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IMPACT OF SHIFTS IN CORRELATION STRUCTURE ON INTERNATIONAL PORTFOLIO DIVERSIFICATION

Sazali Zainal Abidin

Abstract

Studies on international portfolio diversification in both developed and emerging countries suggest international diversification of portfolio investment is superior in terms of risk and terms of returns of a domestically formed portfolio. The more recent research has focused on the stability of the correlation structure that underpins the benefits of international portfolio diversification. The issue of whether correlation across markets for investors in Malaysian stock market (Bursa Malaysia) has shifted over time is addressed in this study. This current issue has significance for judging the benefits of international portfolio diversification. If the global stock markets are moving towards higher positive correlation over time, that would mean that the world's equity markets are becoming more integrated. The implication would be that the benefits for international portfolio diversification will be reduced. This study thus provides a time series analysis of a general trend and the shifts of correlation coefficients of internationally diversified portfolios.

In line with the general belief, results from the study show that there is indeed a positive trend in correlation coefficients between equity markets throughout the world. This is especially true for the developed countries. It is more notable during non-crisis periods. The study suggests that, in general, there is an upward shift in the correlation structure of the Malaysian equity market. The results also show that Malaysian equity market is most correlated with other equity markets in other countries during crisis periods and least correlated during non-crisis periods. The average correlation coefficient between MSCI Malaysia and other countries is mostly higher during crisis periods than those of non-crisis periods. However, it is the opposite for domestic stocks on Bursa Malaysia. The results show that the MSCI Malaysia is most correlated with selected domestic stocks on Bursa Malaysia during non-crisis periods and least correlated during crisis periods.

The study also shows that the average correlation coefficients of domestic-based portfolios are generally lower than those of internationally diversified portfolios. Thus, domestic-based portfolios may sometimes be superior to internationally diversified portfolios. The main determinants for the superiority of a domestic-based portfolio over an internationally diversified portfolio are the correlation coefficients among stocks in the domestic-based portfolio and the stock market or economic condition of the investment period.

Key words: Correlation, international, portfolio, diversification.

1. Introduction

One of the key issues in international equity investment is the measurement of diversification gain. Is there a positive diversification value as a result of international investment? A simple understanding of a positive diversification value is that an international equity investment will lead to higher return via the construction of a lower risk of portfolio of funds (assuming stable currency). However, the significance of benefits from international portfolio diversification has been questioned recently in view of the increasing integration among equity markets throughout the world.

The issue above has prompted many investigations being made to provide evidence of changing correlation coefficient over time across countries. The reason for the significance of this is valid. If the correlation coefficient is shifting haphazardly over time or shifting towards perfect correlation across any two markets, then gains from international diversification will be difficult to predict. It is suspected that the Malaysian market has both characteristics, namely that the correlation coefficient is changing and that over time some of the correlations are upward trending.

Hence, resolving these conditions of the economy is essential before a claim on diversification benefits could be advanced for a relatively volatile market such as the one under study.

International investment has gained credence among institutional portfolio managers in developed countries because of enhanced portfolio returns and reduced risk from global diversification, following the path-breaking work of Harry Markowitz's Portfolio Theory in 1959. The theory of international portfolio diversification is based on the premise that foreign equity investments could represent opportunities not duplicated in the home country. Empirical evidence, which supported international portfolio diversification can be traced back as far as 1968 when Grubel (1968) extended the concept of modern portfolio analysis to global markets but the ever-important breakthrough study in international portfolio diversification is the one made by Solnik (1974). This is further strengthened with other significant studies by Solnik (1988), which concluded that even at an average correlation coefficients of 0.35 among selected countries over a 15-year period from 1971 to 1986, international portfolio diversification is still meaningful in reducing risk and enhancing return.

One of the main issues in international portfolio diversification being debated in the more recent years is whether correlation across markets has increased and the reduced effect of international portfolio diversification. Naturally, many would expect a tendency for correlation across markets to increase as markets around the world are liberalised, capital flows more freely while different economies are more closely integrated through trade and investment flows.

Is it true that the global stock markets are moving towards higher positive correlation over time? In economics, this is equivalent to equity market being more integrated. If this is the case, theoretically, benefits for international portfolio diversification will be lessened over time but does this mean that it is not worth it to diversify internationally? This study shows that as long as the correlation coefficients between countries are less than +1.0, there is still some gain to be made from international portfolio diversification: however, from an academic as well as practical points, any unpredictable shift is likely to make investment practice that much less reliable, while a predictable upward shift towards unity makes the diversification gain marginally smaller over each time period of the upward shift. That latter will also make diversification benefits unmanageable. However, shifts in the structure need to be identified to estimate the extend of the uniform movement of the market towards lessened diversification benefits. This will provide, for the first time, an understanding of the development of the local market as well as practical lessons for the industry.

It would also be interesting to study whether correlation across markets increases at times of crisis or stock market crash. In general, many would expect market correlation to increase during periods of common shocks such as the Gulf Crisis in 1990. The empirical findings on the effects of shift in correlation structure in international portfolio diversification by Durand, Yoon and Maller (2002) showed significant correlation between national indices but unstable between periods, suggesting that simple extrapolation of correlation is not appropriate for investors when deciding to invest internationally.

The general objective of this study is to evaluate the impact of shifts in correlation structure on benefits of international portfolio diversification from the Malaysian perspective over a period of time. The specific objectives of the study are as follows:

i. To generate and analyse the average correlation coefficient between Malaysia and other selected countries during different sub-periods broken by pre-, during- and post-crisis or stock market crash;
ii. To study the differences in pattern of average correlation coefficient when the selected countries are divided into developed countries and emerging countries; and
iii. To analyse the pattern of the average correlation coefficient over a period of time and provide a general trend formed by the average.

2. Literature Review

Theories

Markowitz (1952; 1959) conveyed two significant insights with regard to Modern Portfolio Theory. Firstly, he realised that the mathematics could not pick out a single optimal portfolio

but rather could only identify a set of efficient portfolios. Secondly, he recognised that the appropriate risk facing an investor was portfolio risk, which leads to a fundamental point that the riskiness of a stock should not be measured just by the variance of the stock but also by their covariances. As a hindsight, the best portfolio will consist of assets, which are perfectly negatively (inversely) correlated. However, the world does not have perfectly negatively correlated assets (except when such a stock is created in hedge markets). There are plentiful almost perfectly positively correlated assets.

In Modern Portfolio Theory, the Markowitz stock portfolio model is optimised by minimising the risk of the portfolio as measured by the variance of stock prices, subject to a given portfolio return. The model solves for the optimal weights or percentage of each stock in the portfolio. Varying the returns between the minimum risk portfolio and the maximum return portfolio generates the efficient frontier. This is explained in Markowitz (1959). In short, Modern Portfolio Theory is a way to determine just how many eggs to put in each of several specified baskets.

Looking at the role of international investment, foreign equity investment could be duplicates of those found in the home country. If this is the case, then they do not offer new opportunities hence will not provide positive diversification value. On the other hand, foreign equity investments could represent opportunities not duplicated in the home country. If this is the case, then only investors can enjoy positive diversification value from their foreign equity investments. With this, international diversification can help investors to minimize the risks that arise from unforeseen developments in the world economy.

Bruno Solnik (1974) made a significant impact on development of international portfolio diversification. He showed that substantial advantages in risk reduction can be attained through portfolio diversification in foreign securities as well as in domestic common stocks. Bruno Solnik also highlighted that there is little evidence that either stock or bond markets have become more volatile world-wide, and correlation between markets remain low. However, correlations do appear to increase when market volatility increases, that is, just when the diversification potential offered by low correlation is most needed. While the biggest advantage for investing internationally is diversification, the biggest disadvantage is the currency risk. However, it is worth noted that although international diversification of equity portfolios represents an exposure to security risk and currency risk, it may also offer an opportunity to benefit from security returns and currency returns.

If correlation between international equity markets is sufficiently low, the cost of diversifying into these markets is outweighed by the benefits of reduction of risk as proved by Markowitz's Modern Portfolio Theory. However, the more recent research has focused on the stability of the benefits, or more specifically on the stability of the correlation structure that leads to these benefits. Durand, Yoon and Maller (2002) found that the correlation matrices between national indices proved to be unstable between periods and thus suggesting that simple extrapolation of correlation is not appropriate for international investors.

There have been a number of studies made to ascertain the changing in correlation structure. These studies generally show that correlation is indeed moving with time but the level of instability is difficult to quantify. Naturally, the instability of correlation between markets has an impact on international portfolio diversification. Hence, if investors want to take advantage of these apparent benefits from emerging market investments, then the issue of stability of correlation between the markets in a portfolio is undeniable vital. If the correlation structure is significantly unstable and moving towards high correlation between the chosen markets, then the international diversification benefits may be reduced significantly.

Evidence

In a conference proceeding held by the Association for Investment Management and Research (A.I.M.R.) in September 2002, Solnik, pointed out that:

> *"Correlations do not tell the whole story. Benefits from diversification can still be gained by investing non-domestically. In constructing portfolios, investors need to evaluate the rising importance of industry factors over the country factors when selecting securities. And above all, investors need to con-*

sider company factors, such as where the company does business and how much business is done there, not just where the company is headquartered".

As Bruno Solnik said, correlations do not tell the whole story, he also meant that correlations do to certain extent have an effect on the benefits of diversification. Many studies have been done on the relationship between correlation and international portfolio diversification. Makridakis and Wheelwright (1974) provided earlier study on the instability of correlation when they found that the intertemporal variations on monthly correlation are highly unstable. Jorion (1985) and Eun & Resnick (1988) pointed out the importance of stability in correlation between markets to gain from international portfolio diversification.

Errunza (1983) and Divecha (1992) conducted among the earlier studies on the inclusion of emerging economies' equity markets in internationally diversified portfolios. Their studies both concluded that the low correlation between emerging and developed market economies allows substantial gains from diversification across equity markets. Studies by Claude, Harvey and Viskanta (1994) and Longin and Solnik (1995) show that correlation between international stock market indices tends to vary over time according to the phases of the business cycle. Ragunathan and Mitchell (1996) extended the studies using 18 Morgan Stanley Capital International (MSCI) country indices and found results that do not overwhelmingly indicate the presence of time-varying correlation.

Studies made by Solnik, Boucelle and Le Fur (1996) also found that the pair-wise correlation between developed markets appears to be increasing over time, although there are short term fluctuations as well. Harvey (1995) and Bekaert and Harvey (1997) noted that the correlation between emerging and developed markets, and between emerging market themselves, tends to fluctuate quite wildly but does not increase significantly over time. However, Bekaert and Harvey (1997) also found that the correlation between emerging and developed markets does increase if market liberalisation takes place in the emerging economy or when world market volatility is high relative to local market volatility.

Tang (1996) found that the inter-temporal stability of correlation between emerging markets is much more stable and the diversification benefits that appear to exist are persistent because the correlation coefficients are sufficiently low. The study also found that the stability of correlation and hence benefits from international diversification also appear to increase as sampling interval shortens. A study by Izan, Tan and Walsh (1998) found a quite dramatic ex-post fluctuations in correlation of emerging markets with Australia. However, these fluctuations do not appear statistically significant, except for Latin-America markets. The study concluded that while ex post instability in emerging market correlation structure is insignificant, the benefits from international portfolio diversification are significant.

In a study on Asian emerging markets using the Morgan Stanley Capital International (MSCI) indices for a period from June 1989 to July 1998 by Soydemir (1999), the study found that cross-country correlation increases while the price of covariance risk appears to converge across countries towards the Asian crisis in mid 1997 and diverge afterwards. Durand, Yoon and Maller (2002) examined international portfolio optimisation using the full Markowitz method on daily data for 29 countries over the period of January 1988-December 1999. They found that, on average, the national indices in the sample study generated returns greater than the risk-free rate. Therefore, the study suggested that international diversification is consistent with a range of risk averse utility functions. They also found significant correlation between national indices. The correlation matrices proved to be unstable between periods, suggesting that simple extrapolation of correlation is not appropriate for international investors.

Kumar and Goetzmann (2002) examined the portfolios of more than 40,000 equity investment accounts from a large discount brokerage during a six year period (1991-1996) in recent U.S. capital market history. The study found that a vast majority of investors in the sample are under-diversified. Nonetheless, the study also found that over time, the average degree of diversification has improved but these improvements result primarily from changes in the correlation structure of the U.S. equity market. Adjaouté, Danthine and Isakov (2003) studied the impact on the degree of diversification for European investors as a result of implementation of the Euro dol-

lar and accompanying measures of financial integration. They found robust evidence that the structure of equity returns has changed in Europe specifically.

International diversification of equity portfolios has always been advocated on the basis of the low correlation between national stock markets. However, Longin and Solnik (1995) reminded that the covariance between national markets could change because the volatility of national markets evolves over time and also because the interdependence across markets also changes over time. Kaplanis (1988) studied the stability of the correlation and covariance matrices of monthly returns of ten stock markets over a fifteen-year period from 1967 to 1982. Kaplanis found that the null hypothesis that the correlation matrix is constant over two adjacent sub-periods could not be rejected at the 5 percent confidence level. Longin and Solnik (1995) replicated the global test for a constant unconditional correlation matrix performed by Kaplanis to estimate the unconditional correlation matrix for seven countries over six sub-periods of five years and test for the equality of the correlation matrix over adjacent sub-periods as well as over non-adjacent sub-periods. In the study, the null hypothesis of a constant correlation matrix is rejected at the 15 percent confidence level in 10 out of 15 comparisons and at the 5 percent level in 5 out of 15 comparisons. In addition, the same test applied to the covariance matrix leads to a rejection of the hypothesis of a constant covariance matrix at the 1 percent level in almost all comparisons. These results by Longin and Solnik confirmed the findings by Kaplanis that the covariance matrix is less stable than the correlation matrix. The study by Longin and Solnik resulted to lower p-values for the correlation matrix as compared to the results obtained by Kaplanis. This could be explained by an increased instability in the 1980s, since data in the study by Kaplanis ended in 1982 while those of Longin and Solnik ended in 1990.

3. Data And Methodology

Data

There are two major issues which may distort results using stock market indices of different countries. They are the effect of currency exchange rate and whether calculation of the index takes into account dividend adjustment. This issue is resolved by using the Morgan Stanley Capital International (MSCI) country indices, which provide standardisation as all the country indices are dividend-adjusted and quoted in a single currency, the U.S. Dollar (or a currency of one's choice). The first set of data comprises MSCI country indices for 20 selected countries. The 20 countries were selected based on geographical dispersion and availability of data. These data are used in the study to represent MSCI International Portfolios. A list of the selected countries and the MSCI Country Indices is presented in Table 1 below:

Table 1

List of Selected Countries and MSCI Country Indices

	Countries	MSCI Country Indices
1	Malaysia	MSCI Malaysia Index
2	Singapore	MSCI Singapore Index
3	Thailand	MSCI Thailand Index
4	Philippines	MSCI Philippines Index
5	Indonesia	MSCI Indonesia Index
6	Hong Kong	MSCI Hong Kong Index
7	Korea	MSCI Korea Index
8	Taiwan	MSCI Taiwan Index
9	China	MSCI China Index
10	India	MSCI India Index
11	Pakistan	MSCI Pakistan Index
12	Australia	MSCI Australia Index
13	New Zealand	MSCI New Zealand Index

Table 1 (continuous)

	Countries	MSCI Country Indices
14	Japan	MSCI Japan Index
15	Canada	MSCI Canada Index
16	United States	MSCI United States Index
17	United Kingdom	MSCI United Kingdom Index
18	Germany	MSCI Germany Index
19	France	MSCI France Index
20	Switzerland	MSCI Switzerland Index

To provide a more in-depth study, the 20 countries as in this study are also divided into either developed or emerging countries group in accordance with the classification of International Finance Corporation (IFC). The World Bank defines an emerging country as one having per capita GNP that would place it in the lower or middle-income category. At the end of 1995, an emerging country had an annual per capita GNP less than US$8,955. The classification of countries between Developed and Emerging Countries is shown in Table 2 below:

Table 2

Classification of Countries Between Developed and Emerging Countries

	Developed Countries		Emerging Countries
1	Singapore	1	Malaysia
2	United States	2	Thailand
3	United Kingdom	3	Philippine
4	Japan	4	Indonesia
5	Hong Kong	5	Korea
6	Australia	6	Taiwan
7	New Zealand	7	India
8	Germany	8	Pakistan
9	France	9	China
10	Switzerland		
11	Canada		

To compare the benefits of investing in an internationally diversified portfolio and a domestically diversified portfolio, data on selected domestic counters are needed. For this, the domestically diversified portfolios are represented by two different sets of domestic portfolios. Firstly, the Domestic-Large Portfolio, comprises the top 20 stocks listed on Bursa Malaysia, which consistently are in the list of the top 50 stocks with the largest market capitalisation on each year from 1987 to 2003. Secondly, the Domestic-Smaller Portfolio, comprises stocks on Bursa Malaysia with two constraints. The stocks must be listed on Bursa Malaysia throughout the period of the study (from January 1987 to December 2003) and it must exclude those stocks which have been chosen to form Domestic-Large Portfolio. In this way the research question on diversification can be investigated for two sets of divergent portfolios to document the differences. The stocks which are chosen to form the Domestic-Large Portfolio are as presented in Table 3 while the stocks which are chosen to form the Domestic-Smaller Portfolio are as presented in Table 4.

Table 3

List of Selected Stocks which form the Domestic-Large Portfolio

	Name of Stock		Name of Stock
1	British American Tobacco Malaysia Berhad	11	Malayan Banking Berhad
2	Batu Kawan Berhad	12	Malaysia Mining Corporation Berhad
3	ESSO Malaysia Berhad	13	Multi-Purpose Holdings Berhad
4	Genting Berhad	14	PPB Group Berhad
5	Guinness Anchor Berhad	15	Sarawak Enterprise Corporation Berhad
6	Highlands & Lowlands Berhad	16	Shell Refining Company (Malaysia) Berhad
7	Kuala Lumpur Kepong Berhad	17	Sime Darby Berhad
8	Magnum Corporation Berhad	18	Tan Chong Motor Holdings Berhad
9	Malayan United Industries Berhad	19	Tractors Malaysia Holdings Berhad
10	Malaysian Airlines System Berhad	20	United Plantations Berhad

Table 4

List of Selected Stocks which form the Domestic-Smaller Portfolio

	Name of Stock		Name of Stock
1	Aluminium Company of Malaysia Berhad	11	Lafarge Malayan Cement Berhad
2	Bandar Raya Developments Berhad	12	Malayawata Steel Berhad
3	Boustead Holdings Berhad	13	Mulpha International Berhad
4	Carlsberg Brewery Malaysia Berhad	14	Oriental Holdings Berhad
5	Chemical Company of Malaysia Bhd	15	RHB Capital Berhad
6	Guthrie Holdings Berhad	16	SCB Developments Berhad
7	Hong Leong Industries Berhad	17	Selangor Properties Berhad
8	Hume Industries Malaysia Berhad	18	SESB Berhad
9	IOI Corporation Berhad	19	Tasek Corporation Berhad
10	Kulim Malaysia Berhad	20	UMW Holdings Berhad

As the study also analyses the effects of international portfolio diversification at different periods of pre-, during- and post-crisis, the 17-year period is selected as it covers six major stock market crisis namely the 1987 stock market crash, the Gulf Crisis, the South East Asia Financial Crisis, the September 11, the Invasion of Iraq and the SARS Outbreak. Based on this, the whole 17-year period is then divided into additional 13 sub-periods which are identified in this study as in Table 5 below.

Table 5

Period and Sub-Periods of Study

Period	Name of Period	Date Started and Ended
Period 1	17 Years from January 1987 to December 2003	02 January 1987 to 31 December 2003
Period 2	Pre Crash 1987	02 January 1987 to 09 October 1987
Period 3	During Crash 1987	16 October 1987 to 25 December 1987
Period 4	Post Crash 1987	01 January 1988 to 27 July 1990
Period 5	During Gulf Crisis	03 August 1990 to 01 March 1991
Period 6	Post Gulf Crisis	08 March 1991 to 27 June 1997
Period 7	During Asian Financial Crisis	04 July 1997 to 25 December 1998

Table 5 (continuous)

Period	Name of Period	Date Started and Ended
Period 8	Post Asian Financial Crisis	01 January 1999 to 07 September 2001
Period 9	During September 11	14 September 2001 to 28 December 2001
Period 10	Post September 11	04 January 2002 to 14 March 2003
Period 11	During Invasion of Iraq	21 March 2003 to 18 April 2003
Period 12	Post Invasion of Iraq	25 April 2003 to 31 December 2003
Period 13	During SARS Outbreak	14 March 2003 to 27 June 2003
Period 14	Post SARS Outbreak	04 July 2003 to 31 December 2003

Methodology

In calculating expected return, the return of each asset is taken to be mean of the time series, hence across the portfolio, the portfolio return is the weighted average of the return, where the weight is the proportion invested into each asset. The expected return on the portfolio is given by the weighted average returns of the stock market index for each country. This is shown as below:

$$E(R_P) = \sum_{i=1}^{n} X_i E(R_i), \quad (1)$$

where $E(R_p)$ = the expected return of portfolio *p*,

X_i = the proportion of stock market index *i* in the portfolio,

$E(R_i)$ = the expected return of stock market index *i*, and

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

The portfolio risk is represented by the weighted average of the variability and the correlation coefficient of the returns from the sampled stock market indices. For this, the mean-variance model will be used to identify an optimal allocation of portfolio in several stock market indices. Variance of a portfolio is given by:

$$\sigma^2{}_p = \sum_{i=1}^{n} X^2{}_i \sigma^2{}_i + \sum_{i=1}^{n} \sum_{i=1}^{n} X_i X_j \sigma_{ij}, \quad (2)$$

where $\sigma^2{}_p$ = the variance of portfolio *p*,

$X_i X_j$ = the proportion of stock market index of country *i* and country *j*, respectively, in the portfolio,

$\sigma^2{}_i$ = the variance of stock market index *i*,

σ_{ij} = the covariance between stock market index *i* and *j*, and

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

The Efficient Frontier Calculator is used extensively in the study to generate the correlation matrix and analyse the shifts in correlation structure. By transferring the correlation coefficient matrix in the Efficient Frontier Calculator to an Excel spreadsheet, this study proceeded by calculating the average correlation coefficient for each set of the variable selections (International, Developed Countries, Emerging Countries, Domestic-Large and Domestic-Smaller portfolios) for each sub-periods. With the groupings of sub-periods into either Crisis Period or Non-Crisis Period, comparisons can be made on the average correlation between three groups, namely All Period, Crisis Period and Non-Crisis Period. By doing so, further analyses could be made of the behaviour of the average correlation during crisis and non-crisis periods for all the variable selections.

The analysis goes further in depth into the correlation between MSCI Malaysia and individual countries and stocks in the study. The average correlation between MSCI Malaysia and all variable selections for all period and sub-periods of study are computed and summarised in a table. Comparisons are made between the behaviour of average correlations between MSCI Malaysia and all variable selections during crisis and non-crisis periods. Similar analyses are performed on the behaviour of average correlations between MSCI Malaysia and all the countries selected on a yearly basis from 1987 to 2003 to establish the general trend of this emerging market. The behaviour of the average correlations across time is presented in graphs. The study then discussed the behaviour of the average correlations during crisis and non-crisis periods and its impact on international portfolio diversification.

4. Research Findings And Discussion

Table 6 shows the average correlation of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios for all sub-periods. The table also shows the averages of total average correlation of each of the variable selections for all sub-periods, crisis periods and non-crisis periods.

Table 6

Average Correlation Coefficient of MSCI International, MSCI Developed, MSCI Emerging, Domestic-Large and Domestic-Smaller Portfolios – All Sub-Periods

All Sub-Periods	Period													
	2 (X)	3 (X)	4 (X)	5 (X)	6 (X)	7 (X)	8 (X)	9 (X)	10 (X)	11 (X)	12 (X)	13 (X)	14 (X)	Average (X)
MSCI	0.10	0.39	0.10	0.32	0.14	0.39	0.25	0.38	0.30	0.12	0.37	0.46	0.32	0.28
MSCI Developed	0.10	0.50	0.21	0.46	0.23	0.52	0.37	0.70	0.48	0.25	0.51	0.56	0.47	0.41
MSCI Emerging	0.08	0.26	0.04	0.22	0.11	0.32	0.21	0.21	0.21	(0.01)	0.32	0.48	0.27	0.21
Domestic-Large	0.42	0.68	0.33	0.51	0.27	0.48	0.34	0.24	0.23	0.01	0.20	0.14	0.17	0.31
Domestic-Smaller	0.27	0.56	0.24	0.38	0.23	0.33	0.24	0.12	0.18	0.06	0.22	0.21	0.19	0.25

Non-Crisis Periods	Period													
	2 (X)	4 (X)	6 (X)	8 (X)	10 (X)	12 (X)	14 (X)							Average (X)
MSCI	0.10	0.10	0.14	0.25	0.30	0.37	0.32							0.23
MSCI Developed	0.10	0.21	0.23	0.37	0.48	0.51	0.47							0.34
MSCI Emerging	0.08	0.04	0.11	0.21	0.21	0.32	0.27							0.18
Domestic-Large	0.42	0.33	0.27	0.34	0.23	0.20	0.17							0.28
Domestic-Smaller	0.27	0.24	0.23	0.24	0.18	0.22	0.19							0.22

Crisis Periods	Period													
	3 (X)	5 (X)	7 (X)	9 (X)	11 (X)	13 (X)								Average (X)
MSCI	0.39	0.32	0.39	0.38	0.12	0.46								0.34
MSCI Developed	0.50	0.46	0.52	0.70	0.25	0.56								0.50
MSCI Emerging	0.26	0.22	0.32	0.21	(0.01)	0.48								0.25
Domestic-Large	0.68	0.51	0.48	0.24	0.01	0.14								0.34
Domestic-Smaller	0.56	0.38	0.33	0.12	0.06	0.21								0.28

The results showing the average correlation of the portfolios for all sub-periods are then divided into those of non-crisis periods and crisis periods. Among the average correlation recorded during the non-crisis periods, those of MSCI Developed Countries in Period 12 (Post Invasion of Iraq) was the highest with an average correlation of 0.51. On the other hand, the lowest average correlation among non-crisis periods was those of MSCI Emerging Countries in Period 4 (Post Crash 1987) for an average correlation of 0.04. The results show that among the non-crisis periods, the MSCI country indices tend to move together the most during Post Invasion of Iraq period and the least during Post Crash 1987 period.

Among the average correlation recorded during the crisis periods, those of MSCI Developed Countries in Period 9 (During September 11) was the highest with an average correlation of

0.70. On the other hand, the lowest average among non-crisis periods was for MSCI Emerging Countries in Period 11 (During Invasion of Iraq) with an average correlation of -0.01. The results show that among the crisis periods, the MSCI country indices tended to move together the most during September 11 period and the least during Invasion of Iraq period. Table 6 also shows the averages of total average correlation of each of the portfolios for all the sub-periods, during the non-crisis periods and during the crisis periods. For all the sub-periods, the MSCI Developed Countries portfolio recorded the highest average of total average correlation of 0.41 while the MSCI Emerging Countries portfolio recorded the lowest average of total average correlation of 0.21.

As for the non-crisis periods, the MSCI Developed Country portfolio recorded the highest average of total average correlation of 0.34 while the MSCI Emerging Countries portfolio recorded the lowest average of total average of 0.18. Similarly, for the crisis periods, the MSCI Developed Country portfolio recorded the highest average of total average correlation of 0.50 while the MSCI Emerging Countries portfolio recorded the lowest average of total average correlation of 0.25. The results on the highest and lowest average of total average correlation consistently show that MSCI Developed Countries portfolio recorded the highest average of total average correlation while the MSCI Emerging Countries portfolio recorded the lowest average of total average for all the sub-periods, non-crisis periods and crisis periods. This is a manifestation of the movement of capital from developed economies and also the increasing integration of the developed country economies with the Malaysian economy. Comovement is increasing rather fast with the developed countries than with the emerging countries. This shows that the MSCI country indices of developed countries tend to move together the most while the MSCI country indices of emerging countries tend to move together the least. This holds true both during non-crisis periods and crisis periods. Visually, these results can be seen in Figures 1, 2 and 3 below:

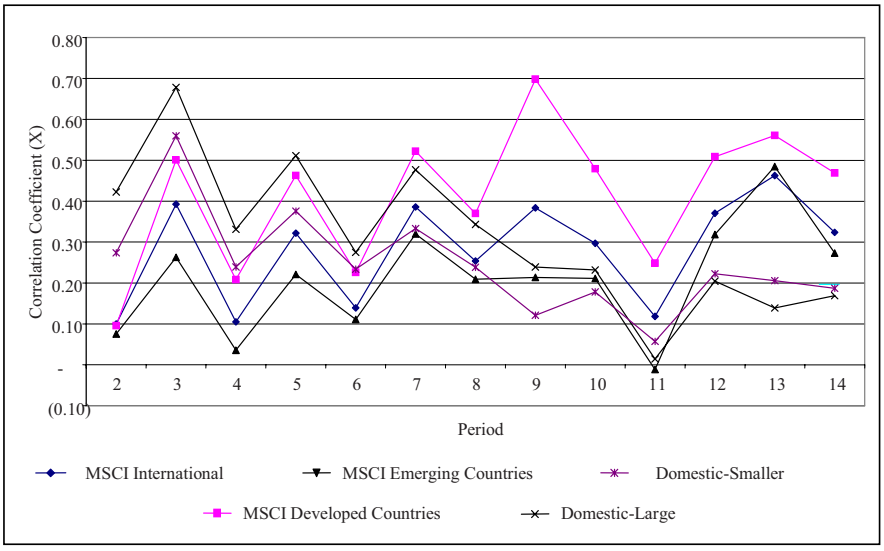

Fig. 1. Average Correlation Coefficient of MSCI International, MSCI Developed Countries, MSC Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios – All Sub-Periods

Figure 1 charts the average correlation of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios for all sub-periods. It shows a zig-zag pattern formed by the average correlations of the portfolios. It can be seen that the average correlations are always on the high side during crisis periods and on the lower side during non-crisis periods (for ease of reference, crisis periods are odd numbers while non-crisis periods are even numbers).

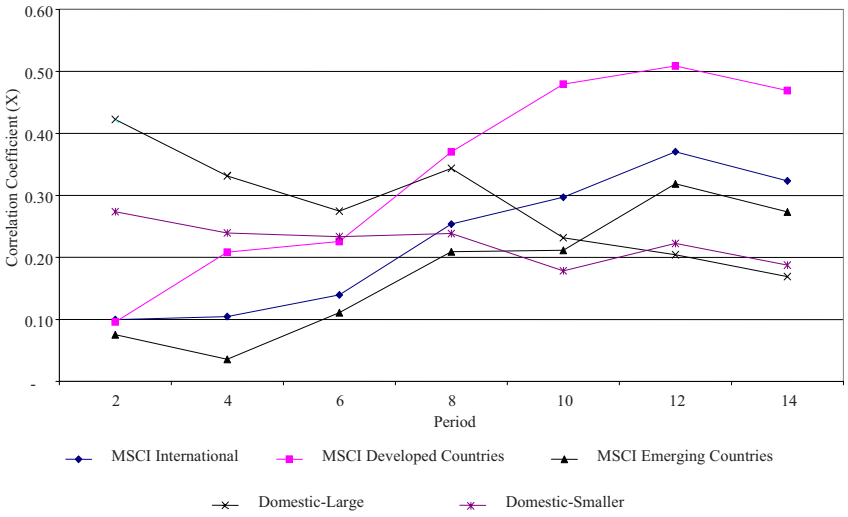

Fig. 2. Average Correlation Coefficient of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios – Non-Crisis Periods

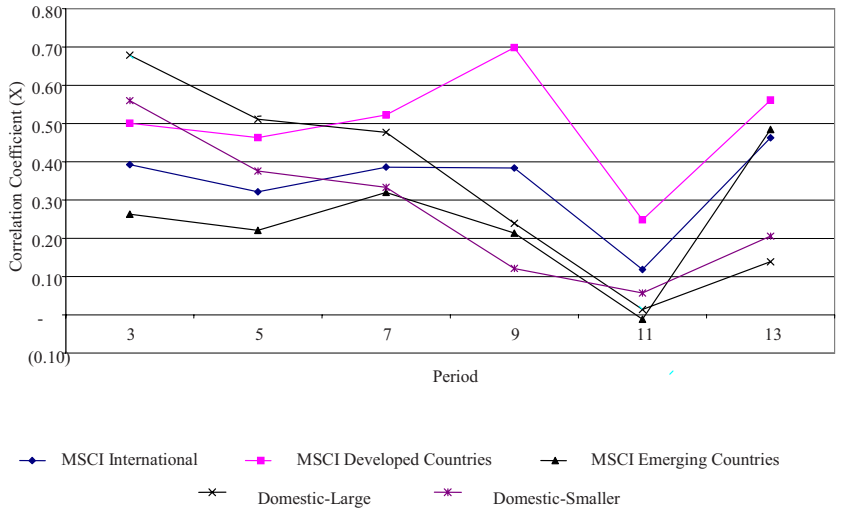

Fig. 3. Average Correlation Coefficient of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios – Crisis Periods

Figure 2 shows the average correlation of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios during non-crisis periods. It is noticeable that there is a contrast in trend between internationally diversified portfolios and domestic-based portfolios. Figure 2 shows that there is a general upward trend of the average correlation throughout the non-crisis periods for all three internationally diversified portfolios. However, the opposite is evidenced for both the domestic-based portfolios where a general upward trend throughout the non-crisis periods is observed. This helps us to conclude that the countries selected in general are moving towards higher correlation to each other throughout the non-crisis periods but the domestic stocks selected are getting less correlated to each other.

Figure 3 on the other hand shows the average correlation of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios during crisis periods. It does not show a general trend of the average correlation throughout the crisis periods. This suggests a conclusion that the countries and domestic-based stocks selected moved rather randomly throughout the crisis periods rather than forming a general trend. Nonetheless, Figure 3 also shows that all of the portfolios have common lowest average correlation during Period 11 (During Invasion of Iraq).

Further analyses of the results show that the averages of total average correlations of each of the portfolios are the highest during the crisis periods as compared to all sub-periods and during non-crisis periods. In addition, the averages of total average correlations of each of the portfolios during non-crisis periods are the lowest as compared to all sub-periods and during crisis periods. For example, the average of total average correlation of MSCI International portfolio during the crisis periods was 0.34 compared to 0.28 for all sub-periods and 0.23 during the non-crisis periods. This sequence from highest to lowest holds true for all the other portfolios as well, namely MSCI Developed Country, MSCI Emerging Country, Domestic-Large and Domestic-Smaller portfolios.

The results appear to support a conclusion that the MSCI country indices and domestic-based stocks tend to move together the most during crisis periods and the least during non-crisis periods. Regardless of whether the MSCI country indices are those of developed countries only, developing countries only or a combination of both developed and developing countries, they tend to move together more during crisis periods than non-crisis periods. In other words, comovement is more accentuated during crisis periods irrespective of the stage of the development of the market or the stability of the economy. Similarly, regardless of whether the domestic-based stocks are those of large market capitalisation stocks or smaller selected stocks, they also tend to move together more during crisis periods than non-crisis periods. Visually, this can be seen from Figure 4 as below.

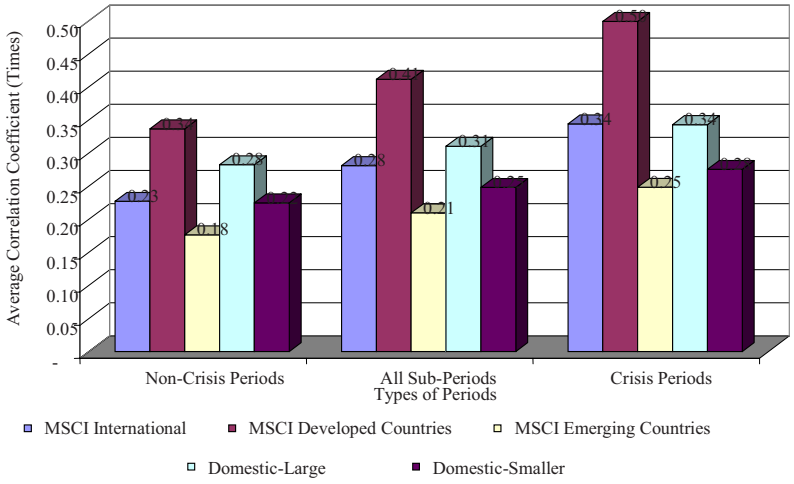

Fig. 4. Average of Total Average Correlation Coefficients of MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios

Figure 4 shows that the averages of total average correlation of each of the portfolios are the highest during the crisis periods as compared to those for all sub-periods and non-crisis periods. Whilst, the averages of total average correlation of each of the portfolios for all sub-periods are higher than those for the non-crisis periods.

In order to find whether the average correlation between all the portfolios are statistically significant or not, a Kruskal-Wallis test (Levin, 1999) is performed between all possible pairs of means of correlation between the portfolios. The Kruskal-Wallis test is a non-parametric test that compares three or more unpaired groups of variables. To perform the Kruskal-Wallis test, all the values in the variables are ranked from low to high, disregarding which group each value belongs.

In a situation where two values are the same, then they both get the average of the two ranks for which they tie. The smallest number shall be assigned a rank of 1 while the largest number gets a rank of N, where N is the total number of values in all the groups. From here, sums of the ranks in each group are calculated and if the sums of the ranks are very different, the P-Value will be small. The discrepancies among the rank sums are combined to create a single value called the Kruskal-Wallis statistic (the H-Value). A larger Kruskal-Wallis statistic corresponds to a larger discrepancy among rank sums. The results of the Kruskal-Wallis test are shown in Table 7.

The results from Table 7 show that the means of correlations of three out of eight possible pairs of portfolios are statistically significant at 5 percent level of significance. The three pairs of portfolios are those between MSCI Developed Countries and MSCI Emerging Countries portfolios with the highest H-Value of 6.98 points, MSCI Developed Countries and Domestic-Smaller portfolios with an H-Value of 5.44 points and lastly between MSCI International & MSCI Developed Countries portfolios with an H-Value of 4.10 points. The means of correlations of the other five pairs of portfolios are not statistically significant at 5 percent level of significance.

Table 7

Kruskal-Wallis Test on Means of Correlation Coefficient of Portfolios for All Sub-Periods – Ranked Between Pairs of Portfolios

H-Value Ranking	Portfolios Pair	Chi-Square Distribution - H-Value	Probability at 5% level of significance - P-Value	Result (at 5% level of significance)
1	MSCI Developed Countries & MSCI Emerging Countries	6.98	0.01	Significant
2	MSCI Developed Countries & Domestic-Smaller	5.44	0.02	Significant
3	MSCI International & MSCI Developed Countries	4.10	0.04	Significant
4	MSCI International & MSCI Emerging Countires	2.61	0.11	Not Significant
5	MSCI Developed Countries & Domestic-Large	2.29	0.13	Not Significant
6	MSCI International & Domestic-Smaller	0.90	0.34	Not Significant
7	Domestic-Large & Domestic-Smaller	0.81	0.37	Not Significant
8	MSCI International & Domestic-Large	0.11	0.74	Not Significant

It is interesting to note that the MSCI Developed Countries is one of the portfolios in all the three pairs of portfolios which are tested to be statistically significant. This suggests that the means of correlations of MSCI Developed Countries portfolio is statistically significant with all of the portfolios except the Domestic-Large portfolio. The results also suggest that the means of correlations of MSCI Developed Countries portfolio is not significantly different from those of Domestic-Large portfolio.

In the context of international portfolio diversification, the high H-Value of 6.98 points for means of correlations between MSCI Developed Countries and MSCI Emerging Countries portfolios suggests that there is a significant difference on how assets in each portfolio are correlated to each other. On the other hand, as for the domestic-based portfolios, the low H-Value of 0.81 points for means of correlations between Domestic-Large and Domestic-Smaller portfolios suggests that the manner in which assets in each of the portfolios is correlated to each other is not significantly different. This is consistent with theory that individual assets must have low covariances, thus low correlations compared with portfolios of assets.

Table 8 shows the correlation between MSCI Malaysia and each of the MSCI country indices of individual countries in the study for all period and sub-periods. The countries are grouped into two groups, namely Developed Countries and Emerging Countries. Period 1 represents the whole 17-year period from January 1987 to December 2003 while Period 2 to Period 14 are the sub-periods as defined in Table 3.7 in Chapter 3. Table 8 also provides the average correlations between MSCI Malaysia and each of the MSCI country indices of individual countries. These average figures exclude Period 1 as Period 1 already represents the whole 17-year period from January 1987 to December 2003. Thus, they are the average figures for Period 2 to Period 14 only. The

table also shows the average correlation of the MSCI International, MSCI Developed Countries and MSCI Emerging Countries portfolios for each of the period and sub-periods.

Table 8

Correlation Coefficients between MSCI Malaysia and Individual MSCI Country Indices within the MSCI Developed Countries and MSCI Emerging Countries Portfolios – All Period and Sub-Periods

	Correlation Coefficient with MSCI Malaysia														
	Period or Sub-Period														
Period / Country	1 (X)	2 (X)	3 (X)	4 (X)	5 (X)	6 (X)	7 (X)	8 (X)	9 (X)	10 (X)	11 (X)	12 (X)	13 (X)	14 (X)	Average (X)
MSCI Developed Countries															
Singapore	0.57	0.84	0.95	0.91	0.97	0.63	0.59	0.14	0.76	0.58	0.22	0.29	0.40	0.37	0.59
United States	0.20	0.15	0.77	0.12	0.45	0.06	0.30	0.18	0.60	0.17	0.24	0.14	0.29	0.09	0.27
United Kingdom	0.27	0.24	0.93	0.26	0.42	0.20	0.41	0.09	0.32	0.09	0.04	(0.03)	0.21	(0.08)	0.24
Japan	0.24	(0.01)	0.63	0.17	0.73	0.12	0.40	0.09	0.23	0.33	0.82	0.27	0.34	0.15	0.33
Hong Kong	0.38	0.38	0.70	0.46	0.84	0.40	0.39	0.19	0.69	0.39	0.09	0.22	0.40	0.25	0.42
Australia	0.10	0.05	0.40	0.30	0.38	0.14	0.38	0.04	0.56	0.35	0.13	0.32	0.27	0.28	0.28
New Zealand	0.23	(0.12)	0.37	0.22	0.41	0.21	0.36	0.10	0.35	0.25	0.51	0.08	0.25	(0.04)	0.23
Germany	0.27	0.10	0.83	0.21	0.77	0.27	0.30	0.21	0.46	0.18	0.11	0.21	0.28	0.22	0.32
France	0.21	(0.02)	0.90	0.01	0.59	0.17	0.36	0.10	0.40	0.09	0.06	0.03	0.17	0.06	0.22
Switzerland	0.04	(0.07)	0.54	(0.06)	0.25	(0.02)	0.31	0.04	0.41	0.10	(0.06)	0.04	0.18	0.06	0.13
Canada	0.25	0.20	0.75	0.14	0.26	0.06	0.43	0.16	0.61	0.29	0.25	0.22	0.35	0.19	0.30
Total	2.76	1.74	7.77	2.74	6.07	2.24	4.23	1.34	5.39	2.82	2.41	1.79	3.14	1.55	
Number of Countries	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
Average	0.25	0.16	0.71	0.25	0.55	0.20	0.38	0.12	0.49	0.26	0.22	0.16	0.29	0.14	0.30
MSCI Emerging Countries															
Thailand	0.45	0.39	0.80	0.36	0.81	0.37	0.53	0.17	0.52	0.28	(0.24)	0.47	0.54	0.40	0.42
Philippines	0.35	0.29	0.33	0.19	0.49	0.34	0.57	0.10	0.36	0.18	(0.66)	0.14	0.16	0.10	0.20
Indonesia	0.34	0.17	(0.11)	(0.01)	0.45	0.33	0.54	0.12	0.27	0.13	(0.27)	0.21	0.31	0.17	0.18
Korea	0.22	0.10	0.34	0.05	0.46	0.12	0.32	0.08	0.56	0.33	0.51	0.36	0.41	0.34	0.31
Taiwan	0.22	0.03	0.53	(0.08)	0.71	0.12	0.42	0.29	0.66	0.39	0.34	0.42	0.58	0.24	0.36
India	0.09	0.15	0.54	0.11	(0.01)	0.02	0.25	0.05	0.60	0.16	0.14	0.24	0.44	0.21	0.22
Pakistan	-	-	-	-	0.10	0.02	0.09	0.16	(0.19)	0.16	0.27	0.04	0.51	(0.02)	0.11
China	-	-	-	-	-	-	0.55	0.04	0.26	0.38	0.22	0.42	0.67	0.46	0.38
Total	1.67	1.13	2.43	0.62	3.01	1.32	3.27	1.01	3.04	2.01	0.31	2.30	3.62	1.90	
Number of Countries	6	6	6	6	7	7	8	8	8	8	8	8	8	8	
Average	0.28	0.19	0.41	0.10	0.43	0.19	0.41	0.13	0.38	0.25	0.04	0.29	0.45	0.24	0.27
MSCI International															
Total	4.43	2.87	10.20	3.36	9.08	3.56	7.50	2.35	8.43	4.83	2.72	4.09	6.76	3.45	
Number of Countries	17	17	17	17	18	18	19	19	19	19	19	19	19	19	
Average	0.26	0.17	0.60	0.20	0.50	0.20	0.39	0.12	0.44	0.25	0.14	0.22	0.36	0.18	0.29

The results in Table 8 show that the average correlation between MSCI Malaysia and MSCI Developed Countries portfolio is the highest at 0.30, followed by MSCI International portfolio at 0.29 and MSCI Emerging Countries portfolio at 0.27. These results suggest that, on average, MSCI Malaysia is more correlated with MSCI country indices of the developed countries than with MSCI country indices of the emerging countries or of all the developed and emerging countries.

On the other hand, a micro analysis on Period 1 (17-year from January 1987 to December 2003) alone shows that the average correlation between MSCI Malaysia and MSCI country indices of emerging countries is the highest at 0.28, followed by those of between MSCI Malaysia and MSCI country indices of all international countries at 0.26 and lastly between MSCI Malaysia and MSCI country indices of developed countries at 0.25. The results suggest that in the long term, Malaysia's equity market is more correlated with equity markets in the emerging countries than with the developed countries. Many factors contribute to this which includes cultural and geo-

graphical, higher intra-asian and regional trade than inter-continents trade and almost similar time zone for the regional stock markets.

Table 9 shows the correlation between MSCI Malaysia and each of the stocks in the domestic-based portfolios for all period and sub-periods. The table also provides the average correlation between MSCI Malaysia and each of the stocks. These average figures exclude Period 1 as Period 1 already represents the whole 17-year period from January 1987 to December 2003. Thus, they are the average figures for Period 2 to Period 14 only. Average correlations of the Domestic-Large and Domestic-Smaller portfolios are also shown.

Table 9

Correlation Coefficients between MSCI Malaysia and Individual Stocks within the Domestic-Large and Domestic-Smaller Portfolios – All Period and Sub-Periods

	Correlation Coefficient with MSCI Malaysia														
	Period or Sub-Period														
Period / Company	1 (X)	2 (X)	3 (X)	4 (X)	5 (X)	6 (X)	7 (X)	8 (X)	9 (X)	10 (X)	11 (X)	12 (X)	13 (X)	14 (X)	Average (X)
Domestic-Large															
BAT	0.06	0.92	0.76	0.65	0.75	0.90	0.31	0.27	0.08	(0.38)	(0.57)	0.52	0.21	0.09	0.35
Batu Kawan	0.44	0.98	0.86	0.31	0.54	0.95	0.78	0.12	0.82	(0.20)	(0.71)	0.62	0.49	0.90	0.50
Esso	0.68	0.96	0.92	0.85	0.72	0.63	0.93	0.10	0.86	0.86	(0.37)	0.76	0.62	0.49	0.64
Genting	0.82	0.11	0.99	0.97	0.18	0.85	0.63	0.76	0.91	0.61	0.77	0.99	0.84	0.96	0.74
Guinness	0.50	0.96	0.97	0.93	0.73	0.27	0.64	0.33	(0.01)	(0.07)	(0.39)	0.93	0.77	0.91	0.54
Hi&Lo	0.72	0.88	0.45	0.69	0.49	0.93	0.50	0.30	0.91	0.40	(0.35)	0.56	0.35	0.56	0.51
KLK	0.21	0.93	0.95	0.30	0.29	0.88	0.26	(0.15)	0.79	0.33	0.07	0.90	0.75	0.88	0.55
Magnum	0.86	0.66	0.96	0.91	0.55	0.90	0.88	0.55	0.04	0.91	0.79	0.81	0.93	0.18	0.70
Malayan Utd. Ind.	0.87	0.90	0.99	0.95	0.90	0.86	0.90	0.31	0.59	0.85	0.54	0.83	0.68	0.78	0.78
MAS	0.54	0.93	0.99	0.84	0.81	0.54	0.94	0.63	0.88	0.77	0.81	0.94	0.90	0.78	0.83
Maybank	0.40	0.96	0.98	0.97	0.81	0.95	0.94	0.95	0.93	0.90	(0.61)	0.97	0.82	0.91	0.81
MMC	0.73	0.96	0.99	0.54	0.94	0.92	0.81	0.15	0.49	0.90	(0.81)	0.88	0.96	0.39	0.62
Multi-Purpose	0.93	0.69	0.97	0.90	0.91	0.91	0.98	0.35	0.33	0.25	0.83	0.49	0.95	(0.10)	0.65
PPB Group	0.81	0.90	0.98	0.85	0.64	0.89	0.88	0.64	0.35	(0.10)	(0.54)	0.95	0.80	0.86	0.62
Sarawak Ent.	0.75	0.93	0.87	0.36	0.68	0.43	0.95	0.62	0.74	0.84	0.22	0.84	0.80	0.45	0.67
Shell	0.76	0.97	0.95	0.93	0.72	0.56	0.82	0.29	0.76	0.75	(0.08)	0.69	0.93	(0.03)	0.64
Sime Darby	0.83	0.99	1.00	0.95	0.82	0.93	0.95	0.53	0.81	0.71	0.29	0.67	(0.43)	0.89	0.70
Tan Chong	0.61	0.96	0.98	0.98	0.87	0.54	0.89	0.69	0.46	0.85	(0.69)	0.88	0.68	0.61	0.67
Tractors	0.71	0.89	0.99	0.96	(0.07)	0.67	0.95	0.82	(0.58)	0.62	(0.28)	0.79	0.54	0.40	0.52
United Plant.	0.76	0.76	(0.04)	0.86	0.00	0.69	0.67	0.25	0.83	(0.37)	0.75	0.90	0.90	0.85	0.54
Total	12.99	17.23	17.52	15.69	12.29	15.20	15.61	8.51	11.00	9.43	(0.33)	15.91	13.46	11.76	
Number of Companies	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Average	0.65	0.86	0.88	0.78	0.61	0.76	0.78	0.43	0.55	0.47	(0.02)	0.80	0.67	0.59	0.63
Domestic-Smaller															
Alcom	0.89	0.50	0.83	0.94	0.89	0.75	0.93	0.83	0.24	0.56	(0.27)	0.84	0.78	0.88	0.67
Bandar Raya	0.92	0.94	0.98	0.85	0.80	0.92	0.95	0.63	0.82	0.93	(0.61)	0.97	0.94	0.92	0.77
Boustead	0.90	0.94	0.99	0.96	0.50	0.96	0.93	0.57	0.81	0.63	(0.03)	0.59	0.62	(0.23)	0.63
Carlsberg	0.28	0.94	0.90	0.89	0.06	0.82	0.56	0.74	0.51	0.64	(0.49)	(0.52)	0.46	(0.45)	0.39
CCM	0.58	(0.54)	0.90	0.79	0.77	0.82	0.81	0.62	0.52	0.84	(0.03)	0.81	0.83	0.54	0.59
Guthrie	0.65	0.84	0.17	(0.49)	0.63	0.96	0.80	0.58	0.46	0.79	(0.16)	0.91	0.81	0.67	0.53
Hong Leong Ind.	0.72	0.76	0.73	0.97	0.62	0.84	0.95	0.89	0.68	0.75	(0.80)	0.97	0.93	0.90	0.71
Hume	0.87	0.80	0.98	0.97	0.80	0.93	0.95	0.63	0.56	(0.36)	0.11	0.97	0.90	0.93	0.71
IOI Corp.	0.33	0.88	0.95	0.90	0.94	0.97	0.70	0.36	0.78	0.40	(0.35)	0.94	0.77	0.94	0.70
Kulim	0.87	0.94	0.80	0.93	0.61	0.95	0.89	0.63	0.85	0.30	0.32	0.81	(0.49)	0.91	0.65
Lafarge MC	0.89	0.88	0.96	0.97	0.77	0.94	0.96	0.85	0.92	0.79	0.72	0.93	0.65	0.94	0.87
Malayawata	0.72	0.92	0.75	0.88	0.27	0.46	0.93	0.74	0.47	(0.29)	(0.66)	0.79	0.69	0.54	0.50
Mulpha Intl.	0.84	0.78	0.91	0.92	0.83	0.76	0.95	0.43	0.70	0.85	0.33	0.93	0.88	0.78	0.77
Oriental	0.52	0.93	0.99	0.96	0.86	0.76	0.89	0.61	0.83	0.91	(0.54)	0.89	0.84	0.51	0.73
RHB Cap.	0.92	0.97	0.96	0.88	0.95	0.96	0.96	0.76	0.94	0.81	0.36	0.97	0.97	0.91	0.88
SCB Devp.	0.51	0.89	0.83	0.45	0.82	0.73	0.85	0.72	0.87	0.83	(0.24)	0.74	0.61	0.93	0.69
Sel. Prop.	0.80	0.76	0.99	0.90	0.89	0.89	0.79	0.79	0.65	0.71	(0.41)	0.81	0.37	0.33	0.65
SESB	0.76	0.95	0.99	0.84	0.92	0.81	0.94	0.37	0.01	(0.41)	(0.05)	0.89	0.77	0.64	0.59
Tasek Corp.	0.87	0.95	0.94	0.97	0.80	0.91	0.88	0.16	0.35	0.45	(0.22)	0.52	0.34	0.63	0.59
UMW Hldgs.	0.67	0.78	0.51	0.94	0.74	0.71	0.96	0.75	0.65	0.78	0.47	0.95	0.92	0.84	0.77
Total	14.49	15.81	17.05	16.41	14.48	16.85	17.57	12.64	12.62	10.90	(2.57)	15.72	13.57	13.05	
Number of Companies	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Average	0.72	0.79	0.85	0.82	0.72	0.84	0.88	0.63	0.63	0.54	(0.13)	0.79	0.68	0.65	0.67

The results in Table 9 show that the average of the correlations between MSCI Malaysia and stocks within the Domestic-Smaller portfolio (at 0.67) is higher than those of between MSCI Malaysia and stocks within the Domestic-Large portfolio (at 0.63). The results suggest that on average, MSCI Malaysia is more correlated with smaller stocks on Bursa Malaysia than the larger

stocks on Bursa Malaysia although the different is not significant. On the other hand, a micro analysis on Period 1 (17-year from January 1987 to December 2003) alone shows that the average correlation between MSCI Malaysia and stocks within the Domestic-Smaller portfolio (at 0.72) is higher than that between MSCI Malaysia and stocks within the Domestic-Large portfolio (at 0.65). The results suggest that, in the long term, the MSCI Malaysia is more correlated with smaller stocks on Bursa Malaysia than larger stocks on Bursa Malaysia.

The results from Table 9 also show that on average, MSCI Malaysia is more correlated with stocks with smaller market capitalisation as compared to stocks with larger market capitalisation. Nonetheless, the difference between the two average correlations of only 0.04 is too small. More paramount to the difference between the two average correlations is that both figures are far from positive 1.0 correlation coefficient which means that any portfolios constructed from stocks in the portfolio will bring risk reduction benefits. On top of that, the results also show that the average correlation coefficient of each portfolios diverse widely between the sub-periods. For both portfolios, the average correlations for Period 11 (During Invasion of Iraq) are in the negative territory.

Comparing the results presented in Tables 8 and 9, it can be concluded that in the context of the study, on average, MSCI Malaysia is most correlated with stocks within the Domestic-Smaller portfolio (at 0.67) and least correlated with MSCI country indices of the MSCI Emerging Countries (at 0.27). These are the results for the whole sub-periods from Period 2 to Period 14.

The results for the whole sub-periods are then grouped into two groups, non-crisis periods and crisis periods. By doing so, the study analyses the shifts in correlations between MSCI Malaysia and the portfolios during non-crisis periods only and during crisis periods only. This is presented in Table 10. The table presents the average correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios. It also provides the averages of correlations between MSCI Malaysia and each of the portfolios for all the sub-periods, during the non-crisis periods and during the crisis periods. For all the sub-periods, the Domestic-Smaller portfolio recorded the highest average of total average correlation of 0.67 while the MSCI Emerging Countries portfolio recorded the lowest average of total average correlation of 0.27.

Table 10

Average Correlation Coefficients between MSCI Malaysia and MSCI International, MSCI Developed, MSCI Emerging, Domestic-Large and Domestic-Smaller – All Sub-Periods, Non-Crisis Periods and Crisis Periods

All Sub-Periods	**Sub-Period**													
	2 (X)	**3 (X)**	**4 (X)**	**5 (X)**	**6 (X)**	**7 (X)**	**8 (X)**	**9 (X)**	**10 (X)**	**11 (X)**	**12 (X)**	**13 (X)**	**14 (X)**	**Average (X)**
MSCI International	0.17	0.60	0.20	0.50	0.20	0.39	0.12	0.44	0.25	0.14	0.22	0.36	0.18	0.29
MSCI Developed Countries	0.16	0.71	0.25	0.55	0.20	0.38	0.12	0.49	0.26	0.22	0.16	0.29	0.14	0.30
MSCI Emerging Countries	0.19	0.41	0.10	0.43	0.19	0.41	0.13	0.38	0.25	0.04	0.29	0.45	0.24	0.27
Domestic-Large	0.86	0.88	0.78	0.61	0.76	0.78	0.43	0.55	0.47	(0.02)	0.80	0.67	0.59	0.63
Domestic-Smaller	0.79	0.85	0.82	0.72	0.84	0.88	0.63	0.63	0.54	(0.13)	0.79	0.68	0.65	0.67

Non-Crisis Periods	**Sub-Period**													
	2 (X)	**4 (X)**	**6 (X)**	**8 (X)**	**10 (X)**	**12 (X)**	**14 (X)**							**Average (X)**
MSCI International	0.17	0.20	0.20	0.12	0.25	0.22	0.18							0.19
MSCI Developed Countries	0.16	0.25	0.20	0.12	0.26	0.16	0.14							0.18
MSCI Emerging Countries	0.19	0.10	0.19	0.13	0.25	0.29	0.24							0.20
Domestic-Large	0.86	0.78	0.76	0.43	0.47	0.80	0.59							0.67
Domestic-Smaller	0.79	0.82	0.84	0.63	0.54	0.79	0.65							0.72

Crisis Periods	**Sub-Period**													
	3 (X)	**5 (X)**	**7 (X)**	**9 (X)**	**11 (X)**	**13 (X)**								**Average (X)**
MSCI International	0.60	0.50	0.39	0.44	0.14	0.36								0.41
MSCI Developed Countries	0.71	0.55	0.38	0.49	0.22	0.29								0.44
MSCI Emerging Countries	0.41	0.43	0.41	0.38	0.04	0.45								0.35
Domestic-Large	0.88	0.61	0.78	0.55	(0.02)	0.67								0.58
Domestic-Smaller	0.85	0.72	0.88	0.63	(0.13)	0.68								0.61

As for the non-crisis periods, the Domestic-Smaller portfolio recorded the highest average correlation of 0.72 while the MSCI Developed Countries portfolio recorded the lowest average of total average correlation of 0.18. While for the crisis periods, the Domestic-Smaller portfolio recorded the highest average correlations of 0.61 while the MSCI Emerging Countries portfolio recorded the lowest average correlation of 0.35.

The results on the highest and lowest average of total averages correlation almost consistently show that Domestic-Smaller portfolio recorded the highest average of total average correlation while the MSCI Emerging Countries portfolio recorded the lowest average of total average correlation for all the sub-periods, non-crisis periods and crisis periods. Except for the non-crisis periods, the lowest average of total average correlation was recorded by MSCI Developed Countries portfolio instead of the MSCI Emerging Countries portfolio.

The results show that the Domestic-Smaller portfolio was the most highly positively correlated portfolio with MSCI Malaysia while the MSCI Emerging Countries portfolio was the least correlated with MSCI Malaysia (except for non-crisis period where the least correlated with MSCI Malaysia was the MSCI Developed Countries portfolio). Visually, these results can be seen in Figure 5 which charts the average correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios for all sub-periods. It shows a zigzag pattern formed by the average correlations of the portfolios. It can be seen that the average correlations are always on the high side during crisis periods and on the lower side during non-crisis periods.

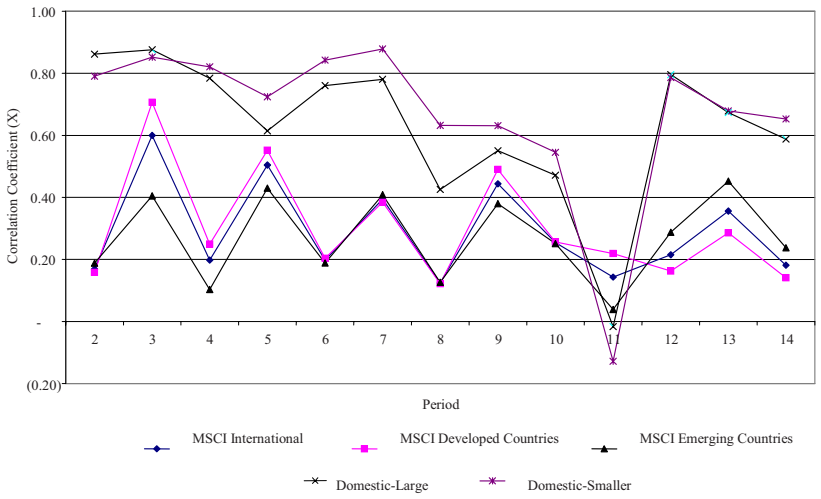

Fig. 5. Average Correlation Coefficients between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios – All Sub-Periods

It also shows that in most of the sub-periods, the Domestic-Smaller portfolio is always the most highly positively correlated portfolio with MSCI Malaysia while the MSCI Emerging Countries portfolio is always the least correlated with MSCI Malaysia. In addition, the average correlations between MSCI Malaysia and domestic-based portfolios are always higher than the average correlations between MSCI Malaysia and internationally diversified portfolios. The only sub-periods where this is not true is for Period 11 (During Invasion of Iraq) where the average correlations of all three internationally diversified portfolios with MSCI Malaysia are higher than the average correlations between MSCI Malaysia and domestic-based portfolios.

The average correlations between MSCI Malaysia and the portfolios for the whole sub-periods form a clear zig-zag pattern but due to this, it is difficult to establish a clear trend of the average correlations. Thus, the next two figures show the pattern of average correlation between

MSCI Malaysia and the portfolios during non-crisis periods only and during crisis periods only. Figure 6 below shows the average correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios during non-crisis periods.

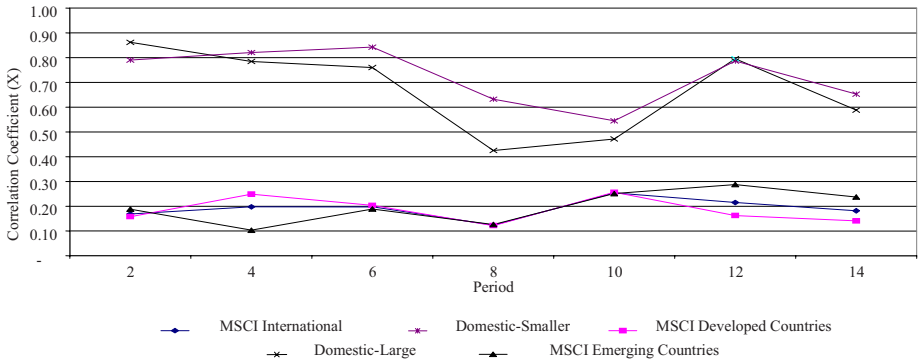

Fig. 6. Average Correlation Coefficients between MSCI Malaysia and MSCI International, Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios – Non-Crisis Periods

The charts in Figure 6 above show a different trend between the average correlations of internationally diversified portfolios with MSCI Malaysia and those of domestic-based portfolios with MSCI Malaysia during the non-crisis periods. Where it can be seen that the average correlation of internationally diversified portfolios with MSCI Malaysia is marginally trending upward towards higher correlation, the average correlations of domestic-based portfolios with MSCI Malaysia is trending downward towards lesser correlation. Figure 6 also shows that the average correlations of internationally diversified portfolios with MSCI Malaysia have a general upward trend from Period 8 (Post Asian Financial Crisis) onwards. Thus, this suggests that as equity markets in the selected countries move towards higher correlation with MSCI Malaysia during non-crisis periods from January 1999, the benefits from international portfolio diversification is lessening.

On the other hand, the average correlations of domestic-based portfolios with MSCI Malaysia have a general downward trend from Period 6 (Post Gulf Crisis) onwards. Thus, this suggests that as the stocks selected in the portfolios moved towards lesser correlation with MSCI Malaysia during non-crisis periods, the domestic-based portfolios constructed from the selected stocks become more superior than internationally diversified portfolios. This is consistent with risk formation theory: as the markets recover, the covariance risk is reduced. From the analyses above, the study establishes that there is an inverse relationship between correlation and the superiority of efficient frontier of a portfolio. The higher the correlations between assets in a portfolio are, the less superior the portfolio is and vice-versa. Figure 7 plots the average correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller portfolios during crisis periods.

As opposed to the charts shown in Figure 5 which shows a different trend between the average correlations of internationally diversified portfolios with MSCI Malaysia and those of domestic-based portfolios with MSCI Malaysia during the non-crisis periods, the charts in Figure 6 show that the average correlations of all the portfolios with MSCI Malaysia moved in almost similar direction throughout the crisis periods. That is, all crises appear to create similar responses in the Bursa Malaysia's behaviour. From Period 3 (During Stock Market Crash 1987) to Period 11 (During Invasion of Iraq), in general, the average correlations of all the portfolios with MSCI Malaysia moved towards lesser correlation except for Period 7 (During Asian Financial Crisis) when the average correlations of domestic-based portfolios with MSCI Malaysia moved towards higher correlation.

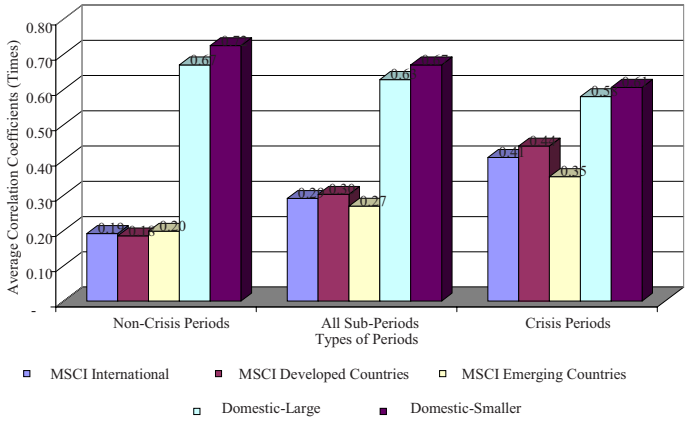

Fig. 7. Average of Total Average Correlation Coefficient Between MSCI Malaysia and MSCI International, MSCI Developed Countries, MSCI Emerging Countries, Domestic-Large and Domestic-Smaller Portfolios

However, the average correlations of all the portfolios with MSCI Malaysia share their lowest average correlations in crisis periods during the same sub-period of During Invasion of Iraq (Period 11). Again, it is not a coincidence that all the portfolios, whether they are internationally diversified portfolios or domestic-based portfolios, have their highest Efficient Frontier Index in Period 11 (During Invasion of Iraq). This further strengthens the conclusion that there is an inverse relationship between correlation and superiority of efficient frontier of a portfolio, thus the observed facts are consistent with theory. The averages of total average correlations between MSCI Malaysia and all the portfolios are presented in Figure 7.

The charts in Figure 7 show that the averages correlations of all the internationally diversified portfolios (MSCI International, MSCI Developed Countries and MSCI Emerging Countries) are the highest during the crisis periods as compared to all sub-periods and during non-crisis periods. In addition, the averages correlations of all the internationally diversified portfolios during non-crisis periods are the lowest as compared to all sub-periods and during crisis periods. For example, the average of total average correlations between MSCI Malaysia and MSCI International portfolio during the crisis periods is 0.41 as compared to those for all sub-periods of 0.29 and during the non-crisis periods of 0.19. This sequence from highest to lowest holds true for MSCI Developed Countries and MSCI Emerging Countries portfolios.

However, the sequence for domestic-based portfolios differs from those of internationally diversified portfolios. For both the domestic-based portfolios (Domestic-Large and Domestic-Smaller), the averages of total average correlations are the highest during the non-crisis periods as compared to all sub-periods and crisis periods. In addition, the average correlations of both domestic-based portfolios during crisis periods are the lowest as compared to all sub-periods and non-crisis periods. For example, the average correlations between MSCI Malaysia and Domestic-Large portfolio during the non-crisis periods is 0.67 compared to those for all sub-periods of 0.63 and during the crisis periods of 0.58. This sequence from highest to lowest holds true for Domestic-Smaller portfolio as well.

The results appear to point to the conclusion that the MSCI Malaysia is most correlated with other MSCI country indices during crisis periods and least correlated during non-crisis periods. Regardless of whether the MSCI country indices are those of developed countries only, developing countries only or a combination of both developed and developing countries, they are more correlated with MSCI Malaysia during crisis periods than non-crisis periods. Thus, shifts in correlations during crisis periods will make Bursa Malaysia's investment expectations rather disappointing. On the other hand, the results also suggest that the MSCI Malaysia is most correlated with stocks of Domestic-Large and Domestic-Smaller companies during non-crisis periods and least correlated during crisis periods.

The results presented in Table 10, Figure 4, Figure 5, Figure 6 and Figure 7 show that the average correlations are always on the high side during crisis periods and on the lower side during non-crisis periods. In addition, the average correlations between MSCI Malaysia and domestic-based portfolios are always higher than the average correlations between MSCI Malaysia and internationally diversified portfolios. While the average correlation of internationally diversified portfolios with MSCI Malaysia is marginally trending upward towards higher correlation, the average correlation of domestic-based portfolios with MSCI Malaysia is trending downward towards lesser correlation.

To see the pattern of average correlation between MSCI Malaysia and the portfolios which is unbiased to stock market and economic conditions of pre-, during- and post-crisis, an analysis is made on the average correlations between MSCI Malaysia and the portfolios based on yearly basis from 1987 to 2003. This is presented in Table 11 as below.

Table 11

Average Correlation Coefficient between MSCI Malaysia and Individual MSCI Country Indices within the MSCI Developed Countries and MSCI Emerging Countries Portfolios – Yearly from 1987 to 2003

	Correlation Coefficient with MSCI Malaysia																	
Year / Country	1987 (X)	1988 (X)	1989 (X)	1990 (X)	1991 (X)	1992 (X)	1993 (X)	1994 (X)	1995 (X)	1996 (X)	1997 (X)	1998 (X)	1999 (X)	2000 (X)	2001 (X)	2002 (X)	2003 (X)	Average (X)
MSCI Developed Countries																		
Singapore	0.96	0.98	0.96	0.98	0.66	0.58	0.99	0.63	0.73	(0.53)	0.96	0.84	0.97	0.58	0.51	0.79	0.96	0.74
United States	0.90	0.55	0.89	0.75	0.02	0.39	0.88	0.54	0.16	0.80	(0.84)	(0.14)	0.74	0.41	0.15	0.52	0.87	0.45
United Kingdom	0.95	(0.01)	0.36	(0.02)	(0.03)	(0.55)	0.93	0.55	0.37	0.70	(0.88)	0.53	0.44	0.58	0.22	0.68	0.85	0.33
Japan	0.45	0.46	(0.21)	0.64	0.33	(0.26)	0.49	0.11	0.26	(0.41)	0.42	0.66	0.89	0.85	(0.10)	0.86	0.95	0.38
Hong Kong	0.88	0.84	(0.29)	0.50	(0.23)	0.43	0.98	0.46	0.50	0.64	0.51	0.57	0.88	0.68	0.30	0.75	0.94	0.55
Australia	0.59	0.93	0.41	0.70	(0.33)	(0.64)	0.93	0.32	0.19	0.83	0.67	0.71	0.36	0.52	0.07	0.69	0.91	0.46
New Zealand	0.39	0.04	0.35	0.79	0.42	(0.54)	0.93	0.58	0.50	0.63	0.39	0.87	(0.41)	0.85	0.08	(0.28)	0.91	0.38
Germany	0.83	0.37	0.86	0.80	0.23	(0.61)	0.93	0.46	0.55	0.56	(0.71)	(0.22)	0.39	0.89	0.28	0.73	0.89	0.43
France	0.59	0.62	0.88	0.60	(0.10)	(0.36)	0.82	0.28	0.67	0.89	(0.51)	(0.31)	0.66	0.59	0.23	0.69	0.87	0.42
Switzerland	0.53	(0.10)	0.53	0.49	0.13	0.03	0.70	0.33	0.05	0.51	(0.80)	0.06	(0.71)	(0.37)	0.35	0.82	0.86	0.20
Canada	0.89	0.73	0.86	0.80	0.18	(0.70)	0.75	0.38	0.44	0.82	(0.57)	0.77	0.83	(0.24)	0.30	0.69	0.92	0.46
Total	7.97	5.43	5.59	7.04	1.30	(2.24)	9.33	4.64	4.42	5.42	(1.36)	4.35	5.04	5.35	2.39	6.95	9.92	
Number of Countries	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
Average	0.72	0.49	0.51	0.64	0.12	(0.20)	0.85	0.42	0.40	0.49	(0.12)	0.40	0.46	0.49	0.22	0.63	0.90	0.44
MSCI Emerging Countries																		
Thailand	0.69	0.83	0.93	0.86	0.85	0.76	0.88	0.83	0.80	(0.65)	0.95	0.80	0.64	0.87	0.63	0.63	0.93	0.72
Philippines	0.65	0.84	0.81	0.71	0.10	0.18	0.94	0.64	0.79	0.33	0.98	0.76	(0.02)	0.81	0.30	0.67	0.89	0.61
Indonesia	0.21	0.48	0.72	0.63	0.76	(0.20)	0.97	0.41	0.73	0.59	0.97	0.67	0.84	0.83	0.69	0.78	0.87	0.65
Korea	0.27	0.62	0.11	0.47	(0.35)	0.12	0.79	0.45	(0.03)	(0.50)	0.77	0.18	0.93	0.83	0.23	0.76	0.94	0.39
Taiwan	0.24	0.70	0.72	0.53	0.58	(0.43)	0.38	0.55	(0.15)	0.80	0.34	0.92	0.91	0.92	0.32	0.76	0.96	0.53
India	(0.06)	0.76	0.70	(0.73)	(0.58)	(0.04)	0.79	0.76	0.02	0.03	0.04	0.88	0.89	0.83	0.49	0.32	0.93	0.36
Pakistan	-	-	(0.17)	(0.02)	(0.52)	(0.49)	0.88	(0.16)	(0.15)	(0.39)	(0.42)	0.86	0.75	0.89	0.22	(0.57)	0.75	0.09
China	-	-	-	-	-	-	0.41	0.43	0.68	(0.21)	0.28	0.91	0.78	0.28	0.06	0.81	0.95	0.32
Total	1.99	4.23	3.82	2.45	0.85	(0.10)	6.03	3.92	2.69	0.01	3.91	5.99	5.73	6.27	2.95	4.16	7.23	
Number of Countries	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8	8	8	
Average	0.33	0.70	0.64	0.41	0.12	(0.01)	0.75	0.49	0.34	0.00	0.49	0.75	0.72	0.78	0.37	0.52	0.90	0.49
MSCI International																		
Total	9.95	9.66	9.41	9.49	2.15	(2.34)	15.36	8.56	7.11	5.43	2.56	10.34	10.77	11.62	5.34	11.12	17.16	
Number of Countries	17	17	17	17	18	18	19	19	19	19	19	19	19	19	19	19	19	
Average	0.59	0.57	0.55	0.56	0.12	(0.13)	0.81	0.45	0.37	0.29	0.13	0.54	0.57	0.61	0.28	0.59	0.90	0.46

The results from Table 11 show that the average of total average of the correlations between MSCI Malaysia and MSCI Emerging Country portfolio is the highest at 0.49, followed by MSCI International portfolio at 0.46 and MSCI Developed Country portfolio at 0.44. The results suggest that, on average, MSCI Malaysia is more correlated with MSCI Country indices of the emerging countries than with MSCI country indices of the developed countries or MSCI country indices of all the developed and emerging countries. The results above do not fall in line with those from Table 8. When analysis is made based on sub-periods of pre-, during- and post-crisis, the results suggest a conclusion opposites to the results when analysis is made based on yearly basis. From Table 8, the results based on sub-periods suggest that on average, MSCI Malaysia is more correlated with MSCI Country indices of the developed countries than with MSCI country indices of the emerging countries or MSCI country indices of all the developed and emerging countries.

The conflicting results between using sub-periods and yearly basis suggest that the manner by which an investment period is divided into sub-periods will affect the correlations between assets in a portfolio. This also means that the correlations among assets in a portfolio are different when they are calculated for a period of specific stock market condition and when they are calculated based on a simple yearly basis. Nonetheless, although dividing the whole period into a simple yearly basis is an unbiased way of determining the average correlation, the results from Tables 8 and 11 suggest that in practical sense, dividing the whole period into sub-periods of pre-, during- and post- crisis, will yield better results. The average correlations of all the three internationally diversified portfolios based on sub-periods of pre-, during- and post-crisis are much lower than those portfolios based on yearly basis. As such, the study established that the benefits of portfolio diversification are higher when the correlation is low.

The averages of total average of correlation between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries based on sub-periods of pre-, during- and post- crisis are 0.29, 0.30 and 0.27 respectively. The averages of total average of correlation between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries based on yearly basis are 0.46, 0.44 and 0.49 respectively, much higher than those based on sub-periods of pre-, during- and post- crisis.

Table 11 also provides the yearly average correlations between MSCI Malaysia and each of the MSCI country indices of individual countries for the 17 years period from 1987 to 2003. The results show that among the developed countries, MSCI Singapore was the highest correlated with MSCI Malaysia for the 17 years period with a yearly average correlation of 0.74 while the lowest correlated was MSCI Switzerland with a yearly average correlation of 0.20. As for among the emerging countries, results from Table 11 show that MSCI Thailand was the highest correlated with MSCI Malaysia for the 17 years period with a yearly average correlation of 0.72 while the lowest correlated was MSCI Pakistan with a yearly average correlation of 0.10.

The conflicting results obtained from Table 8 and Table 11 show that when analysis were made based on yearly basis, the outcome will differ from analysis made based on sub-periods (crisis and non-crisis) basis. On top of that, it also found that the average correlations of all the three internationally diversified portfolios based on sub-periods of pre-, during- and post-crisis are much lower than those portfolios based on yearly basis.

The yearly average correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries portfolios are presented in Table 12. The table also provides the averages of total yearly average correlations between MSCI Malaysia and each of the portfolios. For the 17-year period from 1987 to 2003, the MSCI Emerging Countries portfolio recorded the highest average of total yearly average correlation of 0.49. This is followed by the MSCI International portfolio with an average correlation of 0.46 and lastly the MSCI Developed Countries portfolio with an average correlation of 0.44.

The results show that, based on a yearly basis for the 17-year period from 1987 to 2003, the MSCI Emerging Countries portfolio was the most highly positively correlated portfolio with MSCI Malaysia among the internationally diversified portfolios. This was followed by MSCI International and MSCI Developed Countries portfolios. Visually, these results can be seen in Figure 8.

Table 12

Average Correlation Coefficient between MSCI Malaysia and MSCI International, MSCI Developed and MSCI Emerging Portfolios – Yearly from 1987 to 2003

Year / Portfolio	1987 (X)	1988 (X)	1989 (X)	1990 (X)	1991 (X)	1992 (X)	1993 (X)	1994 (X)	1995 (X)	1996 (X)	1997 (X)	1998 (X)	1999 (X)	2000 (X)	2001 (X)	2002 (X)	2003 (X)	Average (X)
MSCI International	0.59	0.57	0.55	0.56	0.12	(0.13)	0.81	0.45	0.37	0.29	0.13	0.54	0.57	0.61	0.28	0.59	0.90	0.46
MSCI Developed Countries	0.72	0.49	0.51	0.64	0.12	(0.20)	0.85	0.42	0.40	0.49	(0.12)	0.40	0.46	0.49	0.22	0.63	0.90	0.44
MSCI Emerging Countries	0.33	0.70	0.64	0.41	0.12	(0.01)	0.75	0.49	0.34	0.00	0.49	0.75	0.72	0.78	0.37	0.52	0.90	0.49

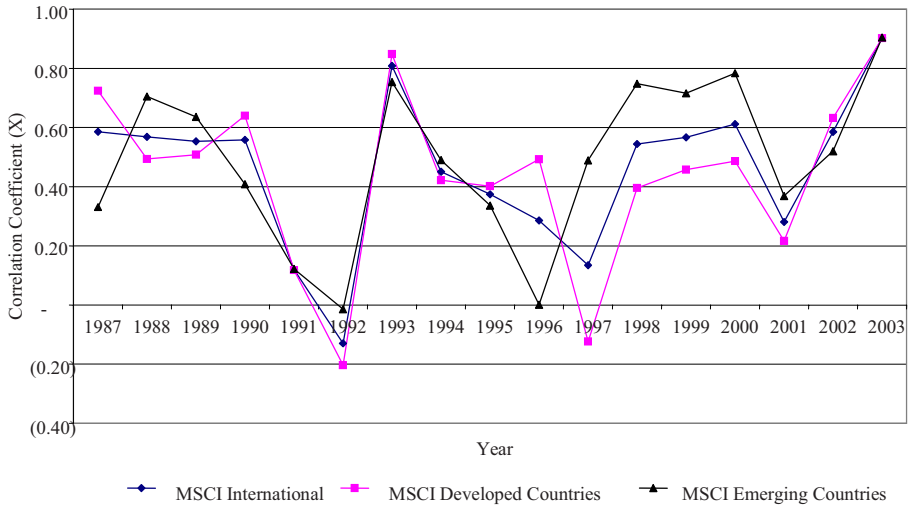

Fig. 8. Average Correlation Coefficient between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries Portfolios – Yearly from 1987 to 2003

Figure 9 also shows that in 1992, all the three average correlation coefficients between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries recorded negative average yearly correlation of -0.13, -0.20 and -0.01 respectively. Besides the figures in 1992, the only other negative average yearly correlation recorded by the study was in 1997 for the MSCI Developed Countries portfolio. The results also show that the average yearly correlation of 0.90 recorded in 2003 was the highest throughout the 17 years period. Results from Table 12 show that based on a yearly basis, for the 17-year period from 1987 to 2003, the MSCI Emerging Countries portfolio was the most highly positively correlated portfolio with MSCI Malaysia among the internationally diversified portfolios. Visually, it can also be seen from Figure 9 that there is a general upward trend in correlations between MSCI Malaysia and the internationally diversified portfolios, which assists us to further establish the greater integration of Bursa Malaysia with world markets.

It is not a coincidence that the results in both Table 6 and Table 10 revealed that the average correlations for crisis periods are higher than those for all sub-periods and non-crisis periods. A general upward trend is also observed for all the internationally diversified portfolios and domestic-based portfolios during non-crisis periods as shown in Figure 2. Nonetheless, despite the evidence showing increasing correlation among countries and stocks over time, there are also plenty of evidences that international portfolio diversification is still relevant, though lot more unpredictable: while there is a marginal upward trend, which reduces the diversification benefits from plans, the unexpected crises appear to make significant impacts on the correlations, therefore on the diversification benefits.

The conflicting trends in the average correlations of internationally diversified portfolios with MSCI Malaysia and domestic-based portfolios with MSCI Malaysia as shown in Figure 6 affect the benefits of international portfolio diversification in the study. As the average correlations of internationally diversified portfolios with MSCI Malaysia are marginally trending upward towards higher correlation, the benefits of international portfolio diversification is becoming lesser. As the average correlations of domestic-based portfolios with MSCI Malaysia are trending downward towards lower correlation, it suggests that the superiority of domestic-based portfolios is increasing over time. Thus, as the superiority of domestic-based portfolios is increasing over time, the opposite is happening to internationally diversified portfolios. This further strengthens the suggestion that the benefits of international portfolio diversification are becoming lesser. Diversifica-

tion gains are based on a chain of covariance structure over time and on market conditions as well as local shifts in structures.

The charts in Figure 9 clearly show that the average correlation of the internationally diversified portfolios with MSCI Malaysia based on yearly analysis is strongly trending upwards from the year 2001 to 2003. In fact, the yearly average correlation of all the three internationally diversified portfolios with MSCI Malaysia in 2003 was at 0.90, the highest throughout the 17-year period.

5. Conclusions

In the early part of this study, the results appear to suggest that the MSCI country indices and domestic-based stocks tend to move together the most during crisis periods and the least during non-crisis periods. On average, MSCI Malaysia is more correlated with MSCI Country indices of the developed countries than with MSCI country indices of the emerging countries. However, the results over a long term (17-year period as for Period 1) show that MSCI Malaysia is more correlated with MSCI Country indices of the emerging countries than with MSCI country indices of the developed countries.

The study further discussed on the impact of shifting of correlations to international portfolio diversification. The study shows that the conflicting trends in the average correlations of internationally diversified portfolios with MSCI Malaysia and domestic-based portfolios with MSCI Malaysia affect the benefits of international portfolio diversification. Over time, the average correlations of internationally diversified portfolios with MSCI Malaysia are marginally trending upward towards higher correlation, and this results in declining benefits of international portfolio diversification.

On the other hand, the average correlations of domestic-based portfolios with MSCI Malaysia are trending downward towards lower correlation, increasing the superiority of domestic-based portfolios. These findings are significant to the study as such it assists us to establish that Bursa Malaysia is indeed moving towards a greater integration with the world stock markets. Thus, these findings suggest that international portfolio diversification gain is reducing in the perspective of Malaysian investors.

The issue of shifts in correlation coefficients among equity markets in developed countries toward higher correlation is becoming more popular over recent years. In the wake of higher integration among capital markets in the developed countries as more and more markets are liberalised, it is argued that this leads to lesser diversification benefits from international investments. As such, to many Malaysian investors who are presently shying away from international investments, a declining benefit in international portfolio diversification may further supports their strategy to remain invested domestically.

This study addressed a main practical issue: will increasing correlation coefficients among equity markets in the world make international portfolio diversification nonviable to Malaysian investors? If the correlation coefficients among equity markets in the world are too highly correlated (close or at +1.0) to each other, the gain from international portfolio diversification may be insignificant that it is not worthwhile for Malaysian investors to invest abroad.

In line with the general belief, results from the study shows that there is indeed a general upward trend in correlation coefficients between equity markets throughout the world, especially among developed countries. The trend is more notable during non-crisis periods. In the analyses based on a yearly basis, there is a clear and strong upward trend in average correlation coefficients between MSCI Malaysia and internationally diversified portfolios from the year 2001 to 2003. The results suggest, that among the portfolios in the study, the MSCI country indices of developed countries tend to move together the most (a finding documented widely in the literature) while the MSCI country indices of emerging countries tend to move together the least – this is a new finding from Malaysian perspective. This holds true both during non-crisis periods and crisis periods.

Further analysis shows that the averages correlation of each of the five portfolios in the study are the highest during the crisis periods as compared with the numbers in all sub-periods and during non-crisis periods. However, results that are more interesting were also found. In the analy-

sis on the averages correlations between MSCI Malaysia and the five portfolios, the averages for MSCI Malaysia and internationally diversified portfolios are higher during crisis periods than non-crisis periods. On the other hand, the averages for MSCI Malaysia and domestic-based portfolios are higher during non-crisis periods than crisis periods.

The results assist us to conclude that MSCI Malaysia is most correlated with other MSCI country indices during crisis periods and least correlated during non-crisis periods. However, it is the opposite for domestic stocks on Bursa Malaysia. The results prove that the MSCI Malaysia is most correlated with domestic stocks on Bursa Malaysia during non-crisis periods and least correlated during crisis periods. Domestic stocks on Bursa Malaysia react more differently to each other during crisis period as compared to during non-crisis periods since these stocks belong to diverse types of industries and business activities which are affected differently to different types of economic or stock market crisis. These conflicting results between MSCI country indices and domestic stocks on Bursa Malaysia suggest that international equity markets and domestic equities perform differently during non-crisis or crisis periods.

On analyses based on yearly basis from 1987 to 2003, the results suggest that on average, MSCI Malaysia is more correlated with MSCI Country indices of the emerging countries than with MSCI country indices of the developed countries or MSCI country indices of all the developed and emerging countries. This contradicts some other results, where a similar analysis is carried out using the sub-periods of pre-, during- and post-crisis instead of on a yearly basis. This also suggests that the manner by which an investment period is divided into sub-periods will affect the correlation coefficients between assets in a portfolio. Thus, the correlation coefficients between assets in a portfolio are different when they are calculated for a period of specific stock market condition and when they are calculated based on a simple yearly basis.

Further analysis suggest that, on a yearly basis, there is a general upward trend in average yearly correlations between MSCI Malaysia and MSCI International, MSCI Developed Countries and MSCI Emerging Countries portfolios from 1987 to 2003. In fact, all the three internationally diversified portfolios share a strong correlation coefficient of 0.90 times for the year 2003, the highest throughout the 17 years period.

As such, planning to get huge diversification gains from international investments is unlikely to be achieved in a market such as this because of the shifts in the correlations structures. These shifts are being caused by unexpected crises, which may negate or enhance the gains depending upon how the shifts occurred and how the currency responds. A downward shift may at first be beneficial as the correlation declines, but the worsening of a foreign currency may lead to adverse results unplanned by investment planners.

On the practical issue of the study, it is established that in general, the correlation coefficients among equity markets in the world are indeed moving towards higher correlation. In other words, the equity markets in the world are getting more integrated. Undoubtedly, the increasingly high positive correlation coefficients among these countries, moving towards higher positive correlation, do not augur well for the benefits of international portfolio diversification. However, the study shows that despite this worry, diversification benefits from international portfolio investments are still significant, although the gains are diminishing.

In the context of Malaysian investors, the study suggests that in general, the Malaysian equity market is getting more correlated with equity markets in other countries over time. This is clearly evidenced from the strong upward trend in the average correlation coefficients between MSCI Malaysia and all the internationally diversified portfolios from the year 2001 (below 0.40 times) to 2003 (at 0.90 times). If this upward trend continues, the correlation between Malaysia's market will be too high with equity markets of other countries and may reach a point whereby the gain from international portfolio diversification will be insignificant.

Naturally, the lower the correlation among stocks in the portfolio is, the more superior the portfolio is. Contrary to the general belief, the results show that the average correlation coefficients of domestic-based portfolios are generally lower than those of internationally diversified portfolios. This means that the selected domestic stocks are less correlated to each other as compared to equity markets of the selected countries. Furthermore, the results also show that selected

smaller stocks on Bursa Malaysia are less correlated with each other compared to large market capitalisation stocks on Bursa Malaysia.

It must be noted, that for the purpose of this study, the stocks selected in both domestic-based portfolios are based on certain pre-set criteria. The Domestic-Large portfolio comprises of the top 20 stocks listed on Bursa Malaysia, which consistently are in the list of the top 50 stocks with the largest market capitalisation on each year from 1987 to 2003. The Domestic-Smaller portfolio comprises selected stocks which are listed on Bursa Malaysia throughout the period of the study (from January 1987 to December 2003) and excludes those stocks which have been chosen to form Domestic-Large portfolio. Thus, the stocks in the portfolios are not selected based on low correlation to each other. This also means that Malaysian investors can construct a more superior domestic-based portfolio than those in this study. There are only 40 domestic-based stocks selected in this study, with certain selection constraints whereas there are 906 listed securities on Bursa Malaysia as at end of 2003.

The study thus provides a guide to investors, investment analysts and fund managers as to the best investment strategy to adopt during or in anticipation of certain stock market or economic conditions. The general rule of diversification still applies, the benefits of diversification are the most when the correlation coefficient between two assets in the portfolio is the lowest (-1.0): for practical purposes, closer to zero. The study also shows that Bursa Malaysia is not short of stocks which are lowly correlated to each other. In the context of portfolio diversification, this is good. If the stocks on Bursa Malaysia are highly correlated to each other, it will be difficult to construct a superior portfolio for risk reduction purposes.

As the study and many other similar studies as well show, it is very difficult, and may be nearly impossible to find two perfectly negatively correlated equities in the world. However, the Modern Portfolio Theory says that as long as the correlation coefficient between two assets is less than +1.0, there will be a reduction in risk by combining both assets in a portfolio. The task is thus to find assets which are lowly correlated to each other during or in anticipation of certain stock market or economic conditions, and construct an efficient portfolio from the assets.

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