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Correlation and Benefits of Portfolio Diversification among Equity Markets of Developed Countries and Emerging Countries in South East Asia Region

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ABSTRACT

The specific objective of this paper is to generate and analyze the average correlation coefficient or return, between the Malaysian equity market and equity markets in other selected countries during 17 year period from January 1987 to December 2003. The period of 17 years is further divided into 13 different sub-periods divided by pre, during and post crisis to study the differences in pattern of average correlation coefficients during the sub-periods. The study found that average correlations were higher during the non crisis periods as compared to crisis periods. The study also divided the group of countries according to region (South East Asia), developed countries and emerging countries. It is found that the Malaysian market is more correlated with the regional market and emerging markets as compared to the developed markets. The study also analyzes the evolution of correlation of the Malaysian market and other countries throughout the study period. It concludes that there is a weak or no linear relationship on correlations between the Malaysian market and foreign markets and the time factor. This suggests that there is instability in market correlations over time. In the perspective of Malaysian investors, this paper concludes that international portfolio diversification still offers diversification benefits.

Keywords: Correlation Coefficient, International Portfolio Diversification, South East Asia, Crisis Period, Emerging Countries

INTRODUCTION

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

Chakraborti (2006) found that there is a positive relationship between the level of portfolio risk' and the mean correlation coefficient between two securities. 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. Is it true that the global stock markets are moving towards higher positive correlation over time? In economics, this is equivalent to equity markets being more integrated. If this is the case, theoretically, benefits for international portfolio diversification will lessen over time, but does this mean that it is not worthwhile to diversify internationally? However, from an academic as well as practical point of view, any unpredictable shift is likely to make investment practices that much less reliable, while a predictable upward shift towards unity makes the diversification gain marginally smaller over each time period of an upward shift. The latter will also make diversification benefits u nattainable. Nonetheless, shifts in the structure needs to be identified so as to estimate the extent of the uniform movement of the market towards reduced diversification benefits. This will provide an understanding of the development of the local market as well as practical lessons for the industry.

Due to the importance of market correlation in international portfolio diversification, this study will specifically look into the correlation between the Malaysian market and other selected foreign markets. This paper is divided into two sections. The first section focuses on generating and analyzing the average correlation coefficient between the Malaysian market and the markets of other selected countries during different sub-periods broken into pre, for

[1] The risk of a portfolio, as measured by the standard deviation of returns, for the case of two securities, 1 and 2, is $\sigma_p = [w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2(w_1)(w_2)(r_{1,2})\,\sigma_1\sigma_2]^{1/2}$

the duration of and post crisis periods, and to study the differences in pattern of average correlation coefficients when the selected countries are divided into developed countries and emerging countries categories. The second section focuses on analyzing the pattern of average correlation coefficients over a period of time and to determine whether there is a strong correlation between the Malaysian market and other foreign markets over time and to understand the behaviour of correlation during different stock market conditions.

LITERATURE REVIEW

Theory of Shifts in Correlation Structure

Solnik (1974) found that 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 proven by Markowitz's Modern Portfolio Theory. However, 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 et al. (2002) found that the correlation matrices between national indices proved to be unstable between periods, thus suggesting that a simple extrapolation of correlation is not appropriate for international investors. There have been a number of studies made to ascertain the change in correlation structure such as Claude et al. (1994) and Bekaert et al. (1997). 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 the benefits of international diversification, then the issue of stability of correlation between the markets in a portfolio is undeniably vital. If the correlation structure is significantly unstable and moving towards high correlation between the chosen markets, then international diversification benefits may be reduced significantly.

Empirical Evidence

Many studies have been done on the relationship between correlation and international portfolio diversification. Makridakis and Wheelwright (1974) and Maldonado and Saunders (1981) provided earlier studies on the instability of

correlation where they found that the inter-temporal variations on monthly correlation are highly unstable. Jorion (1985) and Eun and Resnick (1988) pointed out the importance of stability in correlation between markets to gain from international portfolio diversification. Errunza (1983) and Divecha (1992) conducted earlier studies on the inclusion of emerging economies' equity markets in internationally diversified portfolios. Both their studies concluded that the low correlation between emerging and developed market economies allow substantial gains from diversification across equity markets. Studies by Erb et al. (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. Longin and Solnik (1995) and Solnik et al. (1996) also found that pair-wise correlation between developed markets appears to be increasing over time, although there are short-term fluctuations as well. Haryey (1995) and Bakaert and Harvey (1997) noted that the correlation between emerging and developed markets, and between emerging market themselves, tend to fluctuate quite wildly but do not increase significantly over time. The study also found that the correlation between emerging and developed markets does increase if market liberalization takes place in the emerging economy or when world market volatility is high relative to local market volatility.

Harvey (1995) and Bakaert and Harvey (1997) found that emerging market returns have different statistical structure to developed markets. Among other things they tend to be driven by exogenous variables, which means that local variables are more important for emerging markets. This may be the reason why correlation between emerging markets and developed markets do not appear to be increasing. Harvey (1995) even suggested that there may be substantial variation in the risk premium of firms in emerging markets due to the developing nature of their industrial structure. 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 coefficient is sufficiently low. The study also found that the stability of correlation and hence benefits from international diversification

also appear to increase as sampling intervals shorten. Izan et al. (1998) found 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 markets correlation structure is insignificant, the benefits from international portfolio diversification are significant.

Soydemir (1999), in a study on Asian emerging markets using the Morgan Stanley Capital International (MSCI) indices, for a period from June 1989 to July 1998, found that cross-coutry correlation increases while the price of covariance stock risk appears to converge across countries towards the Asian crisis in mid 1997 and diverge thereafter. Duran et al. (2002) examined international portfolio optimism using the full Markowitz method on daily data for 29 countries over the period 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 adverse utility functions. They also found significant correlation between national indices. The correlation matrices proved to be unstable between periods, suggesting that the simple extrapolation of correlation is not appropriate for international investors.

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 compared matrices estimated over several sub-periods of 46 months using Box (1949) and Jenrich (1970) tests. 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 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 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 in lower p-values for the correlation matrix as compared to the results obtained by Kaplanis. This could be explained by the increased instability in the l980's, since data in the study by Kaplanis ended in 1982 while those of Longin and Solnik ended in 1990.

Solnik (1991) studied the correlation coefficients of monthly returns from 1971 to 1989 for 17 countries. The study proves that although the correlation coefficients between stock markets vary over time, they are always far from in unity. For investors, this means there is ample room for successful risk diversification. He also pointed out that correlation coefficients between countries are not constant. In some periods, all stock markets are affected by the same worldwide factors. This was the case with the oil shock of 1974, the worldwide stock market crash of October 1987 and the Gulf Crisis of 1990.

DATA AND METHODOLOGY

Data Sampling

The studies used the weekly closing figures of Morgan Stanley Capital International (MSCI) country indices for 20 selected countries for the 17 year period from January 1987 to December 2003. The 20 countries were selected based on geographical dispersion and availability of data. MSCI is used to provide standardization as all the indices are dividend-adjusted and quoted in a single currency, the US Dollar. The data is gathered from database managed by Datastream Limited. A list of selected countries, stock exchanges and stock market indices is presented in Table 1.

Table 1 List of Selected Countries and MSCI Country Indices

	Countries	MSCI Country Indices		Countries	MSCI Country Indices
1	Malaysia	MSCI Malaysia Index	11	Pakistan	MSCI Pakistan Index
2	Singapore	MSCI Singapore Index	12	Australia	MSCI Australia Index
3	Thailand	MSCI Thailand Index	13	New Zealand	MSCI New Zealand Index
4	Philippines	MSCI Philippines Index	14	Japan	MSCI Japan Index
5	Indonesia	MSCI Indonesia Index	15	Canada	MSCI Canada Index
6	Hong Kong	MSCI Hong Kong Index	16	United States	MSCI United States Index
7	Korea	MSCI Korea Index	17	United Kingdom	MSCI United Kingdom Index
8	Taiwan	MSCI Taiwan Index	18	Germany	MSCI Germany Index
9	China	MSCI China Index	19	France	MSCI France Index
10	India	MSCI India Index	20	Switzerland	MSCI Switzerland Index

To provide an in-depth study, the 20 countries in this study are divided according to region (South East Asian), developed and emerging countries. The developed and emerging countries[2] are grouped in accordance to the classification of the World Bank. The classification of countries between Developed and Emerging Countries is shown in Table 2.

Table 2 List of Developed Countries, Emerging Countries and Regional Countries

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

As the study also analyses the correlation at different periods of pre, during and post crisis, the 17 year period chosen covers six major stock market crises namely the 1987 stock market crash, the Gulf Crisis, the South East Asia Financial Crisis, the September 11 event, the invasion of Iraq in 2003 and the SARS outbreak in 2003. These sub-periods are grouped as Crisis Periods. On the other hand, the other seven sub-periods namely Period 2, Period 4**,** Period 6, Period 8, Period 10, Period 12 and Period 14 are grouped as Non-Crisis Periods.

[2] The World Bank defines an emerging country as one having per capita Gross National Income (GNI) that would place it in the lower or middle-income category. At the end of 2004, an emerging country had an annual per capita GNI of USS 1,460 as compared to high income country of US$32,040. Although emerging countries are home to about 85 percent of the world's population, they produce only about 20% of the world's GNI and have only about 11% of the world's stock market capitalization (Source : World Development Indicator Database, August 2005)

Based on these events, the 17 year period is then divided into additional thirteen sub-periods which are identified and summarised as in Table3.

Table 3 Period and Sub-Period of Studies

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
Period 8	Post Asian Financial Crisis	01January 1999 to 07 September 2001
Period 9	During September 11	14 September 2001to 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 18April 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

The study applies the Linear Regression Model to establish the relationship between two variables

$$y = \beta_0 + \beta_1 x + \varepsilon \qquad (1)$$

where,

y = dependent variable (MSCI Malaysia)
x = independent variables (MSCI of other countries)
ε = Random Error
β_0 = y intercept of the line
β_1 = Slope of the line

$$r = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum (X_i - \bar{X})^2 \sum (Y_i - \bar{Y}^2}} \qquad (2)$$

The correlation coefficient (r) is a measure of the strength of the linear relationship between two variables of x and y. It ranges in value between + 1 to - 1. When *r* is close to + 1 or -1, the linear relationship between x and y is strong; when it is close to 0, the linear relationship is weak or does not exist.

The Modern Portfolio Theory says that if the *r* between two assets is less than + 1.0, there will be a reduction in standard deviation (risk) of a portfolio. This is because standard deviation of a portfolio will be directly affected by the r between two stocks. Portfolio risk will be reduced as the r moves from + 1 downward, with everything else being constant. Consequently, when this happens, a portfolio will achieve diversification benefits.

RESULTS AND IMPLICATIONS

Descriptive Statistics of the Correlation Coefficient

The results in Table 4 show the correlations for all periods and sub periods between MSCI Malaysia and MSCI Emerging, MSCI Developed and MSCI Inteational. The average correlation of MSCI Emerging is the highest at +0.59 followed by MSCI International at +0.57 and MSCI Developed at +0.55. The results suggest that, on average, MSCI Malaysia is more positively correlated with MSCI of the emerging countries than with MSCI of the developed countries or MSCI country indices of all the developed and emerging countries. Earlier studies by Errunza (1983) and Divecha (1992) also found a low positive correlation between emerging and developed markets. The average of MSCI International has the smallest spread as compared to others (coefficient variation = 0.40). There is insufficient evidence at 5 percent level to reject the hypothesis that the probability distribution of the average correlations of MSCI Emerging and MSCI Developed are identical using the nonparametric Wilcoxon Rank Sum Test.

Table 4 Correlation Coefficients for All Periods and Sub Periods between MSCI Malaysia and MSCI Emerging, MSCI Developed and MSCI International

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)	SD	CV
MSCI Emerging																	
Thailand	0.82	0.80	0.95	0.95	0.92	0.66	0.95	0.19	0.79	0.48	-0.57	0.90	0.96	0.74	0.68	0.42	0.62
Philippines	0.90	0.86	0.78	0.76	0.87	0.96	0.93	-0.22	0.58	0.73	-0.71	0.86	0.74	0.61	0.62	0.48	0.78
Indonesia	0.66	0.92	-0.06	0.93	0.68	0.80	0.94	0.34	-0.11	0.78	-0.52	0.85	0.82	0.77	0.56	0.46	0.83
Korea	0.42	0.89	0.59	0.47	-0.17	0.50	0.86	0.65	0.71	0.76	0.18	0.94	0.85	0.79	0.60	0.31	0.51
Taiwan	0.30	0.62	0.80	0.67	0.53	0.73	0.95	0.71	0.80	0.79	0.20	0.96	0.86	0.83	0.70	0.22	0.32
India	0.53	-0.79	0.79	0.80	-0.37	0.50	0.91	0.84	0.63	0.23	0.44	0.92	0.84	0.82	0.51	0.51	1.00
Pakistan	0.00	0.00	0.00	0.00	-0.24	0.54	0.83	0.83	-0.02	-0.62	0.03	0.62	0.88	0.34	0.23	0.45	1.98
China	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.20	0.53	0.83	0.57	0.92	0.97	0.82	0.41	0.42	1.02
Total	3.63	3.30	3.85	4.57	2.22	4.69	7.28	3.53	3.91	3.99	-0.37	6.98	6.93	5.70	4.30		
Number of Countries	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8		
Average	0.61	0.55	0.64	0.76	0.32	0.67	0.91	0.44	0.49	0.50	-0.05	0.87	0.87	0.71	0.59	0.25	0.43
MSCI Developed																	
Singapore	0.81	0.94	0.98	0.99	0.96	0.93	0.91	0.72	0.91	0.81	0.55	0.96	0.94	0.89	0.88	0.12	0.14
United States	-0.12	0.85	0.90	0.92	0.55	0.78	-0.64	0.61	0.60	0.59	0.35	0.90	0.82	0.76	0.56	0.44	0.79
United Kingdom	-0.06	0.94	0.98	0.83	0.36	0.79	-0.47	0.09	0.19	0.72	-0.07	0.80	0.82	0.77	0.48	0.46	0.97
Japan	0.27	0.66	0.41	-0.11	0.53	0.57	0.93	0.79	-0.64	0.88	0.80	0.93	0.90	0.78	0.55	0.45	0.82
Hong Kong	0.55	0.83	0.94	0.65	0.74	0.95	0.89	0.80	0.75	0.78	0.51	0.92	0.84	-0.82	0.67	0.45	0.67
Australia	0.27	0.45	0.79	0.46	0.68	0.88	0.81	0.13	0.60	0.68	-0.44	0.90	0.79	0.86	0.56	0.37	0.66
New Zealand	0.29	-0.20	0.81	-0.48	0.54	0.94	0.87	-0.17	0.69	-0.44	-0.09	0.85	0.87	0.70	0.37	0.53	1.44
Germany	-0.03	0.67	0.95	0.93	0.79	0.87	-0.58	0.70	0.48	0.77	-0.18	0.86	0.76	0.72	0.55	0.47	0.85
France	-0.10	-0.11	0.96	0.95	0.65	0.88	-0.64	0.80	0.34	0.73	-0.15	0.81	0.79	0.72	0.47	0.51	1.08
Switzerland	-0.03	0.22	0.84	0.88	0.31	0.88	-0.64	-0.22	0.29	0.82	-0.22	0.83	0.77	0.67	0.38	0.50	1.31
Canada	-0.12	0.83	0.84	0.77	0.78	0.63	0.45	0.71	0.74	0.68	-0.06	0.91	0.85	0.84	0.63	0.33	0.52
Total	1.72	6.08	9.40	6.80	6.89	9.10	1.89	4.95	4.93	7.02	0.99	9.66	9.16	6.89	6.10		
Number of Countries	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11		
Average	0.16	0.55	0.85	0.62	0.63	0.83	0.17	0.45	0.45	0.64	0.09	0.88	0.83	0.63	0.55	0.26	0.48
MSCI International																	
Number of Countries	17	17	17	17	18	18	19	19	19	19	19	19	19	19	19		
Average	0.31	0.55	0.78	0.67	0.51	0.77	0.48	0.45	0.47	0.58	0.03	0.88	0.85	0.66	0.57	0.23	0.40

Note: x = times

A micro analysis on Period l alone (17-year from January 1987 to December 2003) also shows that the correlation between MSCI Malaysia and MSCI country indices of emerging countries is the highest at +0.61, followed by those of between MSCI Malaysia and MSCI country indices of all international countries at +0.38 and lastly between MSCI Malaysia and MSCI country indices of developed countries at +0.16. The results suggest that in the long term, the Malaysian equity market is more positively correlated with equity markets in the emerging market than with the developed market. This may be contributed to various factors such as cultural and geographical factors, higher intra-Asian and regional trade and inter-continental trade and almost similar time zones for the regional stock markets. Therefore, diversification benefits for portfolios with a combination of equities from Malaysia and emerging markets would be reduced due to the higher positive correlation, as · compared to the combination between Malaysia and other markets.

Further analysis on correlation for all periods and sub periods between MSCI Malaysia and MSCI of Regional Countries as presented in Table 5 shows that MSCI Malaysia is even more positively correlated with the MSCI of Regional Countries, with an average correlation of +0.68, than the MSCI Emerging, MSCI Developed and MSCI International. MSCI Malaysia is most positively correlated with MSCI Singapore with average correlation of +0.88, while MSCI Indonesia is the lowest with correlation of +0.56. Of all the MSCI of Regional Countries, MSCI Singapore has the lowest spread as compared to others (coefficient variation = 0.14). High positive correlation between MSCI Malaysia and MSCI of Regional Countries shows that Malaysian portfolio managers will have low portfolio diversification benefits when investing in the regional market.

Results on Shifts in Correlations between MSCI Malaysia and Other World Markets during Non-Crisis and Crisis Periods

The results of the entire 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 other world markets during non- crisis periods and during crisis periods only. This is presented in Table 6. The results appear to support the notion that the MSCI Malaysia is most positively

correlated with other MSCI country indices during non crisis periods and least positively correlated during crisis periods. Regardless of whether the MSCI country indices are those of developed countries, developing countries or a combination of both developed and developing countries, they are more positively correlated with MSCI Malaysia during non crisis periods. The average correlations are always on the high positive during non crisis periods and on the lower positive during crisis periods. The average of non crisis periods has a smaller spread as compared to crisis periods. Thus, shifts to higher positive correlations during non crisis periods as compared to crisis periods will reduce diversification benefits on international portfolio diversification for Malaysian investors as the equity markets are more correlated to each other during the crisis periods.

Table 5 Correlation Coefficients for All Periods and Sub Periods between MSCI Malaysia and MSCI of Regional Countries

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)	SD	CV
REGIONAL																	
Thailand	0.82	0.80	0.95	0.95	0.92	0.66	0.95	0.19	0.79	0.48	-0.57	0.90	0.96	0.74	0.68	0.42	0.62
Philippines	0.90	0.86	0.78	0.76	0.87	0.96	0.93	-0.22	0.58	0.73	-0.71	0.86	0.74	0.61	0.62	0.48	0.78
Indonesia	0.66	0.92	-0.06	0.93	0.68	0.80	0.94	0.34	-0.11	0.78	-0.52	0.85	0.82	0.77	0.56	0.46	0.83
Singapore	0.81	0.94	0.98	0.99	0.96	0.93	0.91	0.72	0.91	0.81	0.55	0.96	0.94	0.89	0.88	0.12	0.14
Total	3.19	3.51	2.65	3.63	3.43	3.35	3.73	1.03	2.17	2.79	-1.25	3.58	3.46	3.00	2.73		
Number of Countries	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Average	0.80	0.88	0.66	0.91	0.86	0.84	0.93	0.26	0.54	0.70	-0.31	0.89	0.87	0.75	0.68	0.34	0.50

Note: x = times

Table 6 Correlation Coefficients between MSCI Malaysia and Other World Markets during Non-Crisis and Crisis Periods

Non-Crisis Periods			Sub-	Period				Average	SD	CV
Country	2 (x)	4 (x)	6 (x)	8 (x)	10 (x)	12 (x)	14 (x)	(x)		
MSCI Emerging Countries	0.55	0.76	0.46	0.44	0.50	0.87	0.71	0.61	0.16	0.25
MSCI Developed Countries	0.55	0.62	0.83	0.45	0.64	0.88	0.63	0.66	0.14	0.21
MSCI International	0.55	0.67	0.73	0.45	0.58	0.88	0.66	0.64	0.13	0.20

Crisis Periods			Sub-	Period			Average	SD	CV
Country	3 (x)	5 (x)	7 (x)	9 (x)	11 (x)	13 (x)	(x)		
MSCI Emerging Countries	0.64	0.32	0.91	0.49	-0.05	0.87	0.53	0.36	0.68
MSCI Developed Countries	0.85	0.63	0.17	0.45	0.09	0.83	0.50	0.33	0.65
MSCI International	0.78	0.51	0.48	0.47	0.03	0.85	0.52	0.29	0.56

Note: x = times

Further analysis on regional countries as presented in Table 7 also shows that Malaysia is most positively correlated with the regional market during non crisis periods (average correlation of +O.75) and least positively correlated during crisis periods (average correlation of +0.59). This is probably attributed to the fact these countries are close to each other, culturally and geographically. Of all the regional countries, MSCI Malaysia is most positively correlated with MSCI Singapore during the non crisis periods (average correlation of (+0.89) while Philippines has the lowest (average correlation of +0.65). This is natural as Singapore is closer to Malaysia and has stronger historical connections with Malaysia compared to any other country in the region. During the crisis periods, MSCI Malaysia is most correlated with MSCI Singapore (+0.87) while Indonesia was the lowest (average correlation of +0.29). Thus, shifts to higher positive correlations during non crisis periods as compared to crisis periods will reduce diversification benefits on regional portfolio diversification for Malaysian investors as the equity markets are more correlated to each other during the crisis periods.

Table 7 Correlation Coefficients between MSCI Malaysia and Regional Markets during Non-Crisis and Crisis Periods

Non-Crisis Periods Country	2 (x)	4 (x)	6 (x)	8 (x)	10 (x)	12 (x)	14 (x)	Average (x)	SD	CV
Regional Countries										
Thailand	0.80	0.95	0.66	0.19	0.48	0.90	0.74	0.67	0.26	0.39
Philippines	0.86	0.76	0.96	-0.22	0.73	0.86	0.61	0.65	0.40	0.62
Indonesia	0.92	0.93	0.80	0.34	0.78	0.85	0.77	0.77	0.20	0.26
Singapore	0.94	0.99	0.93	0.72	0.81	0.96	0.89	0.89	0.10	0.11
Total	3.51	3.63	3.35	1.03	2.79	3.58	3.00			
Number of Countries	4	4	4	4	4	4	4			
Average	0.88	0.91	0.84	0.26	0.70	0.89	0.75	0.75	0.23	0.31

Crisis Periods Country	3 (x)	5 (x)	7 (x)	9 (x)	11 (x)	13 (x)	Average (x)	SD	CV
Regional Countries									
Thailand	0.95	0.92	0.95	0.79	-0.57	0.96	0.67	0.61	0.92
Philippines	0.78	0.87	0.93	0.58	-0.71	0.74	0.53	0.62	1.17
Indonesia	-0.06	0.68	0.94	-0.11	-0.52	0.82	0.29	0.60	2.04
Singapore	0.98	0.96	0.91	0.91	0.55	0.94	0.87	0.16	0.18
Total	2.65	3.43	3.73	2.17	-1.25	3.46			
Number of Countries	4	4	4	4	4	4			
Average	0.66	0.86	0.93	0.54	-0.31	0.87	0.59	0.47	0.79

Note: x = times

Results on Average Correlation between MSCI Malaysia and Other World Markets on Yearly Basis from 1987 to 2003

To see the pattern of average correlation between MSCI Malaysia and other indices which is unbiased to stock markets and economic conditions of pre, during and post crisis, analysis is made on average correlations between MSCI Malaysia and other indices based on yearly basis, from 1987 to 2003. The results in Table 8 show that for the 17-year period from 1987 to 2003, the MSCI Emerging Countries recorded the highest yearly average correlation of +0.51, the most positively correlated with MSCI Malaysia. This is followed by the MSCI International with an average correlation of +0.46 and lastly, the MSCI Developed Countries portfolio with an average yearly correlation of +0.42. The results suggest that, on average, MSCI Malaysia is more positively 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 is probably due to the fact that emerging countries indices tend to have similar movements among themselves compared to movements between emerging countries indices and developed countries indices. The average correlation of MSCI Emerging has a lower spread (coefficient variation = 0.54) as compared to the spread of average correlation of MSCI developed countries (coefficient variation = 0.72). The results above fall in line with those from Table 1. The results suggest a similar conclusion that is, MSCI Malaysia is more positively correlated with MSCI Country indices of emerging countries irrespective of whether analysis is made

based on sub periods or on yearly basis. Therefore, diversification benefits on portfolios with combination of equities from Malaysia and emerging markets Would be reduced due to the higher positive correlation, as compared to the combination from Malaysia and other markets.

The results on yearly basis of the emerging countries show that MSCI Thailand was the highest correlated with MSCI Malaysia for the 17 year period With a yearly average correlation of +0.72 (coefficient variation = 0.51) while the lowest correlation was with MSCI Pakistan, with a yearly average correlation of +0.09 (coefficient variation= 6.17). This is again, probably due to the fact that Malaysia is closer, both culturally and geographically with Thailand than with Pakistan. As for the developed countries, MSCI Singapore Was the highest correlated with MSCI Malaysia for the period, with a yearly average correlation of +0.74 (coefficient variation = 0.50) while the lowest correlation was with MSCI Switzerland with a yearly average correlation of +0.20 (coefficient variation = 2.45). There is insufficient evidence at 5 percent level to reject the hypothesis that the probability distribution of the average correlations of MSCI Emerging and MSCI Developed are identical using the nonparametric Wilcoxon Rank Sum Test.

Further analysis on average correlations between MSCI Malaysia and MSCI of Regional Countries for the 17-year period from 1987 to 2003 as shown in Table 9 shows that MSCI Malaysia is most correlated with the regional tnarket with average correlation of +0.68 as compared to the MSCI Emerging Countries of +0.51. Of all the markets, MSCI Malaysia is most correlated with Mscr Singapore (average correlation of +O.74) and least with MSCI Philippines (average correlation of +0.61). Again, the long history between Malaysia and Singapore, and the closeness between the two countries probably contributes to this. MSCI Indonesia has the lowest spread (coefficient variation = 0.45). Therefore, diversification benefits on portfolios with combination of equities from Malaysia and the regional market would be further reduced due to the higher positive correlation, as compared to the combination between Malaysia and emergmg or developed markets.

Table 8 Correlation Coefficients between MSCI Malaysia and MSCI Emerging, MSCI Developed and MSCI International on Yearly Basis from 1987 to 2003

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Ave	SD	CV
Country	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)		
MSCI Emerging																				
Thailand	0.69	0.83	0.93	0.86	0.85	0.76	0.88	0.83	0.80	-0.66	0.95	0.80	0.65	0.87	0.63	0.63	0.93	0.72	0.37	0.51
Philippines	0.65	0.84	0.81	0.71	0.10	0.18	0.94	0.64	0.79	0.33	0.99	0.76	-0.02	0.81	0.30	0.67	0.89	0.61	0.31	0.51
Indonesia	0.21	0.48	0.72	0.63	0.77	-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	0.29	0.45
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	0.44	1.13
Taiwan	0.24	0.70	0.72	0.54	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	0.39	0.73
India	-0.06	0.76	0.71	-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	0.94	0.36	0.53	1.49
Pakistan	0.00	0.00	-0.17	-0.02	-0.52	-0.49	0.88	-0.16	-0.15	-0.39	-0.42	0.87	0.75	0.89	0.22	-0.57	0.75	0.09	0.54	6.17
China	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.43	0.68	-0.21	0.28	0.92	0.78	0.28	0.06	0.81	0.95	0.32	0.38	1.20
Countries	6	6	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8			
Average	0.33	0.70	0.55	0.35	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	0.51	0.27	0.54
MSCI Developed																				
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	0.37	0.50
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	0.46	1.04
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	0.86	0.33	0.50	1.50
Japan	0.45	0.46	-0.21	0.64	0.33	-0.26	0.49	0.12	0.26	0.41	0.42	0.66	0.89	0.85	-0.11	0.86	0.95	0.42	0.38	0.89
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	0.36	0.66
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	0.08	0.69	0.91	0.46	0.44	0.95
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	0.46	1.21
Germany	0.83	0.38	0.86	0.81	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	0.51	1.19
France	0.59	0.63	0.89	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	0.46	1.11
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	0.87	0.20	0.49	2.45
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	0.52	1.11
Number of Countries	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11.00			
Average	0.72	0.49	0.51	0.64	0.12	-0.20	0.85	0.42	0.40	0.57	-0.12	0.40	0.46	0.49	0.22	0.63	0.90	0.42	0.30	0.72
MSCI Int'l																				
Countries	17	17	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19			
Average	0.53	0.60	0.53	0.49	0.12	-0.11	0.80	0.46	0.37	0.28	0.18	0.57	0.59	0.63	0.29	0.58	0.90	0.46	0.25	0.54

Table 9 Correlation Coefficients between MSCI Malaysia and MSCI of Regional Countries on Yearly Basis form 1987 to 2003

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)	Ave (x)	SD	CV
Regional Countries																				
Thailand	0.69	0.83	0.93	0.86	0.85	0.76	0.88	0.83	0.80	-0.66	0.95	0.80	0.65	0.87	0.63	0.63	0.93	0.72	0.37	0.51
Philippines	0.65	0.84	0.81	0.71	0.10	0.18	0.94	0.64	0.79	0.33	0.99	0.76	-0.02	0.81	0.30	0.67	0.89	0.61	0.31	0.51
Indonesia	0.21	0.48	0.72	0.63	0.77	-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	0.29	0.45
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	0.37	0.50
Total	2.51	3.13	3.41	3.18	2.38	1.32	3.77	2.51	3.06	-0.26	3.87	3.08	2.44	3.09	2.14	2.88	3.66			
Number of Countries	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4			
Average	0.63	0.78	0.85	0.79	0.60	0.33	0.94	0.63	0.76	(0.07)	0.97	0.77	0.61	0.77	0.53	0.72	0.91	0.68	0.25	0.37

Note: x = times

Results on the Evolution of Correlation Coefficients of MSCI Malaysia and MSCI of other countries Over Time

The paper further analyzes the evolution of correlation coefficients of MSCI Malaysia and MSCI of other countries over time. This is to determine whether there is stability in market correlation over time. Also, a strong correlation over time suggests a linear relationship between Malaysia and other countries, thus suggesting the increase in interdependence between them. The results in Table 10 nevertheless, show that there is no linear relationship between the correlation coefficients of MSCI Malaysia and MSCI of other countries with time, as shown by the weak positive correlations. The highest correlation is shown by Indonesia and Japan with correlation coefficients of +0.48 and +0.40 respectively. The weak correlation suggests instability in market correlations over time. The earlier studies by Solnik (1991) and Duran et al. (2002) also found instability in market correlations between different periods. Malaysian investors therefore, could still benefit from the international portfolio diversification following instability in market correlations.

Table 10 Evolution of Correlation Coefficients of MSCI Malaysia and MSCI of other Countries Over Time

MSCI Emerging		MSCI Developed	
Thailand	-0.11	Singapore	-0.18
Philippines	-0.03	United States	-0.23
Indonesia	0.48	United Kingdom	0.19
Korea	0.37	Japan	0.45
Taiwan	0.36	Hong Kong	0.29
India	0.42	Australia	0.14
Pakistan	0.38	New Zealand	0.01
China	0.31	Germany	-0.04
		France	-0.91

CONCLUSION

The research issue of shifts in correlation coefficients between Malaysia and world equity markets towards higher correlation is addressed in the study. Analysis shows that, on average, MSCI Malaysia is more positively correlated with MSCI of the emerging countries than with MSCI of the developed countries or MSCI country indices of all the developed and emerging countries. Analysis of sub periods shows that the average positive correlations are highest during non-crisis periods as compared to the average positive correlations during crisis periods. In other words, there is a shift in market correlation towards higher levels in the non-crisis periods as compared to crisis periods. Diversification benefits therefore would be lower in the non crisis periods as compared to crisis periods. A further analysis shows that Malaysia is even more positively correlated when analysis is done based on the regional market. Higher positive correlation between MSCI Malaysia and MSCI of regional countries shows that Malaysian portfolio managers will have low portfolio diversification benefits when investing in the regional market.

The results from analysis based on yearly basis, from 1987 to 2003, suggest that on average, MSCI Malaysia is more positively correlated with MSCI Country Indices of the emerging countries than MSCI country indices of the developed countries or MSCI country indices of all the developed and emerging countries. The results suggest a similar conclusion, that is, MSCI Malaysia is more positively correlated with MSCI Country indices of emerging countries irrespective of whether analysis is made based on yearly basis or on sub period basis. Based on the study, Malaysian investors therefore could consider investing in the developed market as opposed to developing markets in order to benefit from international portfolio diversification.

Further analysis on average correlations between MSCI Malaysia and MSCI of regional countries for the 17-year period from 1987 to 2003 shows that MSCI Malaysia is even more correlated with the regional market with average correlation of +0.68 as compared to the MSCI emerging countries of +0.51. Therefore, diversification benefits for portfolios with combination of equities between Malaysia and the regional market would be further reduced due to the higher positive correlation, as compared to the combination between Malaysia and emerging or developed markets.

Analysis on the relationship between time and yearly correlation coefficients shows that there is no linear relationship between the correlation coefficients of MSCI Malaysia and MSCI of other countries with time. The weak correlation suggests the instability in market correlations over time. Malaysian investors therefore, could still benefit from international portfolio diversification during the period of low correlation.

The study thus provides a guide to Malaysian investors as to the best investment strategy to be adopted during or in anticipation of certain stock market or economic conditions. The general rule is, the benefit of diversification will be the most when correlation coefficients between two assets in the portfolio is -1.0, for practical purposes, close to zero. This study and other similar studies show that 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 have loe correlations to each other during or in anticipation of certain stock market or economic conditions, and to construct an efficient portfolio from these assets.

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