developed markets

Sub period: Post crisis

(Order: US, Japan, UK, France, Hong Kong, Germany, Canada, Switzerland, Australia, Spain, Malaysia)

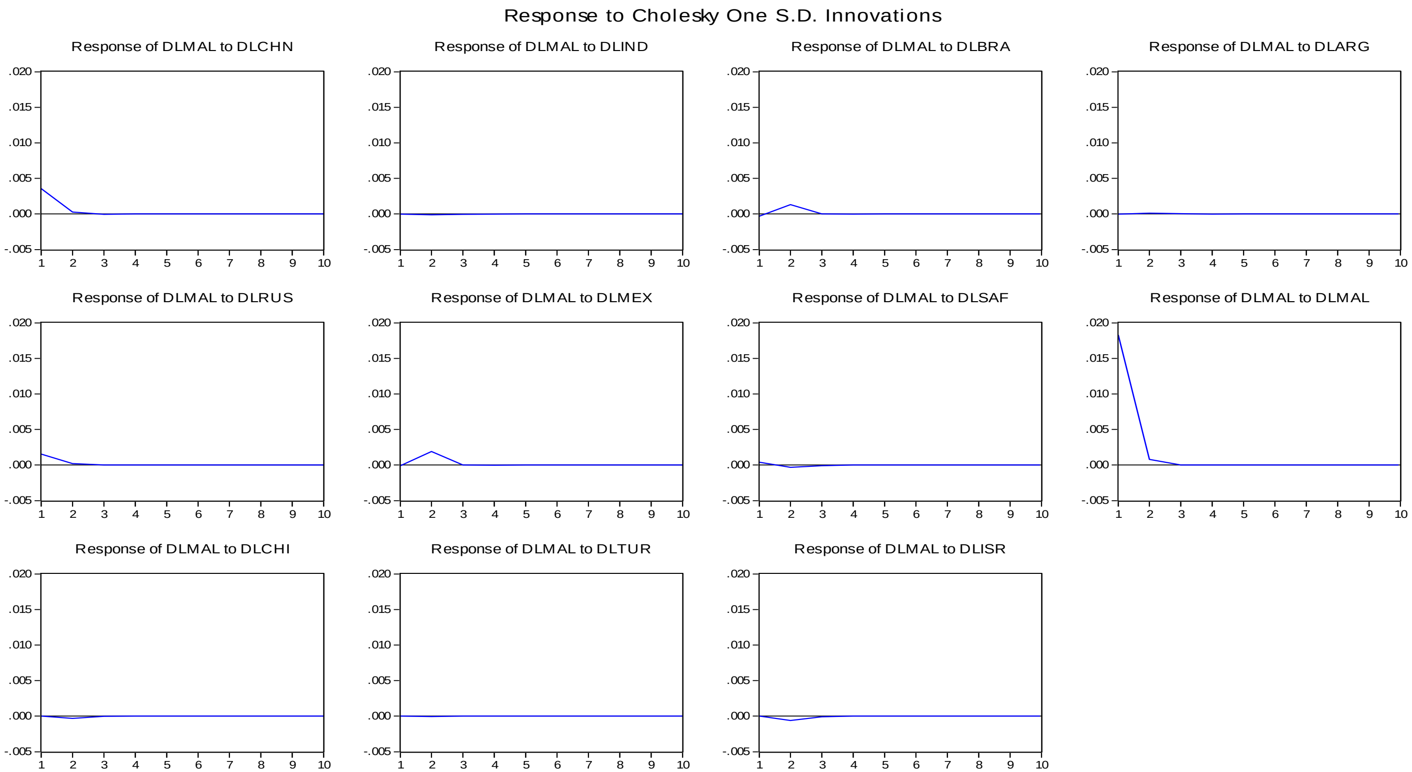

Figure 4.6 Response to Cholesky: Malaysia and developing markets
Sub period: Overall

(Order: China, India, Brazil, Argentina, Russia, Mexico, South Africa, Malaysia, Chile, Turkey, Israel)

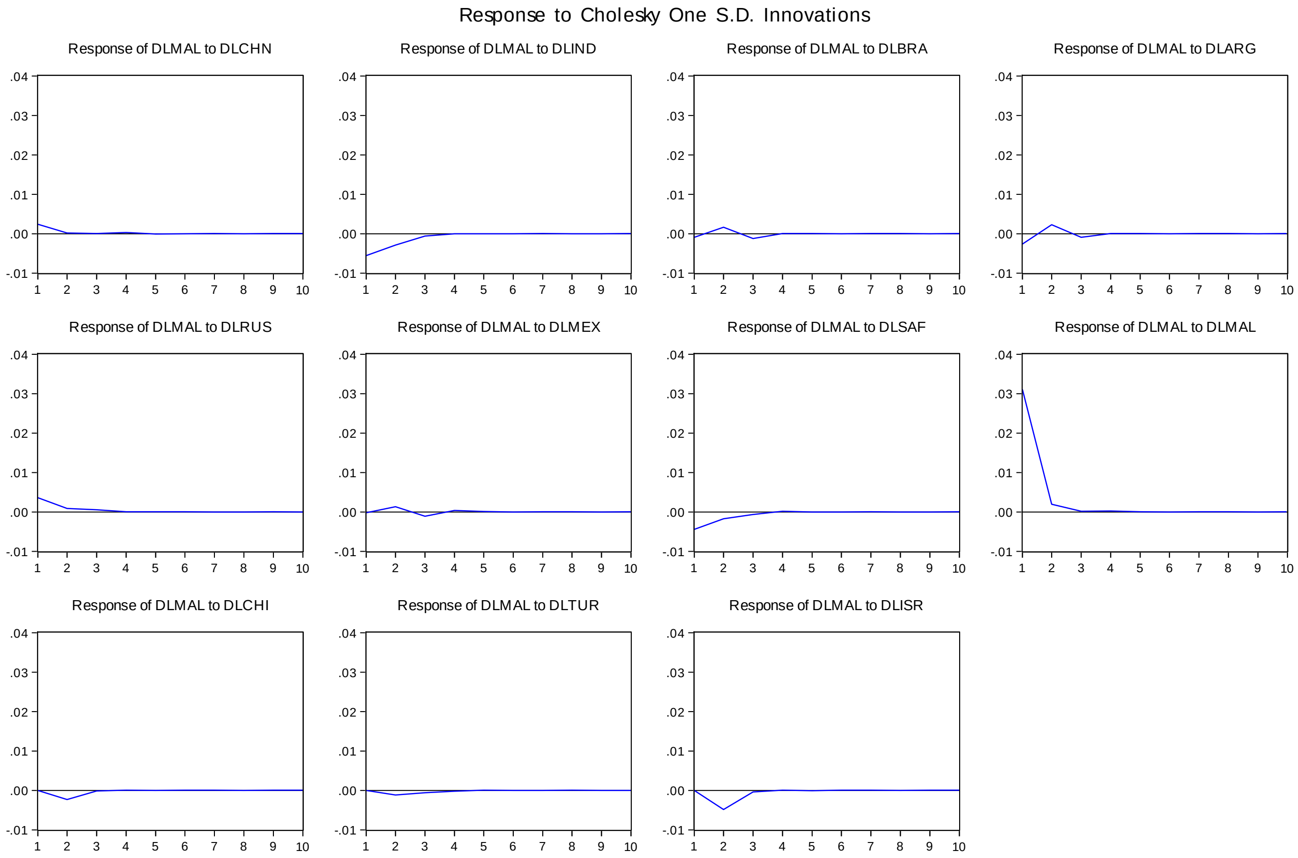

Figure 4.7 Response to Cholesky: Malaysian and developing markets

Sub period: Pre-crisis

(Order: China, India, Brazil, Argentina, Russia, Mexico, South Africa, Malaysia, Chile, Turkey, Israel)

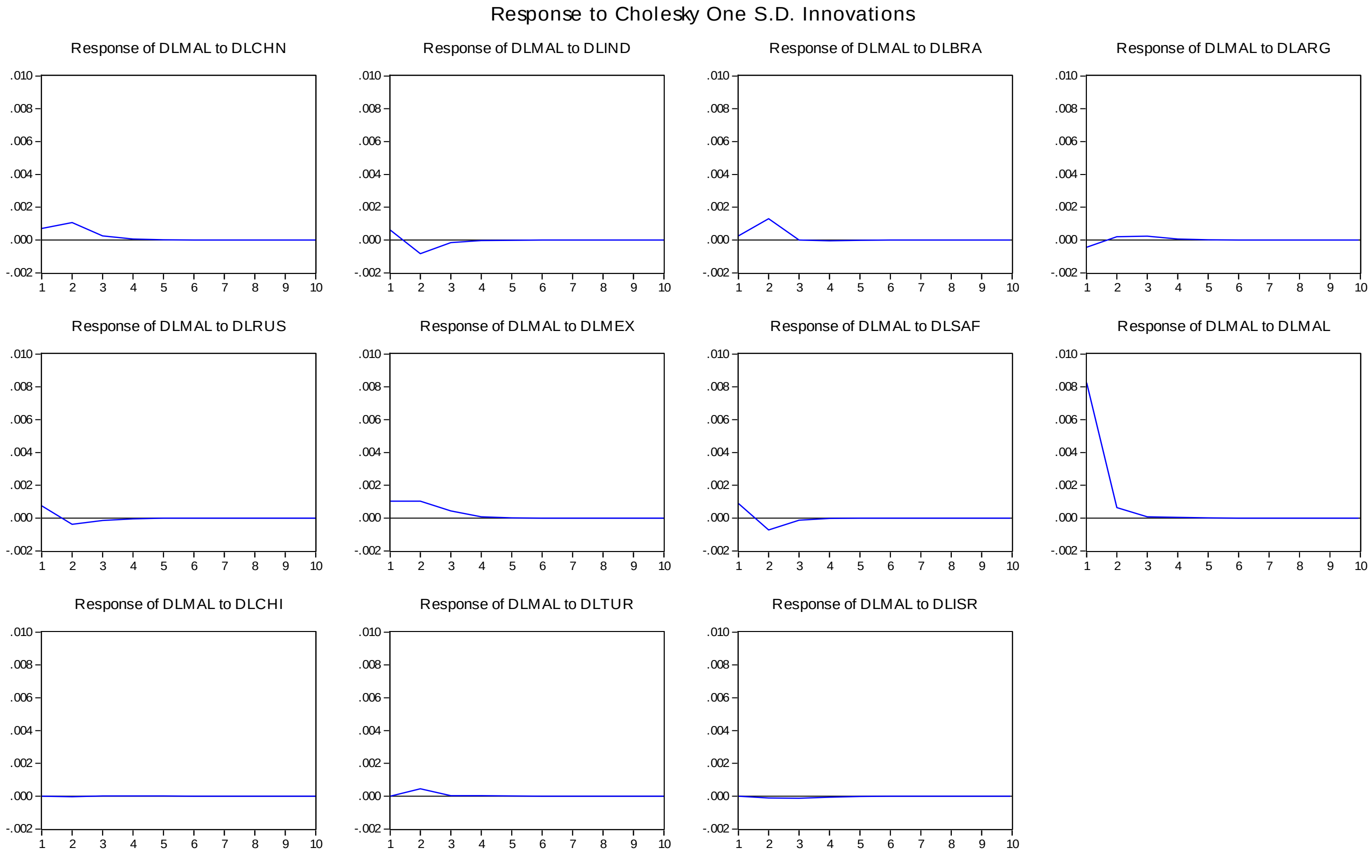

Figure 4.8 Response to Cholesky: Malaysian and developing markets

Sub period: Crisis period

Order: China, India, Brazil, Argentina, Russia, Mexico, South Africa, Malaysia, Chile, Turkey, Israel)

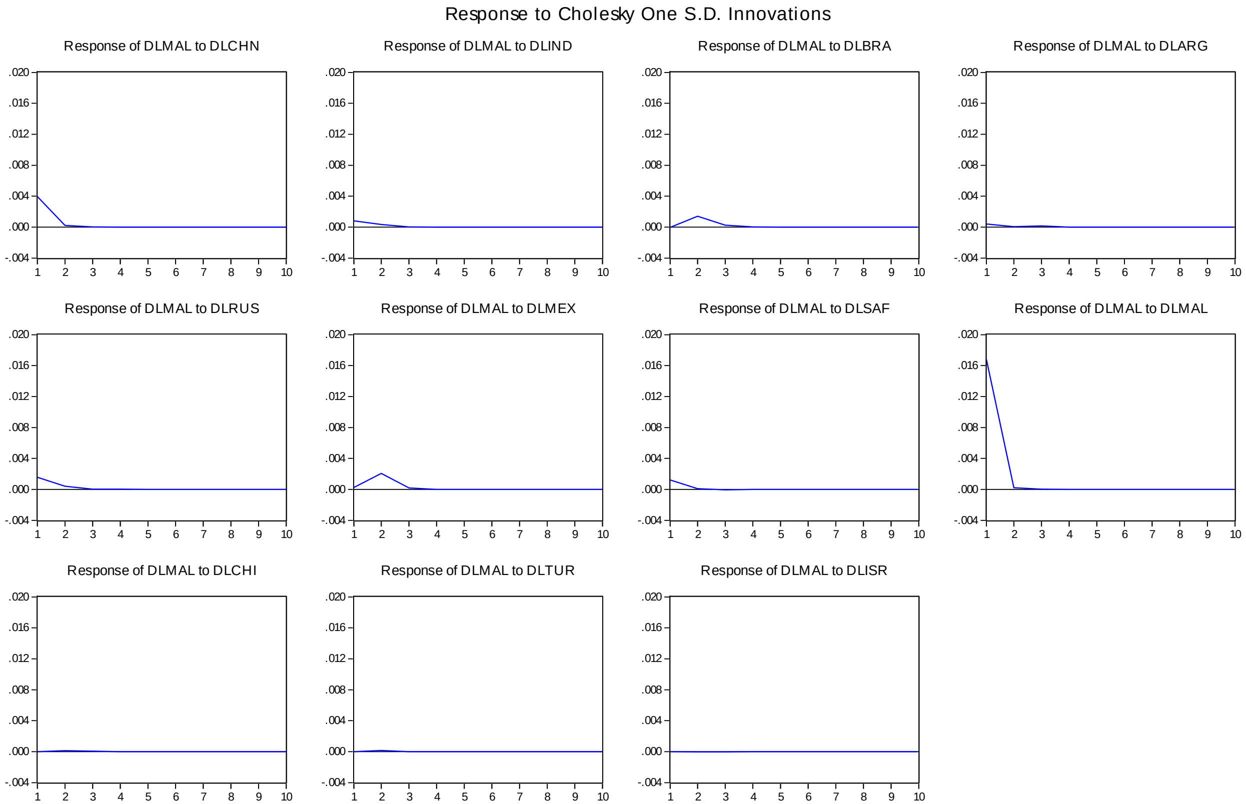

Figure 4.9 Response to Cholesky: Malaysian and developing markets

Sub period: Post Crisis

(Order: China, India, Brazil, Argentina, Russia, Mexico, South Africa, Malaysia, Chile, Turkey, Israel)

Figure 4.6, gives the impulse responses of the Malaysian market from each of the ten developing markets during the overall period. The Malaysian market responded positively to its own shocks. The Malaysian market responded positively to the markets of China, Brazil, Russia and Mexico and gradually subsided after a period of 2-3 days. Furthermore, there was only a slight response of the Malaysian market to India, Argentina, South Africa, Chile, Turkey and Israel shocks. Figure 4.7, reflects the impulse responses of the Malaysian market from each of the ten developing markets during the pre crisis period with the positive response to the Malaysian market itself. The Malaysian market initially responded positively to the markets of China, Brazil, Mexico and Turkey, however, it was a short-term response and relatively small. The Malaysian market responded to these markets positively up to period two, however, it gradually subsided after a period of 3-4 days. The Malaysian market responded negatively to the Australian market up to period two, however, responses from periods two to four were positive and subsided after period four. The Malaysian market responses fluctuated to India, Russia and South Africa, on average, the response was negative over the short period and subsided after a period of 2-3 days. Meanwhile, the Malaysian market did not respond to the shocks to Chile and Israel.

The responses of the Malaysian market to shocks in the developing markets during the crisis period are shown in Figure 4.8. The Malaysian market responded positively to its own innovations. There was a negative response by the Malaysian market to the shocks in India, South Africa, Chile, Turkey and Israel for periods one to four, which gradually subsided after period three. The Malaysian market only responded positively to Chinese and Russian markets and subsided after period two. The Malaysian market responses fluctuated to Brazil, Argentina and Mexico.

Figure 4.9 shows the response of the Malaysian market to innovations from developing markets for the post crisis period. The Malaysian market shocks resulted in positive responses from itself. Overall the Malaysian market responded positively to all developing markets especially to the markets of Argentina, Chile, Turkey and Israel, where there was no response for any of the periods.

4.3.4 Developed, developing countries , optimal portfolio, efficient frontier

Table 4.29 Composition of Optimal Portfolios for selected Return (in per cent)

Malaysian and Developed Markets (overall)

Country	Return					
	0.010	0.020	0.030	0.040	0.050	0.060
Malaysia	0.384	0.274	0.203	0.171	0.081	0.000
United States	0.015	0.281	0.309	0.260	0.083	0.000
Japan	0.600	0.345	0.156	0.049	0.000	0.000
United Kingdom	0.000	0.052	0.084	0.000	0.000	0.000
France	0.000	0.000	0.000	0.000	0.000	0.000
Hong Kong	0.001	0.049	0.022	0.000	0.000	0.000
Germany	0.000	0.000	0.000	0.000	0.000	0.000
Canada	0.000	0.000	0.000	0.000	0.104	0.492
Switzerland	0.000	0.000	0.088	0.000	0.000	0.000
Australia	0.000	0.000	0.138	0.327	0.423	0.068
Spain	0.000	0.000	0.000	0.192	0.309	0.440
Total	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.29 sets out the investment proportion of optimal portfolios for various interest rates of the Malaysian and developed markets during all sub periods. France and Germany can be ignored since no negligible proportion is invested in these countries.

Investments in Malaysia, the United States and Japan account for the majority of the optimal portfolios from the range of 0.015 per cent to 0.600 per cent.

Table 4.30 Composition of Optimal Portfolios for selected Return (in per cent)

Malaysian and Developed Markets (pre-crisis)

Country	Return					
	0.052	0.060	0.070	0.080	0.090	0.100
United States	0.000	0.019	0.085	0.126	0.159	0.184
United Kingdom	0.000	0.000	0.000	0.059	0.157	0.237
France	0.000	0.422	0.320	0.215	0.107	0.005
Hong Kong	0.000	0.000	0.032	0.057	0.073	0.087
Germany	0.000	0.000	0.000	0.002	0.027	0.044
Canada	0.000	0.000	0.046	0.086	0.111	0.132
Switzerland	0.000	0.000	0.085	0.146	0.176	0.197
Australia	1.000	0.560	0.431	0.309	0.190	0.088
Spain	0.000	0.000	0.000	0.000	0.000	0.025
Total	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.30 sets out the investment proportion of optimal portfolios for various interest rates of the Malaysian and developed markets during the pre crisis period. Although eleven countries are included in this study, only nine countries are included in at least one of the optimal portfolios in the relevant range of interest rates. Spain can be ignored since only a negligible proportion of one of the portfolios is invested in this country. Investments in the United States, France and Australia account for the majority of the optimal portfolios, but exclude Malaysia. Depending on the interest rate assumed and the proportion of such investment, accounts for between 0.005 per cent to 1.000 per cent.

Table 4.31 Composition of Optimal Portfolios for selected Return (in per cent)
Malaysian and Developed Markets (crisis)

Country	Return								
	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.250	0.300
United States	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.445	0.458
Japan	0.988	0.863	0.738	0.613	0.526	0.484	0.443	0.056	0.000
United Kingdom	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.048
France	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.228	0.323
Germany	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.157
Canada	0.000	0.000	0.000	0.000	0.029	0.095	0.160	0.000	0.000
Switzerland	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Australia	0.012	0.137	0.262	0.387	0.445	0.421	0.398	0.182	0.015
Spain	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.31 sets out the investment proportion of optimal portfolios for various interest rates for the Malaysian and developed markets during the crisis period. Although eleven countries are included in this study, only nine countries are included in at least one of the optimal portfolios in the relevant range of interest rates. In contrast with the findings in Tables 4.29 and 4.30, many countries can be ignored since only a negligible proportion of one or two of the portfolios are invested in these countries. They are the United States, United Kingdom, France, Germany, Switzerland and Spain. Investments in Japan, Canada and Australia account for the majority of the optimal portfolios. Depending on the interest rate assumed and the proportion of such investment, accounts for between 0.012 per cent to 0.988 per cent.

Table 4.32 Composition of Optimal Portfolios for selected Return (in per cent)

Malaysian and Developed Markets (post-crisis)

Country	Return										
	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.020	0.030	0.040	0.050
Malaysia	0.000	0.000	0.000	0.000	0.009	0.021	0.030	0.091	0.128	0.192	0.955
United States	0.884	0.586	0.476	0.405	0.391	0.384	0.380	0.317	0.206	0.000	0.000
Japan	0.000	0.055	0.181	0.235	0.226	0.217	0.210	0.110	0.032	0.000	0.000
United Kingdom	0.116	0.359	0.343	0.264	0.237	0.223	0.210	0.078	0.000	0.000	0.000
France	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hong Kong	0.000	0.000	0.000	0.000	0.025	0.030	0.030	0.038	0.028	0.000	0.000
Germany	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Canada	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.073	0.252	0.000
Switzerland	0.000	0.000	0.000	0.095	0.111	0.114	0.110	0.097	0.000	0.000	0.000
Australia	0.000	0.000	0.000	0.000	0.000	0.011	0.030	0.228	0.377	0.452	0.045
Spain	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.155	0.105	0.000
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.32 sets out the investment proportion of optimal portfolios for various interest rates for the Malaysian and developed markets during the post period. Similar to the findings in Table 4.28, France and Germany can be ignored since no negligible proportion is invested in these countries. Investments in Malaysia, the United States and the United Kingdom account for the majority of the optimal portfolios for the range of 0.009 per cent to 0.955 per cent.

Table 4.33 Composition of Optimal Portfolios for selected Return (in per cent)
Malaysian and Developing Markets (overall)

Country	Return								
	0.008	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080
Malaysia	1.000	0.938	0.589	0.319	0.210	0.170	0.129	0.085	0.039
China	0.000	0.000	0.000	0.000	0.047	0.123	0.198	0.274	0.351
India	0.000	0.000	0.000	0.067	0.156	0.160	0.163	0.163	0.164
Brazil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Argentina	0.000	0.000	0.000	0.021	0.028	0.019	0.011	0.001	0.000
Russia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mexico	0.000	0.000	0.000	0.000	0.010	0.060	0.110	0.160	0.207
South Africa	0.000	0.000	0.035	0.080	0.049	0.020	0.000	0.000	0.000
Chile	0.000	0.062	0.376	0.422	0.369	0.320	0.268	0.209	0.145
Turkey	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.003
Israel	0.000	0.000	0.000	0.091	0.132	0.126	0.118	0.104	0.091
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.33 sets out the investment proportion of optimal portfolios for various interest rates for the Malaysian and developing markets during the overall period. As can be seen, Brazil and Russia can be ignored since no negligible proportion is invested in these countries. Investments in Malaysia and Chile account for the majority of the optimal portfolios for the range of 0.039 per cent to 1.00 per cent.

Table 4.34 Composition of Optimal Portfolios for selected Return (in per cent)

Malaysian and Developing Markets (pre-crisis)

Country	Return								
	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.110	0.120
China	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
India	0.146	0.135	0.124	0.113	0.103	0.092	0.080	0.000	0.000
Brazil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.103
Argentina	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Russia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.028
Mexico	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
South Africa	0.336	0.284	0.232	0.180	0.127	0.075	0.020	0.000	0.000
Chile	0.429	0.371	0.312	0.253	0.194	0.135	0.080	0.000	0.000
Turkey	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.023
Israel	0.088	0.210	0.332	0.454	0.576	0.698	0.820	0.935	0.846
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.34 sets out the investment proportion of optimal portfolios for various interest rates for Malaysia and the developing markets during the pre-crisis period. Although eleven countries are included in this study, only ten countries are included in at least one of the optimal portfolios in the relevant range of interest rates. In contrast with the findings in Table 4.32, many countries can be ignored since only a negligible proportion of one or two of the portfolios are invested in these countries. The countries are China, Brazil, Argentina, Russia, Mexico and Turkey. Depending on the interest rate assumed India, South Africa, Chile and Israel, account for a minimum of 0.020 per cent to a maximum of 0.935 per cent.

Table 4.35 Composition of Optimal Portfolios for selected Return (in per cent)
Malaysian and Developing Markets (crisis)

Country	Return								
	0.033	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.200
India	0.951	0.908	0.654	0.611	0.568	0.524	0.481	0.438	0.000
Brazil	0.048	0.039	0.170	0.149	0.128	0.107	0.086	0.064	0.000
Argentina	0.000	0.023	0.143	0.157	0.171	0.185	0.200	0.214	0.012
Mexico	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.165
South Africa	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Turkey	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Israel	0.000	0.029	0.032	0.082	0.133	0.183	0.233	0.283	0.824
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.35 sets out the investment proportion of the optimal portfolios for various interest rates for Malaysia and the developing markets during the crisis period. During the crisis period, although eleven countries are included in this study, only seven countries are included in at least one of the optimal portfolios in the relevant range of interest rates. Depending on the interest rate assumed, India, Brazil, Argentina, South Africa and Israel account for the majority of the optimal portfolios.

Table 4.36 Composition of Optimal Portfolios for selected Return (in per cent)
Malaysian and Developing Markets (post-crisis)

Country	Return								
	0.021	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100
Malaysia	0.000	0.085	0.167	0.169	0.155	0.139	0.111	0.076	0.041
China	0.000	0.000	0.000	0.071	0.161	0.249	0.352	0.464	0.577
India	0.000	0.000	0.115	0.169	0.173	0.176	0.169	0.156	0.144
Brazil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Argentina	0.000	0.114	0.048	0.024	0.008	0.000	0.000	0.000	0.000
Russia	0.000	0.000	0.000	0.000	0.000	0.009	0.021	0.032	0.042
Mexico	0.000	0.000	0.000	0.007	0.053	0.093	0.121	0.143	0.165
South Africa	0.000	0.027	0.073	0.063	0.038	0.007	0.000	0.000	0.000
Chile	0.000	0.224	0.356	0.367	0.336	0.301	0.226	0.129	0.031
Turkey	0.000	0.068	0.014	0.000	0.000	0.000	0.000	0.000	0.000
Israel	1.000	0.482	0.227	0.129	0.078	0.025	0.000	0.000	0.000
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.36 sets out the investment proportion of the optimal portfolios for various interest rates for Malaysia and the developing markets during the post crisis period. All eleven countries in the study are included in at least one of the optimal portfolios in the relevant range of interest rates. In contrast with the findings in Table 4.34 (crisis period), many countries cannot be ignored since all negligible of the portfolios are invested in these countries. Investments in Malaysia and Chile account for the majority of the optimal portfolios. Depending on the interest rate assumed the proportion of such investment, accounts for between 0.031 per cent and 0.367 per cent.

Null Hypothesis 4a($H_0$4a)

There is no difference in asset allocation between the Malaysian financial market with the developed and developing financial markets during the pre crisis, crisis and post crisis periods.

The results of the composition of optimal portfolios for selected interest rates (in per cent) between Malaysia and the developed and developing countries have been presented in Tables 4.29 to 4.36. The asset allocation varies significantly for all three periods between Malaysia and the developed and developing countries. Therefore, this study rejects the null hypothesis 4a.

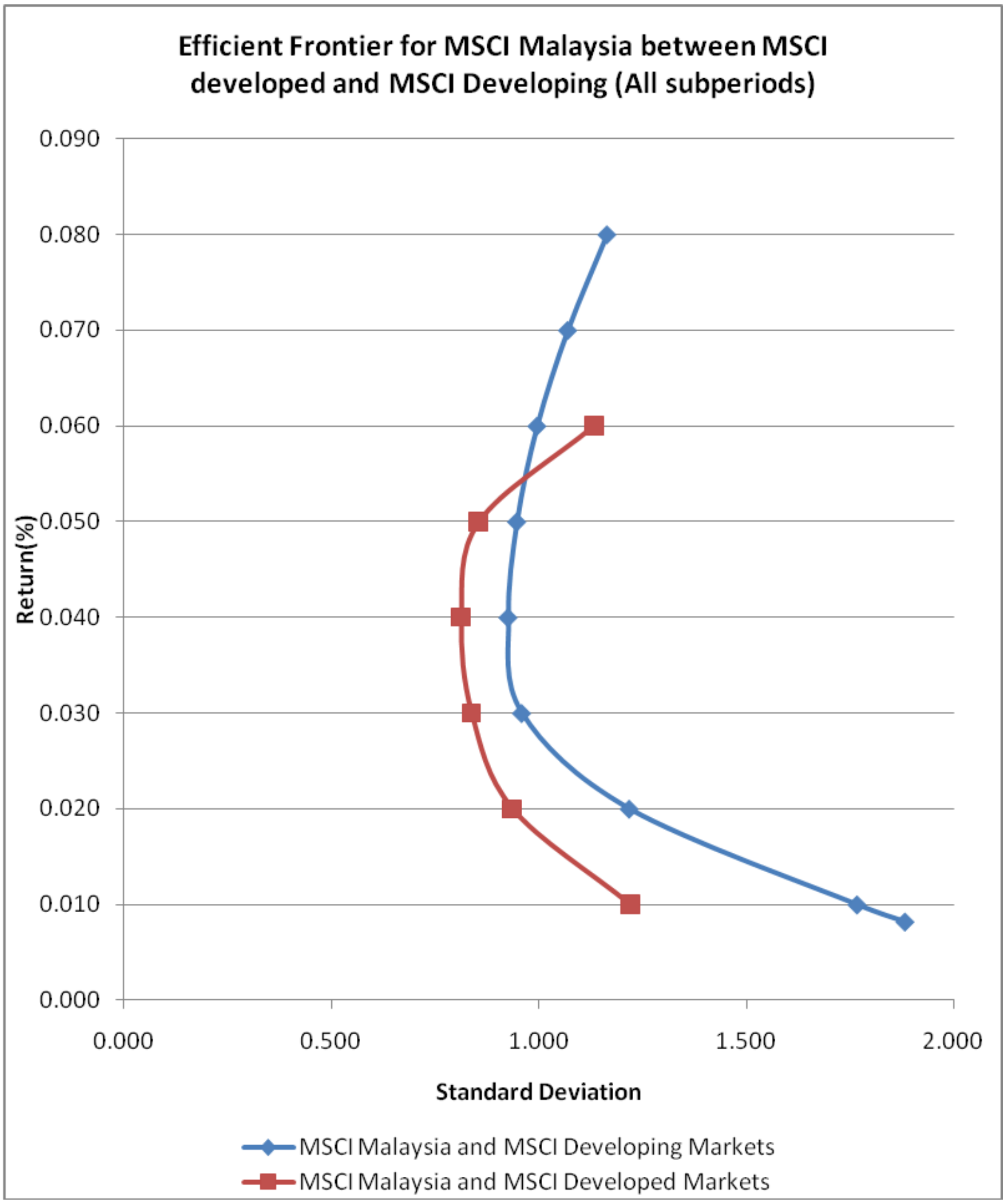

Figure 4.10 Efficient Frontier for MSCI Malaysia and MSCI Developed markets and MSCI Malaysia and Developing Markets – All sub periods

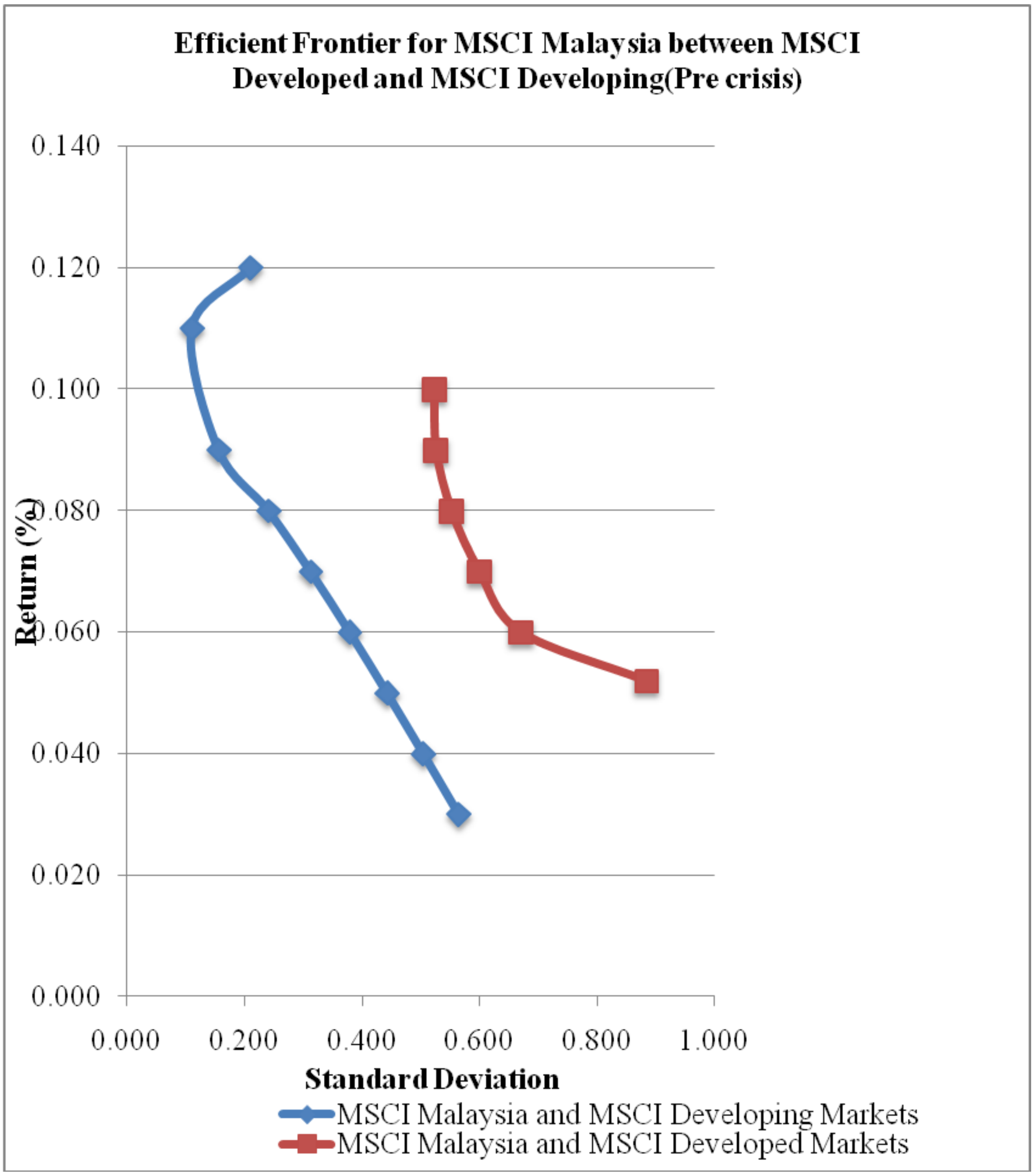

Figure 4.11 Efficient Frontier for MSCI Malaysia and MSCI Developed markets and MSCI Malaysia and Developing Markets – Pre crisis period

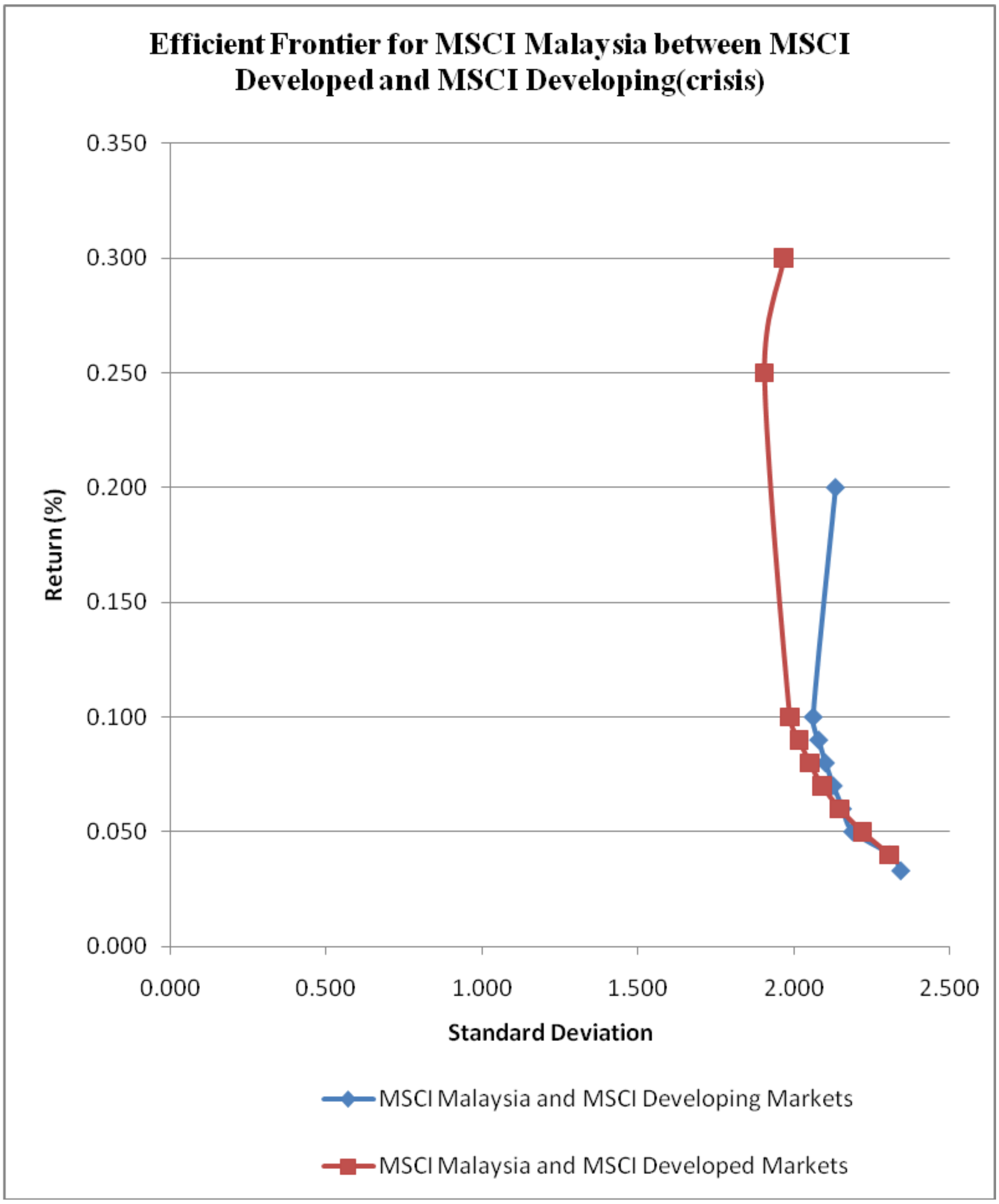

Figure 4.12 Efficient Frontier for MSCI Malaysia and MSCI Developed markets and MSCI Malaysia and Developing Markets – Crisis period

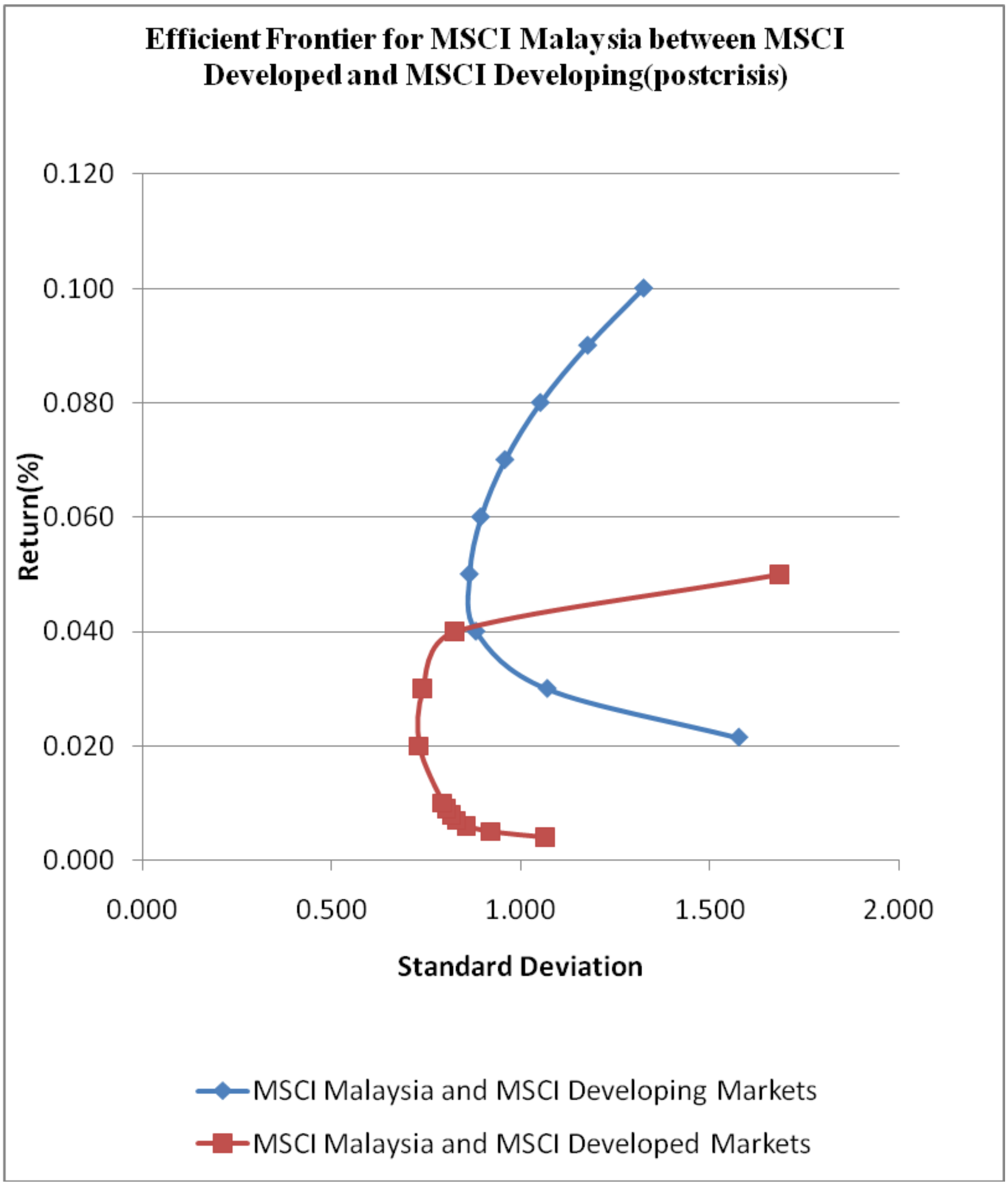

Figure 4.13 Efficient Frontier for MSCI Malaysia and MSCI Developed markets and MSCI Malaysia and Developing Markets – Post Crisis period

Efficient frontiers are constructed to visually evaluate the superiority of the efficient frontiers of two portfolios, which are Malaysia and developed countries and Malaysia and developing countries. Efficient frontiers for each portfolio are then plotted together during the sub periods. Figures 4.10 to 4.13 provide a visual view of the superiority of the efficient frontiers formed by each portfolio during each of the sub periods. Figures 4.10 to 4.13 show that by combining the efficient frontiers of the two portfolios for four different sub periods in a single chart, the chart becomes clear, which makes it easier to evaluate their relative superiority. From the figures 4.10 to 4.13, it can be clearly seen that the efficient frontiers for the Malaysian and developing countries for pre crisis and post crisis periods are generally superior to those for during the overall period and crisis period.

Null Hypothesis 4b($H_0$4b)

There is no difference in the efficient frontiers between the Malaysian financial market with developed and developing financial markets during the pre crisis, crisis and post crisis periods.

Figures 4.10 to 4.13 show that by combining the efficient frontiers of the two portfolios for four different sub periods in a single chart, the chart becomes clear which makes it easier to evaluate their relative superiority. From the figures 4.10 to 4.13, it can be clearly seen that the efficient frontiers of the Malaysian and developing countries for pre crisis and post crisis periods are generally superior to those for during the overall period and crisis period. Therefore, this study rejects the null hypothesis 4b.

4.4 CONCLUSION

The empirical evidence revealed there are distinctions in return among developed countries and developing countries. Such distinction can be varies significantly during crisis period and normalized at post crisis period. In general, as the market in developing countries is yet towards maturity, there is much scope to grow in returns and offered better opportunities in profits as compared to developed countries.

It is a settled principle that equity markets are volatile irrespective of developed and developing countries. There are affected by economic, political and critical financial or debt crisis. The investment return varies before and after crisis and tends to strengthen onwards after any crises period. The investment return on average is higher at the developing market relative to developed market thus giving opportunity of portfolio maximisation and diversification in developing market. The borderless economy and the expanding of bilateral trade would integrate the equity market between countries. Short-term benefits may be achieved through diversification in developing countries but would be normalized to equilibrium in long term.

Countries that are closely connected by geographical would integrate closely thus have no impacts to reduce investment risk even with diversification. This truism applies to both developed and developing market. Developing market with a far distance location would have diversification benefits and offers a slight better investment returns in the short term as compare to developed market. However, in the long run, both developing market and developed market are moving towards cointegration and reach long run equilibrium.

Lastly, Malaysia being the emerging market are cointegrated with both developed market and developing market at all times, be it pre crisis, crisis or post crisis period. Malaysia generally has higher integration with developed country as compared to developing market.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 INTRODUCTION

The main purpose of this chapter is to discuss the findings, and the contribution and implications for investors, policymakers and academicians concerning the issue and results raised in this research study. Finally, the limitations of the study as well as the suggestions for future research end this chapter. This chapter is organised as follows. Section 5.2 summarises the overall findings of this study. Section 5.3 addresses the potential implications of the study, followed by a discussion on research limitations in section 5.4. Section 5.5 offers possible avenues for further research. Section 5.6 concludes the chapter with a brief conclusion.

5.2 SUMMARY AND CONCLUSION

The emphasis of this thesis is to study the potential benefits of investing abroad from the viewpoint of a Malaysian investor. Basically, to examine for long-run and short-run linkages between the Malaysian stock market and developed and developing countries in the world by utilizing cointegration analysis and Markowitz theory (1952).

This study also takes a two-fold approach to investigate the issue of market integration from the perspective of a Malaysian investor who would diversify internationally with world global markets. First, the short and long run co-movements of twenty-one of the most developed and developing equity markets in the world with the Malaysian market are examined employing tests for cointegration. Second, mean variance analysis and the construction of a portfolio are employed to form efficient frontiers, providing the basis for recommending the degree of diversification into the Malaysian equity market. To facilitate a more comprehensive investigation, this study was divided into four sub periods i.e. pre crisis, crisis and post crisis and overall period to capture the effects on the Malaysian markets at various critical stages. In general, the research findings of the study are mixed in relation to the issues discussed in this study.

Taking into account the entire, pre crisis, crisis and post crisis periods, some of the general findings of the short-run and long-run causal influences and the portfolio constructions can be summarized as follows:

1. Between Malaysia and the developed markets, the results from the Johansen test are robust and consistent in suggesting that the Malaysian equity market and the equity markets in the developed markets were cointegrated during the entire period as well as the crisis and post crisis periods. These results are similar to Arshanapalli and Doukas (1993), who found evidence of pairwise cointegration between the US and France, and the US and UK for the period from January 1980 to May 1990, as well as for the post crash period from November 1987 to May 1990, and between the US and Germany for the post crash period. Moreover, the results, suggest that the long-run relationship between the markets under consideration were altered by the crisis and were actually strengthened. This stands in sharp similarity to the case of Asia, where long-run relationships were found to be strengthened after a stock market crisis (Yang et al., 2003). This finding is also in line with many previous findings that documented that world capital markets have been increasingly integrated and that co-movements among them have been rising (Billio and Pelizon, 2003; Chelley-Steely, 2004).

2. The Malaysian market has either unidirectional or bidirectional Granger causality with the US, Japan and Hong Kong in all sub periods. There are fewer bidirectional relationships between the developed and the Malaysian market during the pre crisis and crisis period compared to the post crisis period. We also found that developed countries (larger economies) are higher degree Granger cause developing (smaller economies) countries. The highly significant Granger cause from the US and Japan to Malaysia can be explained by the time zone factor and the "leading" market factor. The overall highly United States Granger-causality of all the other markets is documented in several previous papers studying different geographic areas (Sheng and Tu 2000; Yang et al., 2003; Ibrahim 2006). They discovered that the United States is not only dominant in the ASEAN region, but is the most influential market in the world. The evolution of stock market integration between the Hong Kong market and the Malaysian market may be explained by increased trade between the countries. This finding seems to be consistent with the view that the stronger the bilateral trade ties between two countries, the higher the degree of co-movements (Masih and Masih 1999, Ibrahim 2003, Kearney and Lucey 2004). According to Pretorious (2002), apart from trade bilateral dependencies and financial factors, the geographic distance between different stock markets can also be an important factor contributing to a greater extent of market integration. In the case of the Malaysian and Hong Kong stock markets, the greater degree of integration after the financial crisis could also be due to the geographic distance as compared to other developed stock markets. This finding is similar to Masih and Masih (1997). This means that the potential of developed countries investors for obtaining abnormal profits through portfolio diversification is limited in the long-run.

3. One general conclusion that can be drawn from this finding is that the developing stock markets are moving towards greater integration, either among themselves or with the Malaysian market, during the crisis period and were weakened after the crisis. This stands in sharp contrast to the case of Asia, where long-run relationships were found to be strengthened after a stock market crisis (Arshanapalli et al., 1995; Yang et al., 2003, Sheng and Tu, 2000). This finding was also in contrast with many previous findings that documented that world capital markets have been increasingly integrated and that co-movements among them have been rising (Billio and Pelizon, 2003; Chelley-Steely, 2005). However, our study is in line with Wang et al. (2003) who found that both long-run relationships and short-run causal linkages between the markets investigated were weakened after the crisis. Our findings further imply that there is room to gain benefit from international investment diversification in the developing stocks markets.

4. The Argentinean market was found to have relatively no causalities with the Malaysian market for all periods. Therefore, Malaysian investors would have much scope to include the stock of Argentina as it has maximal benefits of diversification.

5. The Indian market, for example, significantly Granger causes the Malaysian market during all the sub periods except the crisis period. Hence, the highly significant Granger cause from India to Malaysia can be explained by the external trade factor. This finding is consistent with the finding of Masih and Masih (1999), who discovered that higher intra-regional stock dependency among the Asian markets is perhaps partly due to the growing share of intra regional trade and investment. Based on the Bank Negara Report (1997-2009), the external total trade by Malaysian in India has increased

significantly. Apart from trade bilateral dependencies, according to Pretorius (2002), the geographic distance between different stock markets can also be an important factor contributing to the greater extent of market integration.

6. From the figures 4.9 to 4.12, it can be clearly seen that efficient frontiers of the Malaysian and developing countries for the pre crisis and post crisis periods are generally superior than those for during the overall period and crisis period.

5.3 CONTRIBUTION AND POTENTIAL IMPLICATIONS OF THE STUDY

The results of this study are important for academic, researchers in finance field, institutional investors and policymakers. The results document the deterioration of global diversification benefits that result from increased market cointegration between the Malaysian market and developed markets but not with developing markets. These empirical findings have several important implications in respect of portfolio diversification. These implications were analyzed at two levels: the Malaysian market with developed markets and the Malaysian market with developing markets. Studies examining the impact of the market cointegration on portfolio diversification and extending the analysis to an emerging market, namely, Malaysia, are fruitful areas of future academic research. Institutional investors should emphasize cointegrating relationships that mitigate diversifying benefits. This section summarizes and introduces the empirical contributions and managerial implications of this study.

5.3.1 Empirical contributions

The findings of this study have a number of significant empirical contributions.

5.3.1.1 Contribution to the literature on international linkage of stock markets and contagiousness of financial crisis.

The existing literature on the return and linkage between different markets can be generally divided into three groups. First, studies focusing on the linkages between developed markets. Second, literature on the relationship between the emerging markets of different regions and, finally, papers exploring the interrelationship between developed and emerging markets. The first two groups clearly receive the biggest share of attention in the existing literature. However, the work on the relationship between the emerging and developed markets is still very scarce. This thesis fills the gap in the third group of studies by examining the international linkage of the Malaysian market with both developed and developing market, which involve a total of 21 countries within a time series of 11 years. Another empirical contribution is the use of an advanced and well recognized set of econometric models on Malaysian data to investigate the linkages between Malaysia with developed and developing countries instead of using CAPM. Finally yet importantly, this thesis claims to be the first to analyze the financial crisis of 1997 solely and comprehensively. The results provide empirical evidence of integration of the Malaysian market in the world market, namely, with ten top developed and ten top developing countries and the contagiousness of the Malaysian financial crisis of 1997.

5.3.1.2 Contribution to the literature on portfolio construction

There is no doubt that future options and different kinds of derivative products have acquired an ever-increasing importance in today’s modern finance. However, stocks or shares remain the primary securities traded on stock exchanges and the major component of any optimal portfolio, especially in emerging markets. However, despite its importance, this phenomenon has been severely ignored in the context of emerging markets, regardless of their high returns and favourable diversification opportunities. This thesis contributes to the existing literature by examining the relationship between Malaysian stocks and that of developed and developing countries.

5.3.2 Implications of study

The findings of this study have a number of significant implications.

5.3.2.1 Domestic and international fund managers

This study reduces the range of equity market allocation, improves portfolio performance and reduces market search and monitoring costs. These findings should be particularly eye-catching to institutional investors who are deeply aware of the importance of fund cost control in an unpredicted market environment. Portfolio management requires both security selection and market timing decision. International management is inherently more difficult. First, international fund managers must choose from a significantly large universe of portfolios. Second, country and exchange rate risks are unique to international financial management. Therefore, these findings could ease the burden of selection for domestic and international fund managers. In addition, when portfolio managers aim to optimize the return risk relationship, the results indicate that at least in the case of Malaysia, one should account for the Malaysian market when calculating the key inputs for the optimization. Therefore, the implications of our results are useful for both domestic and international investors who are involve in equity investment, equity trading or anyone interested in investing in Malaysia.

5.3.2.2 Policymakers

This thesis has direct policy implications. For example, our findings imply that Malaysian investors would have little scope to include the stock of the US, Japan or Hong Kong as it has minimal benefits of diversification, as the markets move towards a greater integration. Furthermore, for policymaking, any sensations in the United States, Japan, Hong Kong or India equity markets should be taken into consideration by the Malaysian authorities in designing Malaysian policies.

Understanding the process of the integration of the stock market segment, as well as being aware of the current state of financial integration, is necessary in order to further promote Malaysia's integration process. Thus, measuring the degree of stock market integration may be important for policymakers concerning the aspects of Malaysia's integration. The analysis of this study, can aid policymakers in assessing the interdependencies of international equity markets, which are segmented by the adoption of capital controls, then policymakers have room for independent domestic policies.

5.3.2.3 Academicians

The results of the study can generate interest, attention or even alertness for scholars. As an original primary research, this study reveals the benefits of international portfolio diversification by investigating the linkages with the world markets and portfolio constructions. To academicians, even though there is an overabundance of research in developed and developing markets, the inadequate study of the Malaysian market, its correlation with developed and developing market implies that this study has enriched the integration or linkage literature from the perspective of Malaysian investors or policy makers.

5.3.2.4 Literature

This study fills the research gap by investigating the integration using more recent data, longer time series and including all major markets both from developed and developing markets. Compared to the existing literature, several aspects of this research are worth noting. The current available literature is obviously insufficient in providing up to date insight into the linkages of Malaysia with other global markets. Moreover, for investors in small developing countries like Malaysia, global diversification may be very important. Therefore, it is worth investigating the benefits of international diversification from a Malaysian standpoint. Moreover, the literature reviews in chapter two have shown that there are divergent conclusions for potential global stock market linkages. The empirical results differ, depending on the option of equity markets, the sample time selected, the frequency of observations – whether it is daily, weekly or monthly – and the different methodologies used to investigate the relationship of stock markets and the benefits of international diversification. Hence, this subject matter needs further analysis. The primary focus on this research is to study the international linkage in one of the emerging markets, namely, Malaysia. This study adds to our understanding of the linkages of the Malaysian market with global markets, which has received little attention. Furthermore, given the conflicting evidence of the research in this field, empirical study is required to establish firm principle in finance. Therefore, the main purpose of this study is to investigate the potential benefits of investing overseas, to examine long-run and short-run linkages between the Malaysian stock market with developed and developing countries by utilizing cointegration analysis.

For example, one general conclusion that can be drawn from this finding is that the developing stock markets moved towards a greater integration either among themselves or with the Malaysian market during the crisis period and were weakened after the crisis, however, this finding is the opposite for developed countries. Moreover, the results, suggest that the long-run relationship between Malaysia and the developed markets under consideration were altered by the crisis and were actually strengthened.

5.4 LIMITATIONS OF THE STUDY

1. The limitations of the study include the selection of countries in conducting the cointegration analysis and in forming the international portfolio diversification. This study limited the number of selected countries to the ten most developed and ten most developing countries as data collection proved to be very demanding on time, cost and energy.
2. Other limitations could be the time interval used in this study, which is limited to 11 years from July 1996 to June 2007 for the pre crisis, crisis and post crisis periods. 1997 financial crisis is selected as interval and hallmark of division. This study does not include other stock market crashes and other crises such as the market crash in 1987, 11 September in 2001, invasion of Iraq in 2003, Severe Acute Respiratory Syndrom (SARS) in 2003, or the subprime crisis, which started in the middle of 2007.
3. Furthermore, in research design, this study focus solely in equity shares and excludes investment in derivatives, futures, options, commodities and other types of

investment. Portfolio formation of Syariah internationally and domestic investment portfolios is another area that could be investigated.

5.5 SUGGESTIONS FOR FUTURE RESEARCH

There are several avenues for future research that stem from this study. These can be summarized as follows:

1. This study grouped the countries selected into developed and developing countries. Further research may be conducted to re-group the countries based on geographical, political or other criteria. This study grouped the international market according to the IFC and large market capitalisation markets. Therefore, further research may be conducted to study the effect of grouping the stocks based on sectoral and geographical criteria.
2. The sample of study could be extended to include non equity assets in the portfolio such as bonds, fixed income instruments, mutual funds, derivatives and commodities, which has a series of prices and indices. Furthermore, such studies need not be restricted to international markets but could include a blend of other domestic markets regionally as well as globally.
3. This study has used MSCI indices to test for market integration and portfolio diversification. However, it could be interesting to see whether different sectors in those countries are integrated. For example, rather than concentrating on general stock markets, one can study whether specific sectors such as bonds, debentures, unit trust in different markets are integrated.
4. Future studies could be conducted to examine the stock market efficiency in the region or globally. Recently, this issue has attracted a great deal of interest by academicians and practitioners.

5. The liberalization of the stock market is another important topic to be investigated. Future studies could examine the relationship between liberalization, integration and the efficiency of stock markets.

5.6 CONCLUSION

The investment risk would be the same in long run even if the fund manager of developed countries to include Malaysia equity in their portfolio of investment or vice versa. Malaysia equity market indeed is cointegrated with developed market. The fluctuation in equities market in Japan, USA would significantly impact Malaysia equities as these three markets are very closely integrated. Malaysia equity market are strengthen and are closely cointegrated with developed equity market after crisis and even more so in these later debt crisis period faced in USA.

However, Malaysia equity market are moving out of cointegration with developing market after crisis as each market only cointegrated by the mutual trade or close proximate geographical situation. This offer great opportunities of diverts investment risk through expansion of portfolio investment in these developing market, notably evidence in Argentina.

Finally, the financial crisis in 1997 has strengthen the cointegration between Malaysia and developed market but not on developing market.USA remain the main player and the global financial leader that significantly affect the equity market be it in Malaysia, other developing markets or developed markets. The recent debt crisis occurred in August 2011 in USA is clear evidence of persistent contribution to the major down fall in all equity market.

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APPENDICES

APPENDIX A

VAR Lag Order Selection Criteria (Overall period)

(Malaysia and Developed countries)

Endogenous variables: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Exogenous
variables: C

Date: 10/19/10   Time: 11:03

Sample: 7/01/1996 6/29/2007

Included observations: 2860

Lag	LogL	LR	FPE	AIC	SC	HQ
0	30348.33	NA	1.70E-23	-21.21491	-21.192	-21.20665
1	99360.55	137445.3	2.03E-44	-69.39059	-69.11558	-69.29143
2	99969.92	1208.943	1.44E-44	-69.73211	-69.20501*	-69.54205*
3	100133.9	324.0523	1.40E-44	-69.76216	-68.98297	-69.48121
4	100268.1	264.2384	1.39E-44	-69.77142	-68.74012	-69.39956
5	100388.3	235.628	1.39E-44	-69.77083	-68.48745	-69.30808
6	100528.8	274.3937	1.37e-44*	-69.78446*	-68.24898	-69.23081
7	100642.6	221.3749	1.37E-44	-69.77942	-67.99185	-69.13487
8	100765.6	238.3662	1.37E-44	-69.78083	-67.74116	-69.04538
9	100865.6	192.9581	1.39E-44	-69.76612	-67.47436	-68.93978
10	100950	162.2818*	1.43E-44	-69.74054	-67.19669	-68.8233

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX B

VAR Lag Order Selection Criteria(Pre-crisis period)

(Malaysia and Developed countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Exogenous variables: C

Date: 10/19/10 Time: 11:07

Sample: 7/01/1996 6/30/1997

Included observations: 251

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6255.627	NA	6.81E-36	-49.75799	-49.60349	-49.69581
1	9680.305	6521.897	2.52e-47*	-76.08212*	-74.22809*	-75.33601*
2	9799.535	216.6077	2.57E-47	-76.06801	-72.51446	-74.63797
3	9896.436	167.5501	3.15E-47	-75.87598	-70.62292	-73.76202
4	9981.395	139.4554	4.30E-47	-75.58881	-68.63622	-72.79091
5	10064.57	129.243	6.06E-47	-75.28745	-66.63534	-71.80562
6	10173.32	159.4295	7.11E-47	-75.18977	-64.83814	-71.02402
7	10286.39	155.8701	8.26E-47	-75.12661	-63.07546	-70.27692
8	10406.17	154.6131	9.41E-47	-75.11687	-61.3662	-69.58325
9	10532.7	152.2435*	1.06E-46	-75.16096	-59.71077	-68.94342
10	10645.26	125.5603	1.39E-46	-75.09367	-57.94396	-68.1922

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX C

VAR Lag Order Selection Criteria (Crisis period)

(Malaysia and Developed countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Exogenous variables: C

Date: 10/19/10 Time: 11:07

Sample: 7/01/1996 6/30/1997

Included observations: 251

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6255.627	NA	6.81E-36	-49.75799	-49.60349	-49.69581
1	9680.305	6521.897	2.52e-47*	-76.08212*	-74.22809*	-75.33601*
2	9799.535	216.6077	2.57E-47	-76.06801	-72.51446	-74.63797
3	9896.436	167.5501	3.15E-47	-75.87598	-70.62292	-73.76202
4	9981.395	139.4554	4.30E-47	-75.58881	-68.63622	-72.79091
5	10064.57	129.243	6.06E-47	-75.28745	-66.63534	-71.80562
6	10173.32	159.4295	7.11E-47	-75.18977	-64.83814	-71.02402
7	10286.39	155.8701	8.26E-47	-75.12661	-63.07546	-70.27692
8	10406.17	154.6131	9.41E-47	-75.11687	-61.3662	-69.58325
9	10532.7	152.2435*	1.06E-46	-75.16096	-59.71077	-68.94342
10	10645.26	125.5603	1.39E-46	-75.09367	-57.94396	-68.1922

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX D

VAR Lag Order Selection Criteria (Crisis period)

(Malaysia and Developed countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Exogenous variables: C

Date: 10/19/10 Time: 11:13

Sample: 7/01/1997 6/29/1998

Included observations: 250

Lag	LogL	LR	FPE	AIC	SC	HQ
0	5147.893	NA	3.94E-32	-41.09514	-40.9402	-41.03278
1	8332.19	6062.902	8.97e-43*	-65.60152*	-63.74219*	-64.85320*
2	8429.885	177.4131	1.09E-42	-65.41508	-61.85136	-63.98078
3	8523.297	161.4169	1.37E-42	-65.19438	-59.92627	-63.07412
4	8623.134	163.7320*	1.67E-42	-65.02507	-58.05258	-62.21885
5	8701.392	121.4574	2.44E-42	-64.68314	-56.00626	-61.19095
6	8787.239	125.6791	3.45E-42	-64.40191	-54.02064	-60.22375
7	8861.949	102.801	5.46E-42	-64.03159	-51.94594	-59.16747
8	8954.448	119.1383	7.74E-42	-63.80358	-50.01354	-58.25349
9	9060.96	127.8145	1.02E-41	-63.68768	-48.19325	-57.45162
10	9154.544	104.0653	1.57E-41	-63.46835	-46.26953	-56.54633

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX E

VAR Lag Order Selection Criteria (Post Crisis period)

(Malaysia and Developed countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Exogenous variables: C

Date: 10/19/10 Time: 11:18

Sample: 7/01/1998 6/29/2007

Included observations: 2338

Lag	LogL	LR	FPE	AIC	SC	HQ
0	31201.58	NA	7.16E-26	-26.68142	-26.65433	-26.67155
1	82254.42	101581.6	8.58E-45	-70.25015	-69.92511	-70.13174
2	82925.77	1329.488	5.36E-45	-70.72093	-70.09795*	-70.49399*
3	83081.52	306.9638	5.20E-45	-70.75065	-69.82972	-70.41517
4	83193.4	219.4606	5.24E-45	-70.74286	-69.52398	-70.29884
5	83318.48	244.1758	5.22E-45	-70.74635	-69.22952	-70.19379
6	83481.7	317.0741	5.04E-45	-70.78246	-68.96769	-70.12137
7	83605.42	239.1866	5.03E-45	-70.78479	-68.67206	-70.01516
8	83731.12	241.8247	5.01e-45*	-70.78881*	-68.37813	-69.91064
9	83829.7	188.7299	5.11E-45	-70.76963	-68.06101	-69.78292
10	83914.21	161.0078*	5.27E-45	-70.73842	-67.73185	-69.64317

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX F

VAR Lag Order Selection Criteria (Overall period)

(Malaysia and Developing countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Exogenous variables: C

Date: 10/28/10 Time: 17:09

Sample: 7/01/1996 6/29/2007

Included observations: 2849

Lag	LogL	LR	FPE	AIC	SC	HQ
0	9361.593	NA	3.91E-17	-6.564123	-6.541132	-6.55583
1	81565.52	143799.6	4.13E-39	-57.16639	-56.89049*	-57.0669
2	81915.01	693.3349	3.52e-39*	-57.32679*	-56.79799	-57.13608*
3	82009.68	187.0959	3.58E-39	-57.30831	-56.52661	-57.0264
4	82132.46	241.6679	3.58E-39	-57.30955	-56.27495	-56.9364
5	82223.94	179.3735	3.65E-39	-57.28883	-56.00133	-56.8245
6	82333.71	214.3711	3.68E-39	-57.28095	-55.74054	-56.7254
7	82426.24	179.9955	3.76E-39	-57.26096	-55.46765	-56.6142
8	82528.39	197.922	3.81E-39	-57.24773	-55.20151	-56.5098
9	82621.99	180.6212	3.88E-39	-57.22849	-54.92937	-56.3993
10	82708.84	166.9429*	3.98E-39	-57.20452	-54.6525	-56.2842

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX G

VAR Lag Order Selection Criteria (Pre crisis period)

(Malaysia and Developing countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Exogenous variables: C

Date: 10/28/10   Time: 17:15

Sample: 7/01/1996 6/27/1997

Included observations: 250

Lag	LogL	LR	FPE	AIC	SC	HQ
0	4632.987	NA	2.42E-30	-36.9759	-36.82095	-36.9135
1	8323.524	7026.782	9.61e-43*	-65.53219*	-63.67286*	-64.78387*
2	8436.81	205.7282	1.03E-42	-65.47048	-61.90676	-64.0362
3	8503.579	115.3764	1.61E-42	-65.03663	-59.76853	-62.9164
4	8581.916	128.4724	2.32E-42	-64.69533	-57.72283	-61.8891
5	8665.582	129.8504	3.26E-42	-64.39666	-55.71978	-60.9045
6	8773.307	157.7094	3.85E-42	-64.29046	-53.90919	-60.1123
7	8884.986	153.6700*	4.54E-42	-64.21589	-52.13024	-59.3518
8	8989.47	134.5745	5.85E-42	-64.08376	-50.29372	-58.5337
9	9106.438	140.3621	7.10E-42	-64.0515	-48.55708	-57.8155
10	9234.261	142.1396	8.30E-42	-64.10609	-46.90728	-57.1841

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX H

VAR Lag Order Selection Criteria (Crisis period)

(Malaysia and Developing countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Exogenous variables: C

Date: 10/28/10 Time: 17:21

Sample: 7/01/1997 6/29/1998

Included observations: 250

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3984.068	NA	4.35E-28	-31.7846	-31.6296	-31.7222
1	6953.498	5653.794	5.53E-38	-54.572	-52.71266*	-53.82366*
2	7094.364	255.8123	4.74e-38*	-54.73091*	-51.16719	-53.2966
3	7193.108	170.6297	5.74E-38	-54.5529	-49.28476	-52.4326
4	7261.46	112.0963	8.97E-38	-54.1317	-47.15918	-51.3255
5	7343.565	127.428	1.28E-37	-53.8205	-45.14364	-50.3283
6	7439.326	140.1939	1.66E-37	-53.6186	-43.23734	-49.4405
7	7528.27	122.387	2.35E-37	-53.3622	-41.27651	-48.498
8	7639.362	143.0863	2.87E-37	-53.2829	-39.49285	-47.7328
9	7751.628	134.7197	3.62E-37	-53.213	-37.7186	-46.977
10	7885.739	149.1311*	4.02E-37	-53.3179	-36.1191	-46.3959

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX I

VAR Lag Order Selection Criteria (Post crisis period)

(Malaysia and Developing countries)

VAR Lag Order Selection Criteria

Endogenous variables: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Exogenous variables: C

Date: 10/28/10 Time: 17:26

Sample: 7/01/1998 6/29/2007

Included observations: 2327

Lag	LogL	LR	FPE	AIC	SC	HQ
0	11870.37	NA	1.04E-18	-10.19284	-10.16565	-10.18293
1	67155.91	110000.9	2.66E-39	-57.60542	-57.27912*	-57.48653
2	67456.85	595.9248	2.28e-39*	-57.76007*	-57.13466	-57.53219*
3	67550.33	184.2426	2.33E-39	-57.73643	-56.8119	-57.39956
4	67671.19	237.0376	2.33E-39	-57.7363	-56.51267	-57.29044
5	67772.28	197.3247	2.38E-39	-57.7192	-56.19645	-57.16435
6	67896.41	241.0944	2.37E-39	-57.72188	-55.90002	-57.05804
7	67977.18	156.1385	2.45E-39	-57.68731	-55.56634	-56.91449
8	68085.01	207.405	2.48E-39	-57.67599	-55.2559	-56.79418
9	68196.45	213.3114*	2.50E-39	-57.66777	-54.94858	-56.67698
10	68272.36	144.5776	2.60E-39	-57.62902	-54.61071	-56.52923

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX J

Cointegration Test (overall)

(Malaysia and Developed countries)

Date: 10/19/10 Time: 14:23

Sample (adjusted): 7/04/1996 6/29/2007

Included observations: 2867 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.026	335.408	285.143	0.000
At most 1 *	0.020	261.140	239.235	0.003
At most 2 *	0.016	202.928	197.371	0.026
At most 3	0.013	157.808	159.530	0.062
At most 4	0.013	118.952	125.615	0.119
At most 5	0.011	82.108	95.754	0.298
At most 6	0.008	50.089	69.819	0.634
At most 7	0.004	27.502	47.856	0.835
At most 8	0.003	14.673	29.797	0.801
At most 9	0.002	5.973	15.495	0.699
At most 10	0.000	0.616	3.841	0.432

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.026	74.268	70.535	0.022
At most 1	0.020	58.212	64.505	0.175
At most 2	0.016	45.120	58.434	0.521
At most 3	0.013	38.856	52.363	0.567
At most 4	0.013	36.844	46.231	0.349
At most 5	0.011	32.019	40.078	0.302
At most 6	0.008	22.586	33.877	0.562
At most 7	0.004	12.829	27.584	0.894
At most 8	0.003	8.701	21.132	0.856
At most 9	0.002	5.356	14.265	0.696
At most 10	0.000	0.616	3.841	0.432

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX K

Cointegration Test (Pre-Crisis Period)

(Malaysia and Developed countries)

Date: 10/19/10 Time: 14:25

Sample (adjusted): 7/03/1996 6/30/1997

Included observations: 259 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.240	317.188	285.143	0.001
At most 1 *	0.179	246.065	239.235	0.024
At most 2	0.159	194.861	197.371	0.066
At most 3	0.130	149.935	159.530	0.148
At most 4	0.109	113.886	125.615	0.207
At most 5	0.094	84.049	95.754	0.242
At most 6	0.081	58.527	69.819	0.283
At most 7	0.068	36.573	47.856	0.368
At most 8	0.047	18.400	29.797	0.537
At most 9	0.020	5.942	15.495	0.702
At most 10	0.003	0.780	3.841	0.377

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.240	71.123	70.535	0.044
At most 1	0.179	51.204	64.505	0.491
At most 2	0.159	44.926	58.434	0.532
At most 3	0.130	36.048	52.363	0.738
At most 4	0.109	29.838	46.231	0.789
At most 5	0.094	25.521	40.078	0.734
At most 6	0.081	21.954	33.877	0.611
At most 7	0.068	18.173	27.584	0.481
At most 8	0.047	12.458	21.132	0.503
At most 9	0.020	5.162	14.265	0.721
At most 10	0.003	0.780	3.841	0.377

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX L

Cointegration Test (Crisis period)

(Malaysia and Developed countries)

Date: 10/19/10   Time: 14:27

Sample (adjusted): 7/03/1997 6/29/1998

Included observations: 258 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.210	287.221	285.143	0.041
At most 1	0.178	226.376	239.235	0.163
At most 2	0.134	175.753	197.371	0.345
At most 3	0.118	138.649	159.530	0.381
At most 4	0.094	106.321	125.615	0.403
At most 5	0.085	80.756	95.754	0.340
At most 6	0.080	57.712	69.819	0.312
At most 7	0.070	36.306	47.856	0.381
At most 8	0.041	17.493	29.797	0.604
At most 9	0.026	6.749	15.495	0.607
At most 10	0.000	0.083	3.841	0.774

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.210	60.846	70.535	0.291
At most 1	0.178	50.623	64.505	0.523
At most 2	0.134	37.104	58.434	0.918
At most 3	0.118	32.328	52.363	0.908
At most 4	0.094	25.564	46.231	0.955
At most 5	0.085	23.044	40.078	0.874
At most 6	0.080	21.407	33.877	0.653
At most 7	0.070	18.812	27.584	0.429
At most 8	0.041	10.744	21.132	0.673
At most 9	0.026	6.666	14.265	0.529
At most 10	0.000	0.083	3.841	0.774

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX M

Cointegration Test (Post- Crisis Period)

(Malaysia and Developed countries)

Date: 10/19/10 Time: 14:33

Sample (adjusted): 7/06/1998 6/29/2007

Included observations: 2345 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LUSA LJPN LUK LFRN LHKG LGER LCAN LSWZ LAUS LSPN

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.038	364.519	285.143	0.000
At most 1 *	0.027	273.687	239.235	0.001
At most 2 *	0.021	209.949	197.371	0.010
At most 3 *	0.017	161.235	159.530	0.040
At most 4	0.015	120.986	125.615	0.093
At most 5	0.012	85.546	95.754	0.205
At most 6	0.009	57.565	69.819	0.318
At most 7	0.008	36.091	47.856	0.392
At most 8	0.005	16.363	29.797	0.687
At most 9	0.002	4.781	15.495	0.832
At most 10	0.000	0.246	3.841	0.620

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-	0.05

No. of CE(s)	Eigenvalue	Eigen Statistic	Critical Value	Prob.**
None *	0.038	90.832	70.535	0.000
At most 1	0.027	63.738	64.505	0.059
At most 2	0.021	48.714	58.434	0.323
At most 3	0.017	40.249	52.363	0.480
At most 4	0.015	35.440	46.231	0.432
At most 5	0.012	27.981	40.078	0.563
At most 6	0.009	21.474	33.877	0.648
At most 7	0.008	19.729	27.584	0.360
At most 8	0.005	11.582	21.132	0.589
At most 9	0.002	4.534	14.265	0.799
At most 10	0.000	0.246	3.841	0.620

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX N

Cointegration Test (overall)

(Malaysia and Developing countries)

Date: 10/29/10 Time: 08:57

Sample (adjusted): 7/03/1996 6/29/2007

Included observations: 2865 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.028	284.114	285.143	0.055
At most 1	0.016	203.049	239.235	0.617
At most 2	0.014	158.099	197.371	0.763
At most 3	0.010	118.086	159.530	0.883
At most 4	0.009	89.605	125.615	0.874
At most 5	0.007	62.614	95.754	0.913
At most 6	0.006	42.038	69.819	0.910
At most 7	0.004	25.727	47.856	0.898
At most 8	0.003	13.071	29.797	0.888
At most 9	0.002	5.496	15.495	0.754
At most 10	0.000	0.166	3.841	0.684

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.028	81.065	70.535	0.004
At most 1	0.016	44.950	64.505	0.824
At most 2	0.014	40.012	58.434	0.808
At most 3	0.010	28.482	52.363	0.984
At most 4	0.009	26.991	46.231	0.917
At most 5	0.007	20.576	40.078	0.958
At most 6	0.006	16.311	33.877	0.945
At most 7	0.004	12.655	27.584	0.903
At most 8	0.003	7.576	21.132	0.928
At most 9	0.002	5.330	14.265	0.700
At most 10	0.000	0.166	3.841	0.684

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX O

Cointegration Test (Pre-crisis period)

(Malaysia and Developing countries)

Date: 10/29/10 Time: 09:00

Sample (adjusted): 7/03/1996 6/27/1997

Included observations: 258 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.190	284.890	285.143	0.051
At most 1	0.181	230.544	239.235	0.115
At most 2	0.139	179.117	197.371	0.275
At most 3	0.127	140.455	159.530	0.335
At most 4	0.101	105.329	125.615	0.433
At most 5	0.089	77.973	95.754	0.435
At most 6	0.067	53.896	69.819	0.466
At most 7	0.058	35.882	47.856	0.402
At most 8	0.048	20.486	29.797	0.391
At most 9	0.029	7.773	15.495	0.490
At most 10	0.001	0.280	3.841	0.597

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.190	54.346	70.535	0.625
At most 1	0.181	51.428	64.505	0.478
At most 2	0.139	38.662	58.434	0.866
At most 3	0.127	35.126	52.363	0.788
At most 4	0.101	27.356	46.231	0.904
At most 5	0.089	24.077	40.078	0.822
At most 6	0.067	18.014	33.877	0.877
At most 7	0.058	15.395	27.584	0.716
At most 8	0.048	12.713	21.132	0.479
At most 9	0.029	7.493	14.265	0.433
At most 10	0.001	0.280	3.841	0.597

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX P

Cointegration Test (Crisis period)

(Malaysia and Developing countries)

Date: 10/29/10 Time: 09:01

Sample (adjusted): 7/03/1997 6/29/1998

Included observations: 258 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.257	337.763	285.143	0.000
At most 1 *	0.215	261.065	239.235	0.004
At most 2 *	0.177	198.558	197.371	0.044
At most 3	0.127	148.379	159.530	0.172
At most 4	0.124	113.341	125.615	0.219
At most 5	0.107	79.128	95.754	0.394
At most 6	0.080	50.013	69.819	0.637
At most 7	0.051	28.381	47.856	0.797
At most 8	0.033	14.936	29.797	0.784
At most 9	0.024	6.382	15.495	0.650
At most 10	0.000	0.003	3.841	0.957

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized Max- 0.05

No. of CE(s)	Eigenvalue	Eigen Statistic	Critical Value	Prob.**
None *	0.257	76.698	70.535	0.012
At most 1	0.215	62.507	64.505	0.077
At most 2	0.177	50.179	58.434	0.256
At most 3	0.127	35.038	52.363	0.793
At most 4	0.124	34.212	46.231	0.511
At most 5	0.107	29.115	40.078	0.483
At most 6	0.080	21.632	33.877	0.636
At most 7	0.051	13.444	27.584	0.859
At most 8	0.033	8.555	21.132	0.867
At most 9	0.024	6.379	14.265	0.565
At most 10	0.000	0.003	3.841	0.957

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX Q

Cointegration Test (post crisis period)

(Malaysia and Developing countries)

Date: 10/29/10 Time: 09:02

Sample (adjusted): 7/03/1998 6/29/2007

Included observations: 2343 after adjustments

Trend assumption: Linear deterministic trend

Series: LMAL LCHN LIND LBRA LARG LRUS LMEX LSAF LCHI LTUR LISR

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.032	302.600	285.143	0.008
At most 1	0.024	227.100	239.235	0.154
At most 2	0.018	169.511	197.371	0.494
At most 3	0.014	125.832	159.530	0.727
At most 4	0.013	92.644	125.615	0.810
At most 5	0.009	61.238	95.754	0.934
At most 6	0.007	39.719	69.819	0.952
At most 7	0.004	23.818	47.856	0.946
At most 8	0.004	14.176	29.797	0.831
At most 9	0.002	5.146	15.495	0.793
At most 10	0.000	0.014	3.841	0.906

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.032	75.500	70.535	0.016
At most 1	0.024	57.589	64.505	0.195
At most 2	0.018	43.678	58.434	0.607
At most 3	0.014	33.188	52.363	0.877
At most 4	0.013	31.406	46.231	0.696
At most 5	0.009	21.519	40.078	0.933
At most 6	0.007	15.901	33.877	0.957
At most 7	0.004	9.642	27.584	0.989
At most 8	0.004	9.030	21.132	0.830
At most 9	0.002	5.132	14.265	0.725
At most 10	0.000	0.014	3.841	0.906

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX R

Diagnostic test(overall)

(Malaysia and Developed countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.944 [0.331]	2.457*** [0.004]	18.461*** [0.000]
UNITED STATES	1.005 [0.316]	8.313*** [0.000]	5.79E-07 [0.999]
JAPAN	14.426*** [0.000]	4.107*** [0.000]	1.592 [0.207]
UNITED KINGDOM	39.754*** [0.000]	3.967*** [0.000]	4.341** [0.037]
FRANCE	30.961*** [0.000]	6.101*** [0.000]	0.566 [0.452]
	4.584** [0.032]	7.322*** [0.000]	3.028* [0.082]
GERMANY	46.842*** [0.000]	5.242*** [0.000]	4.685** [0.031]
CANADA	4.724** [0.030]	4.070*** [0.000]	1.092 [0.296]
SWITZELAND	33.955*** [0.000]	4.812*** [0.000]	4.205** [0.040]
AUSTRALIA	26.475*** [0.000]	5.057*** [0.000]	3.493* [0.062]
SPAIN	28.131*** [0.000]	6.680*** [0.000]	0.753 [0.386]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX S

Diagnostic test(PRECRISIS)

(Malaysia and Developed countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.869 [0.352]	1.460 [0.140]	2.299 [0.131]
UNITED STATES	0.022 [0.882]	1.132 [0.335]	0.681 [0.410]
JAPAN	0.161 0.689	1.419 0.157	3.258 0.072
UNITED KINGDOM	0.186 0.666	0.746 0.705	0.702 0.403
FRANCE	0.316 0.575	0.989 0.460	0.522 0.471
HONG KONG	0.686 0.408	1.755 0.056	0.866 0.353
GERMANY	0.524 0.470	1.579 0.098	0.539 0.464
CANADA	0.013 0.911	0.657 0.792	0.460 0.498
SWITZELAND	0.001 0.973	2.012 0.024	0.321 0.571
AUSTRALIA	0.050 0.823	0.769 0.682	6.396 0.012
SPAIN	1.793 0.182	1.059 0.396	0.103 0.748

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX T

Diagnostic test(CRISIS)

(Malaysia and Developed countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.228 [0.633]	1.885** [0.037]	9.692*** [0.002]
UNITED STATES	3.623* [0.058]	1.691* [0.069]	1.639 [0.202]
JAPAN	2.636 [0.106]	1.682* [0.071]	0.154 [0.696]
UNITED KINGDOM	0.648 [0.209]	1.437 [0.150]	0.842 [0.360]
FRANCE	0.013 [0.911]	1.229 [0.263]	0.034 [0.854]
HONG KONG	0.173 [0.678]	1.249 [0.250]	6.833** [0.010]
GERMANY	1.305 [0.254]	1.207 [0.279]	0.585 [0.445]
CANADA	2.626 [0.106]	1.486 [0.130]	3.757* [0.054]
SWITZELAND	0.004 [0.948]	0.938 [0.510]	0.244 [0.622]
AUSTRALIA	0.240 [0.624]	1.435 [0.151]	0.409 [0.523]
SPAIN	0.780 [0.378]	1.422 [0.156]	0.045 [0.831]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX U

Diagnostic test(POSTCRISIS)

(Malaysia and Developed countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	2.110 [0.147]	4.676*** [0.000]	21.940*** [0.000]
UNITED STATES	0.720 [0.396]	11.618*** [0.000]	0.101 [0.751]
JAPAN	0.706 [0.401]	3.194*** [0.000]	3.985** [0.046]
UNITED KINGDOM	33.819*** [0.000]	5.055*** [0.000]	7.596*** [0.006]
FRANCE	28.981*** [0.000]	6.327*** [0.000]	2.903* [0.089]
HONG KONG	1.226 [0.268]	4.145*** [0.000]	2.240 [0.135]
GERMANY	36.637*** [0.000]	6.024*** [0.000]	7.436*** [0.006]
CANADA	1.220 [0.270]	6.258*** [0.000]	1.652 [0.199]
SWITZELAND	30.978*** [0.000]	7.201*** [0.000]	7.816*** [0.005]
AUSTRALIA	15.192*** [0.000]	4.681*** [0.000]	5.845** [0.016]
SPAIN	20.470*** [0.000]	5.596*** [0.000]	3.303* [0.069]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX V

Diagnostic test(overall)

(Malaysia and Developing countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.180 [0.671]	3.924*** [0.000]	11.635*** [0.001]
CHINA	1.081 [0.299]	3.432*** [0.000]	5.072** [0.024]
INDIA	0.029 [0.864]	5.847*** [0.000]	0.656 [0.418]
BRAZIL	6.145** [0.013]	5.660*** [0.000]	0.094 [0.759]
ARGENTINA	0.147 [0.701]	1.213 [0.267]	0.162 [0.687]
RUSIA	5.586** [0.018]	16.878*** [0.000]	3.227* [0.073]
MEXICO	0.929 [0.335]	7.150*** [0.000]	4.214** [0.040]
SOUTH AFRICA	0.082 [0.775]	10.519*** [0.000]	7.131*** [0.008]
CHILE	0.815 [0.367]	2.550*** [0.002]	0.009 [0.923]
TURKEY	0.001 [0.981]	4.143*** [0.000]	2.755* [0.097]
ISRAEL	2.062 [0.151]	4.424*** [0.000]	1.930 [0.165]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX W

Diagnostic test(PRECRISIS)

(Malaysia and Developing countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.159 [0.690]	1.902** [0.035]	0.264 [0.608]
CHINA	0.210 [0.648]	0.637 [0.810]	10.055*** [0.002]
INDIA	0.090 [0.765]	0.962 [0.486]	1.467 [0.227]
BRAZIL	0.833 [0.362]	0.738 [0.714]	0.173 [0.678]
ARGENTINA	0.419 [0.518]	1.571 [0.101]	0.201 [0.654]
RUSIA	4.361** [0.038]	1.171 [0.305]	4.607** [0.033]
MEXICO	1.024 [0.313]	0.627 [0.819]	0.201 [0.655]
SOUTH AFRICA	0.001 [0.976]	1.333 [0.200]	3.124* [0.078]
CHILE	2.516 [0.114]	2.365*** [0.007]	0.438 [0.509]
TURKEY	0.196 [0.659]	3.426*** [0.000]	0.018 [0.894]
ISRAEL	0.872 [0.351]	1.203 [0.282]	3.044* [0.082]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX X

Diagnostic test(CRISIS)

(Malaysia and Developing countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	7.045*** [0.009]	1.049 [0.405]	1.086 [0.298]
CHINA	0.103 [0.749]	1.667* [0.075]	0.127 [0.722]
INDIA	0.638 [0.425]	1.755* [0.056]	0.159 [0.691]
BRAZIL	5.554** [0.019]	1.775* [0.053]	0.235 [0.628]
ARGENTINA	3.492* [0.063]	2.187** [0.013]	0.425 [0.515]
RUSIA	0.650 [0.421]	1.457 [0.141]	3.023* [0.083]
MEXICO	4.822** [0.029]	3.228*** [0.000]	0.003 [0.960]
SOUTH AFRICA	0.092 [0.762]	2.719*** [0.002]	6.450** [0.012]
CHILE	1.272 [0.261]	1.853** [0.041]	0.052 [0.820]
TURKEY	0.587 [0.444]	1.813** [0.047]	2.188 [0.140]
ISRAEL	0.286 [0.594]	1.475 [0.134]	1.475 [0.134]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX Y

Diagnostic test(POST CRISIS)

(Malaysia and Developing countries)

Dependent Variables	LM	HETERO	RESET
MALAYSIA	0.001 [0.986]	4.251*** [0.000]	2.466 [0.117]
CHINA	15.109*** [0.000]	6.293*** [0.000]	3.893** [0.049]
INDIA	0.363 [0.547]	10.751*** [0.000]	0.004 [0.951]
BRAZIL	4.998** [0.026]	5.681*** [0.000]	1.074 [0.300]
ARGENTINA	0.322 [0.571]	1.357 [0.180]	0.012 [0.914]
RUSIA	4.769** [0.029]	10.287*** [0.000]	0.429 [0.512]
MEXICO	0.923 [0.337]	5.631*** [0.000]	0.230 [0.632]
SOUTH AFRICA	1.044 [0.307]	7.801*** [0.000]	0.140 [0.708]
CHILE	0.135 [0.714]	3.935*** [0.000]	1.301 [0.254]
TURKEY	1.765 [0.184]	6.122*** [0.000]	0.689 [0.407]
ISRAEL	2.258 [0.133]	5.143*** [0.000]	2.000 [0.158]

Note: ***, ** and* represent significance at the 1 percent, 5 percent and 10 percent levels, respectively.

APPENDIX Z

Table 0.1 Summary of selective empirical evidence on stock market integration

Authors, Year of publication	Sample coverage data (Region/country)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Major Findings
Chelley-Steeley (2005)	Poland, Hungary, Czech republic, Russia.	1994-1999	Daily returns	Vector Autoregressive process (VAR) and smooth transition analysis.	A high degree of segmentation. However, Hungary's and Poland's level of integration slightly increased. Increasing integration among European stock markets.
Bley (2007)	Middle East and North African (MENA) countries: Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Tunisia, Turkey, UAE. India, UK and US.	January 2000-December 2004	Weekly return	VAR	The results indicate that the changing stock market dynamics within the MENA region still yield substantial intraregional diversification benefits and suggest the inclusion of regional equity in a global portfolio.

Eun and Shim (1989)	Australia, Japan, Hong Kong, UK, Switzerland, France, Germany, Canada and US.	December 1979-December 1985	Daily return	VAR model	A substantial amount of multi-lateral interaction is detected among national stock markets. No single foreign market can significantly explain the US market movements.
Ibrahim (2006)	US, Japan, Malaysia, Indonesia, Philippines, Singapore and Thailand.	January 1988-December 2003.	Monthly returns	VAR Multivariate cointegration test of Johansen (1988).	There was no long run relation among share prices in all systems of share prices before the Asian crisis and after the imposition of capital control. US market is more influential in accounting for fluctuations in the ASEAN markets. There are substantial short run dynamic interactions among the regional markets of ASEAN.
Bekaert and Harvey (1997)	Emerging equity markets: Argentina, Brazil, Chile, Colombia, Greece, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Portugal, Taiwan, Thailand, Turkey,	January 1976-December 1992	Annualized returns	Generalized method of moments (GMM).-Hansen's (1982). GARCH. SPARCH. Monte Carlo analysis.	They found that capital market liberalization often increases the correlation between local market returns and the world market but does not drive up local market volatility.

	Venezuela and Zimbabwe.				
Santis and Imrohoroglu (1997)	Europe/Mid-east: Greece, Turkey Asia: India, Korea, Malaysia, Philippines, Taiwan and China. Latin America: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela. Developed markets: Germany, Japan, UK and US.	December 1988-May1996	Weekly returns	GARCH (Bollerslev, 1986)	Emerging markets exhibit higher conditional volatility and conditional probability of large price changes than mature markets. Detect a risk reward relation in Latin America but not in Asia when they assume some level of international integration. Do not find support for the claim that market liberalization increases price volatility.
Bekaert and Harvey (2000)	Argentina, Brazil, Chile, Colombia, Greece, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Portugal, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe.	N/A	N/A	GARCH. Regression.	The capital market integration process reduces the cost of capital. Insignificant increases in the volatility of stock returns following capital market liberalizations. Interestingly, there is only a small increase in correlation with the world market return. Many foreign investors are attracted to emerging markets

					for the diversification.
Bekaert, Harvey and Ng (2005)	European countries: Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal, Spain, Sweden and Turkey. Southeast countries: Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand. Latin America: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela.	January 1980-December 1998.	N/A	GARCH.	Their results suggest that there is no evidence of additional contagion caused by the Mexican crisis. They found economically meaningful increases in residual correlation, especially in Asia, during the Asian crisis.
Bodart and Reding(1999)	Germany, France, Belgium, Italy, UK, Sweden. (Six European countries)	1989-1994	Daily returns	Correlation analysis and threshold analysis	Exchange rate variability influenced the cross-country relationship of stock markets. Degree of international correlation among stock markets is supposed to decrease. Increasing integration among European (CEEC) stock markets.
Baele	Austria, Belgium, France, Germany, Ireland, Italy,	1980-2001	Weekly returns	A regime-Switching	EU and US shock spillover intensity increased during 80s

(2005)	The Netherlands, Spain, Denmark, Sweden, Norway, Switzerland, UK, US, European (EU). (Western Europe)			volatility spillover Model	and 90s. Trade integration, equity market development and low inflation contribute to the increase in EU shock spillover intensity. Contagion from the US market to a number of local European equity markets. Increasing integration among Central and Eastern European Countries (CEEC) stock markets. Increasing integration of European stock (CEEC) markets with international markets.
Beckers, Connor and curds (1996)	Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, The Netherlands, Norway, New Zealand, Spain, Sweden, Switzerland, UK, US. (Developed countries)	1982-1995	Monthly returns	Simple Factor model approach (Heston and Rouwenhorst)	Weak evidence for increasing integration worldwide. Within the EU the degree of integration increased comparatively more than the level of world market integration. Increasing integration among European (CEEC) stock markets.

Freimann (1998)	France, Germany, Italy, The Netherlands, Spain, Sweden, UK.	1975-1996	Monthly returns	Randomization methodology and country-by-country analysis.	Integration of European stock markets is consistent with European economic integration. Between mid 70s until 1996, European stock market correlation has tripled. Diversification bargains of peripheral European countries have disappeared. Increasing integration among European (CEEC) stock markets.
Gerrits and Yuce (1999)	UK, Germany, The Netherlands, US.	1990-1994	Daily returns	Vector error correction model	US influenced the European equity markets in the short- and also in the long-run. Stock markets in Europe showed strong relationships. Increasing integration among European (CEEC) stock markets. Increasing integration of European (CEEC) stock markets with international stock markets.
Kanas (1998c)	UK, Germany, France	1984-1993	Daily prices	EGARCH model	Asymmetric volatility among the examined stock markets. After the 1987 crash more spillovers

					and spillovers of greater intensity existed. Increasing integration among European (CEEC) stock markets.
Bredin and Hyde (2008)	US, UK, German, Ireland and Denmark	1979-2005	Monthly observation of stock returns and macroeconomic variables.	Smooth transition regression (STR) model (Luukkonen et al., 1988) and Terasvirta (1994)	US (global), UK, and German (regional) stock returns are significant determinants of returns in both markets. The role of country-specific domestic variables is typically confined to a single state while global and regional variables pervade all states.
Huang and Yang (2000)	South Korea, Malaysia, Philippines, Thailand, Taiwan, Turkey, Argentina, Brazil, Chile and Mexico. (10 emerging markets coupled with world index)	1986-1998	Daily returns	ARCH Generalized Error Distribution (GED)(Box and Tiao, 1973) and Harvey (1981) ARMA	South Korea, Mexico and Turkey suffered from greater volatility. Argentina, Chile, Malaysia and Philippines experienced diminished volatility and no definitive pattern can be discerned for the other countries after market liberalization.

Kanas (1998a)	US and UK, Germany, France, Switzerland, Italy and the Netherlands (six largest European markets.)	1983-1996	Daily price stock indices.	Pair wise cointegration: Multivariate trace (Phillips and Ouliaris (1990), Johansen (1988) and Bierens' (1997a, 1997b).	US market is not pair wise cointegrated with any of the European markets. Potential long run benefits exist in risk reduction from diversifying in US stocks and stocks in any of the major European markets.
Hatemi-J and Morgan (2007)	Argentina, Brazil, Chile, Colombia, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Philippines, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe.	N/A	Monthly return	Case-wise bootstrapping method (Hatemi-J and Hacker (2005)	Only 4 of the 17 emerging markets have become more integrated with the world market after implementing liberalization policies. International portfolio diversification benefits might still exist for the investor even for the period after the implementation of liberalization policies in emerging markets.
Kazi (2008)	Australia, UK, US, Canada, Germany, France and Japan.	1945-2002	Annual data	Cointegration technique Johansen (1996, 2000)	Analyses confirm that Australian stock market has a long run relationship with overseas equity markets. The significant overseas markets for Australia are UK, Canada and Germany. Therefore, Australian investors

					would have little scope to include stock of the UK, Canada or Germany as they have minimal benefits of diversification.
Li (2007)	US, Japan, UK, Germany, France, Canada, Italy, MSCI world and Equally weighted world (EWW).	January 1980 – August 2004.	Weekly returns	Markov switching autoregressive conditional heteroscedasticity (SWARCH) model. Hamilton and Susmel (1994).	Both the individual and world stock markets during high volatility states will be associated with the minimum benefit f risk-reduction from international diversification and a maximum cross-market correlation.
Lagoarde-Segot, Lucey (2007)	Morocco, Tunisia, Egypt, Jordan, Lebanon, Turkey and Israel-Middle East and North African (MENA)	1998-2006	Weekly returns	Rolling block-bootstrap method-5 optimization models and two risk measure.	Outstanding diversification benefits in the MENA region. These markets could attract more portfolio flows in future.
Boon (1998)	Malaysia (sectorial)	September 1993-July 1998	Weekly indices	Multivariate cointegration method-Johansen-Juselius (1990). VECM.	The study shows that risk reduction through sectoral portfolio diversification is effective in the long-run, as the major sectors of the KLSE appear to share a common stochastic trend in the long-run. Among the various sectors in the

					KLSE, the Industrial Products, Finance and Property are the three leading sectors that exhibit direct causal effect on many other sectors.
Errunza, Hogan and Hung (1999)	Argentina, Brazil, Chile, Greece, India, Korea, Mexico, Thailand, Zimbabwe (emerging markets). Australia, Canada, France, Germany, Italy, Japan, UK (Developed markets)	1976-1993	Monthly returns	Mean Variance spanning and Sharpe ratio. GARCH.	Return correlations, mean-variance spanning, and Sharpe ratio test results provide strong evidence that gains beyond those attainable through homemade diversification have become statistically and economically insignificant. Incremental gains from international diversification beyond homemade diversification portfolios have diminished over time in a way consistent with changes in investment barriers.
Cheung, Mak (1992)	Australia, Hong Kong, Korea, Malaysia, Philippines, Singapore, Taiwan (Asian Pacific markets) and US, and	January 1977-June 1988	Weekly returns	Univariate autoregressive integrated moving average (ARIMA) model (Box and Jenkins (1976)	US market led most of the Asian-Pacific markets in the years 1978-1988 with the exception of Korea, Taiwan and Thailand. Japan seems to have a less significant impact on the Asian-

	Japan.				Pacific markets.
Alkulaib,Najand,Mashayekh (2008)	Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey and UAE. (12 MENA).	3 January 1999-31 December 2004.	Daily returns	State space modelling-(Aoki and Havenner, 1991)	No causality or spillover from one country to another in the North Africa region. The Levant region reveals that there are linkages between stock markets in this region. Gulf Cooperation Council (GCC) region show that there is more interaction and linkage in the GCC region than in the North Africa and Levant regions. UAE's stock market leads all the markets in this region.
Li and Rose (2008)	Chile, China, Indonesia, Korea, Malaysia, Mexico, Peru, Phllippines, Russia, Taiwan and Thailand. (APEC emerging markets)	30 June 1995 – 5 September 2003.	Daily returns	The generalized Pareto distribution model. The copula model with constant extreme correlation.	Both foreign and domestic portfolio investments have contributed to extreme market movements. Extreme correlation is time varying and dependent on local and regional market integrations. The relationship between market integration and extreme correlation varies across markets.

Bae Karolyi, Stulz (2003)	China, Korea, Philippines, Taiwan, India, Indonesia, Malaysia, Pakistan, Sri Lanka, Thailand, Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela (Emerging markets). US and International Europe index.	31 December 1995 - 29 December 2000	Daily returns	A multi nominal logistic regression model.	They found that contagion predictable and depends on regional interest rates, exchange rate changes and conditional stock return volatility. Evidence that contagion is stronger for extreme negative returns than for extreme positive returns is mixed.
Bae, Bailey, and Mao (2006)	Argentina, Brazil, Chile, China, Colombia, Czech Republic, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Portugal, Russia, Souh Africa, Sri Lanka, Taiwan, Thailand, Turkey and Venezuela (Emerging markets)	N/A	Monthly data	Univariate test, regression specifications and control variables.	Increased openness is associated with increase in firm-specific information, analyst coverage, and analyst value-added, and decrease in earnings management. Foreign analysts increase their presence, activity, and contribution to the information environment after openness increases.
Mun (2008)	Pacific Basin Countries: Hong Kong, Indonesia,	1 July 1997	Mean equity	EGARCH-Nelson (1991)	This paper indicates that exchange rate fluctuation

	Japan, Korea, Malaysia, Philippines, Singapore and Thailand.	19August 2001	market returns		contributes largely to higher equity market volatility and cross-market correlations. Falling (rising) US stock markets are associated with depreciating (appreciating) local currencies for most of the sample markets. Results from forecast error variance decomposition indicate that exchange rate fluctuations become more important in explaining the time series behaviour of equity market volatility and cross-market correlations during the Asian financial crisis.
Bekaert and Urias (1996)	US and UK.	January1986-August 1993	Weekly price	Mean-variance spanning test (Hansen and Jagannathan, 1991).	They found significant diversification benefits for the UK country funds, but not for US funds
Bekaert, Harvey and Lumsdaine (2002)	Argentina, Brazil, Chile, Colombia, Greece, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan,	N/A	Monthly returns.	VAR.GARCH (Bekaert and Harvey, 1997). Monte Carlo analysis.	They found strong evidence of structural breaks in emerging equity markets. Integration brings about or is accompanied by an equity market that is

	Philippines, Portugal, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe.				significantly larger and more liquid than before and stock returns that are more volatile and more correlated with world market returns than before.
Gupta and Mollik (2008)	Australia and Brazil, Chile, Greece, India, Korea, Malaysia, Mexico, Pakistan, Philippines, Sri Lanka and Turkey. (Emerging equity markets).	February 1988 – December 2005.	Monthly returns	Linear regression estimates of Asymmetric Dynamic Conditional Correlation model.	The correlations between Australia's equity return and emerging markets equity returns change over time and the variation in correlations is influenced by the volatility of the emerging market returns. The relationship between the correlations and the volatilities is stronger in some country pairs (with Brazil, Chile, India, Malaysia and Philippines) and very weak for Sri Lanka and turkey)
Bekaert and Harvey (1995)	Developed countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Spain,	December 1969- December 1992	Annual returns.	Regime switching model.	They found that a number of emerging markets exhibit time varying integration. Some markets appear more integrated than one might expect based on prior knowledge of investment

	Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland and, UK, US. Emerging markets: Chile, Colombia, Greece, India, Jordan, Korea, Malaysia, Mexico, Nigeria, Taiwan, Thailand and Zimbabwe.				restrictions. Other markets appear segmented even though foreigners have relatively free access to their capital markets. Their country specific investigation found that the world capital markets have not become more integrated.
Girard and Ferreira (2004)	Middle East and North African (MENA) capital markets: Jordan, Turkey, Israel, Egypt, Kuwait, Morocco, Lebanon, Saudi Arabia, Tunisia, Bahrain and Oman.	1 January 1990 -30 December 2001	Daily market index	VAR, GARCH, GIRF (Pesaran and Shin (1998), GVDF.	Their results indicate that most MENA markets are segmented (with the exception of Turkey and Israel). They suggest that MENA markets provide diversification potential for global investors and should not be treated as a block for global tactical asset allocation purposes.
Rezayat and Yavas (2006)	US, UK, France, Germany and Japan	January 1999-February 2002	Daily price	Cross correlation, auto correlation and partial auto correlation analyses. MARMA model.	Their findings indicate that even though the interdependencies among the markets are significant, there is still room for international portfolio diversification. Also the study

					provides mixed results for the hypothesis that the international market correlations change after an exogenous shock.
Driessen and Laeven(2007)	23 developed countries and 29 developing countries	1985-2002	Monthly returns	Regression test mean variance spanning (Huberman and Kandel, 1987)	They found the benefits of investing abroad are largest for investors in developing countries, including when controlling for currency effects. The gains from international portfolio diversification appear to be largest for countries with high country risk. They also provide evidence that diversification benefits vary over time as country risk changes.
DeFusco, Geppert and Tsetsekos (1996)	Emerging markets: Latin America: US and Brazil, Chile, Colombia, Mexico, Venezuela, Pacific Basin: US and Korea, Philippines, Taiwan, Malaysia,	January 1989-May1993	Weekly return	Johansen and Juselieus cointegration test. ARIMA.	The three regions combined with US are cointegrated. The correlation between these market is found to be low. It would appear that international diversification across these capital markets is justified and desirable.

	Thailand, Mediterranean: US and Greece, Portugal, turkey.				
Brooks and Negro (2004)	Companies for 42 developed and emerging countries.	January 1985-February 2002	Monthly returns	Heston and Rouwenhorst (1994,1995)	In the aftermath of the bubble, diversifying across countries may therefore still be effective in reducing portfolio risk.
Yusof and Majid (2006)	Malaysia, US and Japan	June 1996-September 2000	Daily returns	Co integration, Variance decomposition and impulse response functions.	The results indicate that there is only a co-movement of these markets in the post crisis period. The Japanese stock market is found to significantly move the Malaysian stock market compared to the US stock market for the post-crisis period.
Phengpis and Swanson (2006)	NAFTA countries: Canada, Mexico and US.	6 January 1988 - 31 December 2003	Weekly return	VAR model.	During the pre NAFTA period and during the post NAFTA period, consistently indicate the absence of long run interrelations among NAFTA stock markets through a cointegration relationship. Based on increased return volatilities and return

					correlations and the very small per unit of risk diversification gains even when the US stock market performs poorly, US investors' diversification gains have diminished since the implementation of NAFTA.
Mohamad, Hassan, Sori (2006)	Malaysia (sectorial)	September 1993-December 2002	Daily return	ARIMA	The findings imply that investment in one or two sectors f the stock market face higher total risk than in the past due to the increasing "sector" effects on portfolio investment.
Allen and Macdonald (1995)	16 developed stock markets	1970-1992	Monthly stock indices	Engle-Granger two-step cointegration method, and Johansen maximum likelihood framework	Cointegration between Australia and Canada, UK, and Hong Kong when using Engle-Granger method. When using Johansen approach, cointegration between Australia and (Germany and Switzerland).
Masih and Masih (1997)	Taiwan, South Korea, Singapore, Hong Kong, Japan, US, UK and	January 1982-June 1994	Monthly data	Multivariate cointegration, Vector Error Correction model, forecast error variance	Cointegration between Asian markets and developed markets. Hong Kong led the other Asian

	Germany			decomposition and impulse response functions	markets.
Sheng and Tu (2000)	Daily stock prices for the US and 11 Asian-Pacific equity markets.	Before and during the Asian Financial crisis	Daily stock prices	Multivariate cointegration and multivariate Granger causality test	Existence of integration among the equity markets during the crisis, but not before. Also US market causes some Asian markets during the crisis.
Wang et al. (2003)	Five African countries and US.	January 1996-May 2002	Daily stock indices prices	Generalized impulse response analysis	Limited interdependence between African countries. US only influences South Africa. Degree of integration between emerging markets tends to change over time.
Yang et al. (2003)	Ten Asian countries, US and Japan.	January 1995 - May 2001	Daily stock indices prices	Generalized impulse response analysis	Long run cointegration relationship and short run causal linkages among markets were strengthened during the crisis. Markets have been more integrated after the crisis. The degree of integration is changing over time. US influences all countries.

Tahai et al. (2004)	G7 countries	1978-1997	Monthly stock indices	Johansen (1992)	Co-movements of equity returns of market indices of the G7. No gains from diversification to investors with long holding periods in perfectly cointegrated markets.
Narayan et al. (2004)	South Asian countries	January 1995-November 2001	Daily data	ARDL approach	Long run relationship between the four markets in south Asia – India, Pakistan, Bangladesh and Sri Lanka – when stock prices in Pakistan is the dependent variable.

Table 0.2 Empirical studies on integration of European stock markets and European Monetary Union (EMU).

Authors, Year of publication	Sample coverage data (Region/country)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Major findings
Billio and Pelizzon (2003)	Germany, France, Italy, Spain, UK.	1988-2001	Weekly returns	Multivariate Switching regime model	Link between European countries has increased. Importance of world market index shocks and German shock spillover has increased for EMU countries. Increasing integration among European (CEE) stock markets.
Kim, Moshirian and Wu (2005)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Denmark, Sweden, UK, Japan, US.	January 1989-May 2003	Daily returns	Bivariate ARMA-EGARCH model and OLS and SURE	There has been a clear regime shift in European stock market integration with the introduction of the EMU. The EMU has been necessary for stock market integration as unidirectional causality. Increasing integration among European stock markets is due to the EMU.
Morana and Beltratti (2002)	France, Germany, Spain Italy, UK and USA	January 1988-May	Daily stock returns	Standard GARCH +Markov switching three-	Slight influence of the euro on the volatility of European stock markets. As far as the convergence process is concerned, there are signs of a stabilization in the Italian and

		2000		regime model	Spanish stock markets. US has been largely unaffected by the introduction of the Euro. Increasing integration among European stock markets due to the EMU/euro.
Rouwenhorst (1999)	Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, UK.	1978-1998	Monthly returns	Cross section regression analysis	Although fiscal and monetary policies converged, country effects are still important in European stock returns. Country effects dominate industry effects
Westermann (2004)	France, Germany, Italy and US.	1998-1999	Daily returns	GARCH model	Lead-lag relationship between stock market returns, disappeared after the introduction of the Euro. Increasing integration among European stock markets due to the EMU/euro
Chelley-Steeley (2005)	Poland, Hungary, Czech republic, Russia.	1994-1999	Daily returns	Vector Autoregressive process (VAR) and smooth transition analysis.	Eastern Europe stock markets showed a high degree of segmentation. However, Hungary's and Poland's level of integration slightly increased. Increasing integration among European stock markets.
Gilmore and McManus (2002)	Czech Republic, Hungary and Poland, US.	1995-2001	Weekly prices	Cointegration analysis (Engle-Granger methodology	Interdependencies between the Hungarian and the Polish market, no relationship with the US. Czech equity market was not impacted by the European or US stock

				and Johansen framework)	markets. Increasing integration among European stock markets. Decreasing integration of European stock markets with international stock markets.
Hassan, Haque and Lawrence (2006)	Czech Republic, Greece, Hungary, Poland, Russia, Slovakia, Turkey, US and UK.	December 1988-august 2002	Weekly returns	Box-Jenkins (1976) ARMA (pq) model. GARCH.	In general, European emerging markets are stable except Greece, Slovakia and Turkey, which are unpredictable. Results show evidence of autocorrelation in European emerging markets.
Choudhry (1996)	Spain, France, Italy, Sweden, Czechoslovakia and Poland	1925-1936	Monthly stock price	Multivariate co integration method. (Johansen)	The results indicate a stationary long run relationship between the indices during the 1925-1936 and also during the pre-October 1929 market crash period (1925-1929).
Meric and Meric(1997)	Netherlands, UK, Switzerland, Norway, Denmark, France, Belgium, Sweden, Italy, Germany, Spain, Austria and US.	November 1987-February 1994)	Monthly returns	Box M and principal component analysis. MANOVA.	The findings indicate that correlations among the twelve largest European equity markets and between these equity markets and the US equity market increased substantially. Therefore, the benefits of international diversification with these twelve European equity markets decreased considerably after the crash.