Asian Academy of Management Journal. **6(2):** 109-133

INTERNATIONAL INTERDEPENDENCIES OF STOCK MARKETS: HOW INFLUENTIAL ARE WELL-ESTABLISHED EXCHANGES IN AFFECTING MOVEMENTS ON THE KLSE?

Mat Saad Abdullah
Ismail Abdullah
Universiti Teknology Malaysia

ABSTRACT

Several analysts assert that linkages among economies primarily, determine the tendency for stock markets to move together across countries. National stock markets from the countries, which have close trade relations, are believed to be highly correlated. If this is the reality, given the openness of the Malaysian economy, how influential are foreign (well-established) equity markets in affecting movements on the Kuala Lumpur Stock Exchange (KLSE)?

This paper examines the magnitude and behaviour of co-movements between the KLSE and major stock markets from the developed part of the world.

Using the weekly share price indices from the above-mentioned markets for a period of 1984 through 1994, the data are examined from both perspectives: contemporaneous as well as lead-lag interdependencies. Towards this end, the techniques of correlation and partial correlation analyses are utilised. Findings of the study inter alia, suggest that stock return correlations between the KLSE and well-established stock markets have been significantly positive. However, these return correlations are not stable over time. These markets are found to have the tendency to move very closely together during the periods of turbulence (or down markets).

The stock markets from Australia, Hong Kong, Switzerland and the United States (U.S.) are among those exchanges that are found to be influential in affecting movements on the KLSE. In general, in terms of (contemporaneous) partial correlation, about 10% and 9% of the movements on the KLSE can be explained respectively, by the movements on the stock markets of Australia and Hong Kong.

INTRODUCTION

Stock markets around the globe are, to some extent, inter-related. Whereas some markets are moving closely and contemporaneously together, the inter-dependencies between and among other groups of national equity markets might be 'lead-lag' in nature. Actually, much has been written about the inter-relatedness of equity returns across countries. Several analysts posit that international trades and investments play a pivotal role in determining the state and behaviour of international stock market linkages [see e.g., Roll (1992); Lin et. al (1994); Chen and Zhang (1997)]. Economies, which are strongly linked, are claimed to have the tendency for their national stock markets to move closely together. If this is the reality - given the openness of the Malaysian economy [see e.g., Fong (1990)] - how close are the stock markets from the developed nations to the stock market of Malaysia in terms of their co-movements in returns? An investigation into the behaviour of international inter-dependencies among stock markets is useful for investors and portfolio managers (in their asset allocation decisions) for two basic reasons:

(i) if two or more stock markets are found to be lowly correlated, then including equities from these markets in a portfolio could contribute towards reducing the unsystematic risks of the portfolio,
(ii) if two or more stock markets are found to be very close in terms of their inter-relatedness, then innovations in one market could be beneficial in predicting future movements in another market. Expressed differently, knowledge of the magnitude and behaviour of international stock market co-variations could be exploited by both local as well as international investors in planning their investment strategies and trading positions.

The purpose of the present paper is to verify and quantify the nature of co-movements between the Kuala Lumpur Stock Exchange (KLSE) and some selected stock markets from the developed economies of Asia, Europe, North America and Australia. To meet this goal, the remainder of the paper is organised as follows; we begin, in Section Two, with a brief survey of the literature and research on international stock market inter-dependencies. This is followed, in Section Three, by an elucidation of the analytical methods to be employed in this study. The data on which the present investigation is based are detailed in Section Four. This is followed by Section Five that involves data analysis and the presentation of results. The concluding remarks for the paper are offered in Section Six.

REVIEW OF PREVIOUS WORK

The concept and practice of international portfolio diversification is de facto, not new: it is as old as the financial markets themselves, as claimed by Tapley and Simmonds (1982: 64). Whilst the benefits that may be derived from portfolio diversification have been demonstrated as early as the 1950s in the pioneer works of Markowitz (1952) and Tobin (1958), research in the area of international linkages among equity markets (and hence, international portfolio diversification) appears to have started only in the late 1960s or early 1970s. With the seminal works of Grubel (1968), Levy and Sarnat (1970), Grubel and Fadner (1971), Lassard (1973) and Solnik (1974), the idea of international diversification of equity portfolios has started to attract the attention of both academicians and practitioners [see also (inter alia Errunza (1977); Hunter and Coggin (1990); Heston and Rouwenhorst (1994)]. This concept has been advocated on the basis of low correlations between national stock markets.

The decade of the 1980s has witnessed the emergence of cross-border investments or global asset allocation strategies as a new phenomenon in the investment community. Several economic and political developments that had taken place in many parts of the world since the beginning of this (1980s) decade - particularly in Eastern Europe, Latin America and Asia (China) -have perhaps served as the galvanising force behind this rapid growth in international investing. Ayling (1986: 6) however, attributes the process of internationalisation of world stock markets to four main forces: (a) increased links between money and capital markets; (b) moves towards deregulation; (c) innovations in financial markets; and (d) breakthroughs in information and communications technology. Congruent with the above-mentioned developments and trends, the issues of international equity market linkages as well as international portfolio diversification have become increasingly popular as research topics in finance literature in recent years. Among the interesting findings of recent research is that correlations of equity returns among emerging equity markets as well as between emerging equity markets and well-established exchanges are relatively low. Such an argument has been documented, among others, by Errunza (1983; 1994), Errunza and Padmanabhan (1988), Bailey and Stulz (1990) and Solnik (1990). Meanwhile, with the increased globalisation of financial activities in the recent past, a group of analysts have argued that international capital markets have become more integrated. Included in this group of researchers are Cho *et al.* (1986), Wheatley (1988), Eun Shim (1989), and Jeon and Von Furstenberg (1990).

Correspondingly, if this is the current reality of international equity markets, the benefits from international portfolio diversification have decreased. Such a finding on the contrary, suggests that (to some extent), movements in some markets could be utilised for predicting purposes in other market(s). In their examinations of the international inter-relatedness of the stock markets, several statistical methods have been employed by previous researchers to analyse the data. Among the major ones are as follow:

(i) Correlation analysis [Errunza (1977); Watson (1980); Othman Yong (1993); Dwyer and Hafer (1988); Grinold *et al.* (1989); Longin and Solnik (1995); Chen and Zhang (1997)];
(ii) Principalcomponents analysis [Lessard (1973); Makridakis and Wheelwright (1974); Philippatos *et al.* (1983); Meric and Meric (1988)];
(iii) Cluster analysis [Panton *et al.* (1976); Drummen and Zimmermann (1992); Cheung and Ho (1991)];
(iv) Spectral analysis [Granger and Morgenstern (1970); Hilliard (1979)]; and
(iv) Cointegration analysis [Arshanapalli *et al.* (1995); Phylaktis (1997)].

EMPIRICAL METHODOLOGY

In this study, the nature and behaviour of international stock market co-movements will be examined by applying two statistical procedures. These methods as described in some detail in the following sub-sections are, correlation analysis and partial correlation analysis.

Correlation Analysis

Correlation analysis is the study of the relationship between two variables, and the correlation coefficient, r, is calculated to measure the strength as well as the direction of this linear relationship [Clark (1991: 65)]. One statistic that can compute the correlation between two variables, X and Y, is known as the Pearson product-moment or simply Pearson coefficient. It is defined as follows:

$$r_{xy} = \frac{\sigma_{xy}}{\sigma_x \sigma_y} = \frac{Cov(X,Y)}{\sqrt{[Var(X)Var(Y)]}} \qquad (1)$$

where σ_x and σ_y are the standard deviations for variable (X) and variable Y respectively. The correlation coefficient can range from +1.0 to -1.0. While a correlation coefficient of -1.0 indicates a perfect negative or inverse relationship, a correlation coefficient of +1.0 indicates a perfect positive or direct relationship. When r_{xy} equals 0, there is no relationship between the two variables, X and Y. When the correlation coefficient is squared, it is known as the coefficient of determination. The coefficient of determination, which is denoted as r^2 and may range from 0.0% to 100.0%, tells us the percentage of variation in the dependent variable (Y), which is explained by the (independent) variable (X). To test the null hypothesis that the value of r is zero, the test statistic given by

$$t = \frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}} \qquad (2)$$

is calculated and this follows Student's t-distribution with (n-2) degrees of freedom [Kanji (1993: 33)]. As noted in the previous section, correlation analysis is a method which has been widely used by previous researchers in examining the magnitude of inter-relatedness among national equity markets [see also Grubel and Fadner (1971); Watson (1978); Errunza and Padmanabhan (1988); Othman Yong (1987,88), 1989, 1993); Hunter and Coggin (1990); Divecha et al. (1992) and Spiedell and Sappenfield (1992)]. Appropriately, in the present study, employing this method in analysing the data from a different combination of stock markets based on a different sample period would enable us to compare our results with those of the previous studies.

Partial Correlation analysis

Partial correlation analysis could be considered as a 'more detailed analysis of correlation'. It is a special case of correlation analysis: conditional correlation analysis. The partial correlation coefficient is a particularly useful tool in searching for causal relationships [Stoodley et al. (1980)]. Accordingly, for stock markets, which are detected to be highly correlated with the KLSE, we proceed with our study by examining their partial correlation coefficients. A partial correlation coefficient as defined by Daniel and Terrell (1992), is a measure of the contribution of an individual variable when the other variables are held constant. This implies that by computing the partial correlation coefficient we can measure the net correlation between the dependent variable and one independent variable after eliminating the influence of one or more variables in the model. Suppose that we have three variables: Y, X_1 and X_2. In order to exclude the influence of X_2 on Y, we regress Y on X_2 and find the residual

find the residual $e_1 = Y^*$. To eliminate the influence of X_2 on X_1, we regress X_1 on X_2 and find the residual $e_2 = X_1^*$. Then, Y^* and X_1^* representing the variations in Y and X_1 respectively, left unexplained after we have removed the influence of X_2 from both Y and X_1. The partial correlation between Y and X_1 holding X_2 constant - denoted by $r_{y1.2}$ - is nothing else than the simple correlation between the residuals, Y^* and X_1^*; that is

$$r_{y1.2} = r_{y^* x_1^*} \tag{3}$$

The partial correlation between Y and X_1 holding X_2 constant, which ranges in value from -1.0 to +1.0 (as does simple correlation), can be expressed in terms of simple correlation as

$$r_{y_{12}} = \frac{r_{y_1} - r_{y_2} r_{12}}{\sqrt{[(1 - r^2_{y_2})(1 - r^2_{12})]}} \tag{4}$$

To test the null hypothesis that $r_{y_{12}}$ is zero, we can use the *t*-test statistic as given by equation (2), but with $(n-4)$ degrees of freedom. As far as our empirical work is concerned, we are going to find the partial correlation between Y and X, holding R and S constant. This process involves the following steps:

- constructing Y^* by finding residual of Y, after regressing Y on R;
- constructing X^* by finding residual of X, after regressing X on R;
- constructing Y^{**} by finding residual of Y^*, after regressing Y^* on S;
- constructing X^{**} by finding residual of X^*, after regressing X^* on S.

The final stage involves finding the correlation between Y^{**} and X^{**}, which is the *net* correlation of Y and X after excluding the influence of R and S. For example, we can implement the above process to find the partial correlation (or the *net* correlation coefficient) between the stock price (or stock return) on the Kuala Lumpur Stock Exchange at time t ($KLSE_t$) and the stock price (or stock return) on the Hong Kong Stock Exchange at time t ($HKSE_t$) by excluding the influence of the $KLSE_{t-1}$ and the stock return on the New York Stock Exchange at time t ($NYSE_t$). The coefficient of partial determination that is the square of the partial correlation provides useful information about the interrelationships among variables. For instance, $r^2_{y_{1.2}}$ tells us what proportion of the remaining variability in Y is explained by X_1 after X_2 has explained as much of the total variability in Y as it can [Daniel and Terrell (1992)].

DATA DESCRIPTION

As noted earlier, the present study involves examining the co-variations of stock returns between the KLSE and some selected well-established stock markets. Following the precedent in the literature and research of international stock market co-movements, the data on which this investigation is based are share price indices from sixteen national stock markets. These markets are, respectively, from Australia, Belgium, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, Norway, Spain, Sweden, Switzerland, United Kingdom, United States and Malaysia. Weekly share price indices of these markets obtained from Datastream, an economic information service, are listed in Table 1.

Table 1: Share Price Indices Used In The Study

COUNTRY	SHARE PRICE INDEX
AUSTRALIA	Australian Joint Stock Exchange All-Ordinary
BELGIUM	Bank Brussels Lambert
CANADA	Toronto Stock Exchange Composite Index
DENMARK	Copenhagen Stock Exchange Index
FRANCE	Datastream Total Market Index
GERMANY	Commerzbank Index
HONG KONG	Hang Seng Bank Index
ITALY	Milan Banca Commerciale Italiana
JAPAN	Nikkei Dow Jones Average Index
MALAYSIA	KLSE Composite Index
NORWAY	Oslo Stock Exchange Index Companies
SPAIN	Madrid Stock Exchange Index
SWEDEN	Veckans Affarer Weighted (All-share) Index
SWITZERLAND	Swiss Bank Corporation General Index
UNITED KINGDOM	Financial Times 500-share Index
UNITED STATES	New York Stock Exchange Composite Index

The purpose of using weekly data (rather than daily data) in this study is, to mitigate the problem of time zone (or non-synchronous trading). Besides, international investors, in managing their portfolios, might be more interested in medium or long-

term co-movements of equity prices (rather than daily co-movements). The data cover a period of eleven years; that is, 19841 through 1994. The rationale behind the employment of this sample period for our study is twofold:

(i) Whilst the concept and practice of international portfolio diversification is in fact not new, rapid growth in global investing has only started some time in the 1980s [see e.g., Murphy (1991)]. Then, the relevant issue (that might be interesting to international investors) to be examined here would be: with increased globalisation of equity markets, has the chance to exploit the benefits of international portfolio diversification diminished (or disappeared at all)?

(ii) The international stock market crash of October 1987 has been considered by many as the most serious worldwide crash in the history of stock markets. A number of studies suggest that international stock markets have become more integrated during the years after 1987. Is this also the case for the Malaysian stock market? How did the Malaysian stock market behave in terms of its co-variations with the well-established stock markets in 1987?

It is hoped that by choosing a sample, which covers a period of several years before and after the 'October meltdown' of 1987, some interesting and useful results towards constructive international portfolio decisions could be produced. The initial step in our statistical analysis of the data involves the transformation of these share price indices into their natural logarithms. Appropriately, stock returns here are defined in terms of natural logarithm as follows:

$$Ln(R_{it}) = Log_e(I_t) - Log_e(I_{t-1}) \qquad (5)$$

where

Ln (or Log_e) = Natural or Napierian logarithm;

R_{it} = Return on market (index) i at time t;

I_t = Stock price index at time t;

I_{t-1} = Stock price index at time t-1.

EMPIRICAL RESULTS

Our research begins by inspecting the correlation coefficients of the KLSE vis-à-vis well established markets based on the whole sample data (that is, the data which cover

the whole period of the study: 1984:01 through 1994:12). Results of this analysis are summarised in Table 2.

Table 2: Whole-Period Correlations Between The Klse And Well-Established Stock Markets :1984 – 1994

COUNTRY	PRICE INDEX	SAME TIME	LAG THE KLSE			LAG OTHER MARKETS		
		(t)	(t - 1)	(t - 2)	(t -3)	(t -1)	(t -2)	(t -3)
AUSTRALIA	AUSTALL	0.444*	0.154*	0.009	-0.035	0.179*	0.096*	0.084*
BELGIUM	BKBRLAM	0.300*	0.168*	0.070**	-0.002	0.070**	0.050	0.004
CANADA	TTOCOMP	0.327*	0.051	0.025	0.063	0.180*	0.072**	0.100*
DENMARK	CHAGENI	0.209*	0.102*	0.034	0.018	0.060	0.038	0.063
FRANCE	TOTMKFR	0.219*	0.034	-0.033	-0.033	0.125*	0.008	0.031
GERMANY	FURTCOM	0.345*	0.019	0.045	-0.047	0.112*	0.078**	0.045
HONG KONG	HNGKNGI	0.409*	0.186*	0.042	-0.046	0.136*	0.095*	-0.016
ITALY	MILANBC	0.205*	0.014	0.025	0.121*	0.048	0.042	0.025
JAPAN	JAPADOWA	0.312*	-0.008	0.009	-0.020	0.005	0.039	0.049
NORWAY	OSEINDX	0.409*	0.197*	0.098*	0.037	0.101*	0.071**	0.053
SPAIN	MADRIDI	0.306*	0.052	-0.058	0.042	0.103*	0.068	0.055
SWEDEN	VECWALL	0.314*	0.119*	0.138*	0.035	0.099*	0.010	0.005
SWITZERLAND	SWBKGEN	0.407*	0.071**	0.029	-0.034	0.157*	0.039	0.023
UNITED KINGDOM	FTA500I	0.382*	0.132*	0.072**	0.029	0.077**	0.114*	0.000
UNITED STATES	DJCMP65	0.323*	-0.021	-0.037	0.047	0.217*	0.095*	0.040

N.B * = Significantly different from zero at 5% level (of the two-tailed *t-test)*
** = Significantly different from zero at 10% (of the two-tailed *t-test*)
n = 575

Referring to Table2, column three reports the contemporaneous (weekly) correlation coefficients between the KLSE and the developed exchanges; columns four through nine on the other hand, display the lead-lag correlation coefficients (for three weeks; that is, up to $t-3$). Whereas columns four through six exhibit the extent to which the developed exchanges have been leading the KLSE, columns seven through nine quantify the strength of the KLSE as a leader to the well-established markets.

Figures in column three clearly indicate that contemporaneous correlation coefficients between the KLSE and all developed exchanges are significantly positive. As such, the null hypothesis of zero correlation between the KLSE and the developed stock markets has to be rejected (at 5% level of the *t-test*). With the exception of only Denmark, France and Italy, the correlation coefficients between the KLSE and all other markets in our sample are not less than 0.30. In particular, the KLSE appears to have been moving very closely together with four foreign equity markets: Australia (0.444), Hong Kong (0.409), Switzerland (0.407) and surprisingly Norway (0.409).

In terms of coefficients of determination (i.e., r^2), our evidence suggests that about 19 percent of the movements on the KLSE are the results of influences common to the Australian stock market. Further, about 17 percent of the variations on the KLSE could be explained by the variations on the stock markets of Hong Kong, Norway and Switzerland, respectively. High correlations recorded between the KLSE and the stock markets of Australia and Hong Kong could be explained by the fact that these markets are located in the same region. A number of previous studies [see e.g., Solnik (1996)] have documented that international stock markets tend to be regionally integrated (due to, perhaps, the closeness in relation among economies located in the same region).

Given the fact that New York, London and Zurich are influential international financial centres, one might expect the Malaysian capital market to be relatively highly correlated with its counterparts in the United States (0.323), United Kingdom (0.382) and Switzerland (0.407). However, we do not expect our stock market to be highly correlated with the stock market(s) in Norway (0.409) [and Sweden (0.314)] because these countries do not appear to have close economic relations with Malaysia. Perhaps, such relatively high correlations could be attributed to the 'global factors' that over time might provide the impetus for global stock market co-variations. Alternatively, these apparent correlations could be due to coincidental relationships in the data.

Another aspect of our results, which we find difficulty in providing a satisfactory explanation, is the relatively low correlation (i.e., 0.312) between the KLSE and the stock market of Japan. Since the economic relation between Malaysia and Japan seems

to be relatively close, the Malaysian stock market should necessarily be highly correlated with the Japanese market (compared to, for example, the stock market of Norway). Probably, this issue deserves further research. [However, it is interesting to note that this result appears to align with the findings of Cheung and Mak (1992), Arshanapalli et al. (1995) and Wei et al. (1995) that Asian equity markets are less integrated with Japan's equity market than they are with the U.S. market]. When the data are examined on a lead-lag basis, our results reveal that the correlation coefficients between the KLSE and overseas markets in the sample (with the exception of Italy and Japan) are still significantly positive , at least at lag one [see columns four and seven] , albeit the values of correlation coefficients have declined. This finding could be interpreted as implying that stock markets in our sample are not really efficient informationally [see Lofthouse (1994)] ,in the sense that they have been quite slow in processing international information.

However, based on our evidence, it is not very clear for us to interpret whether well-established bourses have been leading the Malaysian stock market, or vice versa. Perhaps a clearer picture of lead-lag relationships could be produced if the research is based on daily data. Our major interest in this paper as its title implies is, in quantifying the influence of certain well-established stock markets in affecting the movements on the KLSE. As such, we proceed by examining the tendency of the KLSE to move together with these markets from the perspective of conditional or partial correlation. This part of the study features the following:

The focus of this study will only be on contemporaneous partial correlation because, as shown in Table II, the lead-lag correlation coefficients are found to be very low compared to the contemporaneous correlation coefficients.

(i) For the sake of conserving space, we confine our analysis to only four stock markets, which are identified to be influential and instrumental (i.e., relatively highly correlated) in determining the nature and magnitude of fluctuations on the KLSE as shown in Table 2. These markets are respectively from Australia (AJSE), Hong Kong (HKSE), Switzerland (SWISS) and the United States (NYSE)

(ii) In order to understand the inter-temporal behaviour of co-movements between the KLSE and the four selected well-established markets mentioned in (ii) above, the data are examined not only for the entire period (i.e., 1984 through 1994), but they are also analysed on yearly basis. In other words, the inter-temporal stability in stock returns relationships in this study are investigated by employing the data, which are broken into eleven one-year periods. Results for this aspect of the study are displayed in

Tables 3 through 6. For each of these tables, the partial correlations between the KLSE and a foreign bourse [when two other markets are held constant] can be found in columns two, three and four.

Table 3: Partial Correlation Between The KLSE $_t$ And The AJSE $_t$: 1984 - 1994

(Holding constant: the $HKSE_t$, NYSE$_t$, SWISS$_t$ and the KLSE$_{t-1}$ Constant)

YEAR	STOCKS MARKET HELD CONSTANT		
	HKSE$_t$ & $KLSE_{t-1}$	NYSE$_t$ & KLSE$_{t-1}$	SWISS$_t$ & KLSE$_{t-1}$
1984 -1994	0.326* (0.106276)	0.351* (0.123201)	0.279* (0.078344)
1984	-0.060	-0.281*	-0.159
1985	0.102	0.184	0.178
1986	0.245**	0.224	0.162
1987	0.709*	0.574*	0.567*
1988	0.335*	0.434*	0.387*
1989	0.028	0.120	0.083
1990	0.279*	0.447*	0.222
1991	0.341*	0.266**	0.184
1992	0.067	-0.010	-0.052
1993	0.204	0.321*	0.215
1994	0.057	0.261**	0.296*

N.B:

* = Significantly different from zero at 5% level (of the two-tailed *t-test*)

** = Significantly different from zero at 10% level (of the two-tailed *t-test*)

n = 575 (for the whole period data) and 52 (for the yearly data).

In the parentheses are coefficients of (partial) determination

Table 4: Partial Correlation Between The $KLSE_t$ And The $HKSE_t$: 1984 - 1994

(Holding Constant: the $AJSE_t$, $NYSE_t$, $SWISS_t$ and the $KLSE_{t-1}$)

YEAR	STOCK MARKETS HELD CONSTANT		
	$AJSE_t$ & $KLSE_{t-1}$	$NYSE_t$ & $KLSE_{t-1}$	$SWISS_t$ & $KLSE_{t-1}$
1984 - 1994	0.265* 0.070225)	0.348* (0.1211004)	0.289* (0.083521)
1984	0.301*	0.252**	0.278*
1985	0.151	0.244**	0.227
1986	-0.052	0.018	-0.500*
1987	0.233	0.322*	0.281*
1988	0.168	0.235**	0.283*
1989	0.604*	0.609*	0.670*
1990	0.704*	0.702*	0.564*
1991	-0.139	-0.089	-0.234
1992	0.303*	0.231	0.247**
1993	0.405*	0.394*	0.424*
1994	0.228	0.407*	0.416*

N.B:

* = Significantly different from zero at 5% level (of the two-tailed *t-test*)

** = Significantly different from zero at 10% level (of the two-tailed *t-test*)

n = 575 (for the whole period data) and 52 (for the yearly data)

In the parentheses are coefficients of (partial) determination

Table 5: Partial Correlation Between The KLSE $_t$ And The SWISS $_t$: 1984 – 1994

(Holding Constant: the $AJSE_t$, $HKSE_t$, $NYSE_t$ and the $KLSE_{t-1}$)

YEAR	THE STOCK MARKETS HELD CONSTANT		
	$AJSE_t$ & $KLSE_{t-1}$	$HKSE_t$ & $KLSE_{t-1}$	$NYSE_t$ & $KLSE_{t-1}$
1984 - 1994	0.228* (0.051984)	0.306* (0.093636)	0.299* (0.089401)
1984	0.224	0.216	-0.041
1985	-0.027	-0.060	-0.026
1986	0.170	0.250**	-0.227
1987	0.324*	0.603*	0.385*
1988	0.009	0.091	0.110
1989	0.219	0.404*	0.235**
1990	0.589*	0.373*	0.581*
1991	0.300*	0.443*	0.336*
1992	0.470*	0.444*	0.296*
1993	0.196	0.167	0.270**
1994	0.071	0.018	0.136

N.B:

* = Significantly different from zero at 5% level (of the two-tailed *t-test*)

** = Significantly different from zero at 10% level (of the two-tailed *t-test*)

n = 575 (for the whole period data) and 52 (for the yearly data)

In the parentheses are coefficients of (partial) determination

Table 6: Partial Correlation Between The $KLSE_t$ And The $NYSE_t$:1984 - 1994 (Holding Constant: The $AJSE_t$, $HKSE_t$, $SWISS_t$ And The $KLSE_{t-1}$)

YEAR	THE STOCK MARKETS HELD CONSTANT		
	$AJSE_t$ & $KLSE_{t-1}$	$HKSE_t$ & $KLSE_{t-1}$	$SWISS_t$ & $KLSE_{t-1}$
1984 - 1994	0.203* (0.041209)	0.274* (0.075076)	0.179* (0.32041)
1984	0.489*	0.396*	0.394*
1985	-0.084	-0.131	-0.086
1986	0.068	0.104	0.035
1987	0.450*	0.619*	0.456*
1988	0.321*	0.213	0.272**
1989	0.026	0.052	-0.032
1990	0.411*	0.197	0.047
1991	0.117	0.221	0.022
1992	0.444*	0.409*	0.247**
1993	0.040	0.080	0.074
1994	0.092	0.128	0.200

N.B:

* = Significantly different from zero at 5% level (of the two-tailed *t-test*)

** = Significantly different from zero at 10% level (of the two-tailed *t-test*)

n = 575 (for the whole period data) and 52 (for the yearly data)

In the parentheses are coefficients of (partial) determination

For example, Table 3 exhibits the (contemporaneous) partial correlations between the Malaysian stock market and the Australian stock market. Figures in column two of the table are the partial correlation coefficients between these two markets when the stock returns on the Hong Kong stock market at time *t* and the stock returns on the Malaysian stock market at time *t-1* are held constant. Similarly, the partial correlation coefficients between the $KLSE_t$ and the $AJSE_t$ shown in column three are based on the condition that the NYSE at time *t* and the KLSE at time *t-1* are held constant. The variables held constant (in obtaining the correlation coefficients) in column four are the stock returns on the stock market of Switzerland at time *t* and the stock returns on the Malaysian stock market at time *t-1*.

For each of the Tables 3 through 6, as indicated by column one - row one displays the partial correlation coefficients for the entire-period data. The rows that follow on the other hand are for the partial correlation coefficients calculated on a yearly basis.

Upon inspecting Tables 3 through 6, the findings of this study could be summarised and interpreted in the following words:

(i) the entire-period partial correlations between the KLSE and the four selected stock markets under our investigation (see column one: Tables 3 through 6) are lower than their corresponding unconditional correlation coefficients as displayed in Table 2. However, these entire-period correlation coefficients are still significantly (positively) different from zero. We interpret these findings as follow:

Whilst the global factors [see e.g., Grinold et al. (1989); Cheung and Mak (1992); Lin *et. al* (1994)] are influential in affecting the tendency for equity markets from different countries to move together, 'national factors' or 'country factors' [see Eun and Shim (1989); Grinold *et. al* (1989); Beckers et. al (1996)] are crucial in determining the nature and magnitude of their international co-variations. For example - comparing Table 2 (row one: column three) and Table 3 (row one: columns two, three and four) reveals that the HKSE at time *t*, the NYSE at time *t*, as well as the SWISS at time *t* (and the KLSE at time *t-1*) have some influence on the contemporaneous correlation between the KLSE and the AJSE. Nonetheless, the whole period correlations between the $KLSE_t$ and the $AJSE_t$ have still been significantly positive even when the $HKSE_t$, $NYSE_t$, $SWISS_t$ and the $KLSE_{t-1}$ are held constant.

ii) In terms of the coefficient of (partial) determination - referring to Table III - about 11% of the movements in stock returns on the KLSE at time *t* are the results of influences common to the AJSE at time *t*, in the absence of the 'Hong Kong factor'. Similarly, when the 'U.S. factor' and the 'Switzerland factor' are held constant

respectively, about 12% and 8% of the movements on the KLSE are common to the AJSE. Thus, as far as the results displayed in Table 3 are concerned, in general, the 'Swiss factor' appears to be more influential than the 'Hong Kong factor' in affecting movements on the KLSE. On the other hand, the 'Hong Kong factor' appears to be more influential then than the 'U.S. factor' in determining the movements on the KLSE (in relation to the AJSE).

When we compare the entire-period coefficients of (partial) determination in Tables 3, 4, 5 and 6, it is clear that, among the four selected well-established stock markets - the AJSE, the HKSE, the NYSE and the SWISS - the AJSE appears to be the most influential market (see Table 5 or Table 6: row one, column two) in affecting movements on the KLSE. This is followed by the HKSE (see Table 6: row one, column three). Hence our evidence supports the findings of several previous studies that equity markets tend to be regionally integrated [see e.g., Roll (1992); Grinold *et. al* (1989); Solnik (1996)].

(iii) By examining the yearly (partial) correlation coefficients as shown in Tables 3 through 6, one will find that they are not stable over time. [Such inter-temporal instability in international stock market interrelationships has been detected in the previous studies by Makridakis and Wheelwright (1974), Panton et al. (1976), Maldonado and Saunders (1981) and Erb et al. (1994), just to name a few]. Depending on the different stock markets we are considering, these markets have been positively (significantly) correlated with the KLSE during certain years, whereas they have been lowly (and even negatively) correlated during other years.

(iv) Whilst the magnitude of partial correlations has been unstable over time, our evidence suggests that the KLSE tends to be highly correlated with foreign bourses during the periods of turbulence. As shown in Tables 3 through 6, the (partial) correlation coefficients between the Malaysian stock market and the four selected well-established markets have been strikingly high in 1987 (the year of world-wide international stock market crash) and 1990 (the year of Gulf War). [In addition to this eight-month period of the Kuwaiti Invasion (or Desert Storm), the Japanese financial crisis (and hence a large decline in Japanese stock market) as noted in Roll (1992) also occurred in 1990 (January)].

As far as the HKSE is concerned - as displayed in Table 4, in addition to 1987 and 1990, the Malaysian stock market has also been highly correlated with this bourse in 1984, 1989, 1992, 1993 and 1994. Another market with which the KLSE is found to have been highly correlated with in 1984 is the NYSE (see Table 6).

The relatively high correlations between the KLSE and the HKSE as well as the NYSE during the periods noted above could be attributed (to some extent) to several socio-political and economic developments. As recorded in Keesing's Contemporary Archives: Record of World Events, Volume XXX (1984), Longman, a number of events that took place in 1983/1984 that might have directly or indirectly affected the performance of the KLSE [and hence the correlation between the KLSE and the HKSE (and the NYSE)]:

(i) The five-month constitutional crisis in Malaysia (which started on August 1, 1983 and ended on January 10, 1984);
(ii) The general assembly of *UMNO*, the dominant party in the ruling coalition Government of Malaysia (which was held on May 25, 1984): "The election campaign had been particularly intense and divisive" (p. 33029);
(iii) The banking scandal, which involved *Bank Bumiputra Malaysia Bhd.*, one of the largest banks in Malaysia. The scandal was revealed in October 1983.
(iv) In 1983, the uncertainty over the political future of Hong Kong led to a continued decline in the value of the Hong Kong dollar. "... the lack of progress in Peking talks led to a crisis of confidence in the stock market in September, however, and the index fell from 1,000.23 on August 22 to 690.06 on October 4, the lowest level of the year" (p. 32626). In 1984, the Hong Kong financial markets were reported as "remained highly volatile during the period of talks between Britain and China over Hong Kong's future". These general political and economic uncertainties in 1984 "subsequently brought the index " (i.e., the *Hang Seng Index*), " down to 746.02 on July 13, although by early August it had recovered to around 900" (p. 33097).
(v) November 1984 was the month of the United States (U.S.) presidential election. [For a study on the impact of the U.S. presidential election upon stock market movements, see e.g., Neiderhoffer *et al.* (1970)].

To generalise, findings of the study inter alia, suggest that stock returns correlations between the KLSE and the well-established stock markets have been significantly positive. However, these returns correlations are not stable over time. These markets are found to have the tendency to move very closely together during periods of turbulence (or down markets).

The stock markets from Australia, Hong Kong, Switzerland and the United States (U.S.) are among those markets, which are found to be influential to the movements on the KLSE. In general, in terms of (contemporaneous) partial correlation, about 10%

and 9% of the movements on the KLSE could be explained respectively, by the movements on the stock markets of Australia and Hong Kong.

CONCLUDING REMARKS

Notwithstanding that the findings of the present study cannot claim to be totally novel, they appear to be insightful for investors. The conclusions of our results for portfolio management and investment planning could be conjectured as follow:

(i) Even though the correlation coefficients between the KLSE and well-established stock markets are in general significantly positive, they are less than 0.5 (i.e., they are far from being in unity). Simply put, the Malaysian stock market is far from being perfectly correlated with the stock markets from the developed countries. This implies that there is still room for international investors from these developed markets to enjoy the benefits of portfolio diversification by diversifying into the Malaysian stock market.
(ii) The presence of (significantly) positive lagged correlations (at least at time $t-1$) between the Malaysian stock market and well established markets as displayed in Table 2, could be considered as the evidence of the slowness of the stock markets in processing international information. If this is the case, then it is reasonable to believe that stock markets are somewhat predictable: that past information on stock returns movements (or co-movements) could be used for predicting future movements.
(iii) The evidence that the Malaysian stock market has been relatively highly correlated with the stock markets from Australia, Hong Kong, Switzerland and the United States suggests that major socio-political and economic events that have taken place in these countries could provide some insights for investors into predicting future directions of stock price movements on the KLSE.
(iv) The tendency for the Malaysian stock market to be highly correlated with foreign bourses during the periods of turbulence (or during the periods of high volatility) , that bad news seem to affect international stock markets more than good news (or no news), suggests that stock market movements (or co-movements) could be more effectively predicted during such a period. Such a finding could benefit investors (and speculators alike), primarily in planning their (short term) trading positions or investment strategies.
(v) The evidence of inter-temporal instability in international stock market inter-relationships (or co-variations in returns, as shown in Tables 3 through 6), justifies the practice of *dynamic asset allocation* in portfolio management.

REFERENCES

Arshanapalli, B. And J.Doukas (1993), International Stock Market Linkages: Evidence From The Pre- And Post-October1987 Period, Journal Of Banking And Finance, Vol. 17, No. 1, February, pp. 193 - 208.

Arshanapalli, B., J.Doukas And L.H.P.Lang (1995), Pre And Post-October 1987 Stock Market Linkages Between U.S. and Asian Markets, Pacific-Basin Finance Journal, 3, pp. 57 - 73.

Ayling, D.E. (1986), The Internationalisation Of Stock Markets, Gower Publishing Company, Limitedaldershot.

Bailey, W. And R.M.Stulz (1990), Benefit Of International Diversification: The Case Of Pacific Basin Stock Markets, The Journal Of Portfolio Management, Summer, pp. 57 - 61.

Beckers, S., G.Connor And R.Curds (1996), National Versus Global Influences On Equity Returns, Financial Analysts Journal, March/April, pp. 31 - 39.

Bertero, E. And Mayer, C. (1990), Structure And Performance: Global Interdependence Of Stock Markets Around The Crash Of October 1987, European Economic Review, Vol. 34, pp. 1155 - 1189.

Bertoneche, M.L. (1979), An Empirical Analysis Of The Interrelationships Among Equity Markets Under Changing Rate Systems, Journal Of Banking And Finance, Vol. 3, pp. 397 - 405.

Black, F. (1986), Noise, The Journal Of Finance, Vol. Xl1, No. 3, July, pp. 529 - 543.

Chen, N. And F.Zhang (1997), Correlations, Trades And Stock Returns Of The Pacific-Basin Markets, Pacific-Basin Finance Journal, 5, pp. 559 - 577.

Cheung, Y.L. and Y.K.Ho (1991), The Intertemporal Stability Of The Relationship Between The Asian Emerging Equity Markets And The Developed Equity Markets, Journal Of Business Finance & Accounting, Vol. 18, pp. 235 - 329.

Cho, D., C.S.Eun and L.W.Senbet (1986), International Arbitrage Pricing Theory: An Empirical Investigation, The Journal Of Finance, Vol. XlV, pp. 313 - 329.

Chung, P.J. and D.J.Liu (1994), Common Stochastic Trends In Pacific Rim Stock Markets, The Quarterly Review Of Economics And Finance, Vol. 34, No. 3, Fall, pp. 241 - 259.

Clark, L.J. (1991), The Essentials Of Business Statistics I, Research And Education Association, New Jersey.

Daniel, W.W. and J.C.Terrell (1992), Business Statistics For Management And Economics (Sixth Edition), Houghton Miffin Company, Boston.

Drummen, M. and H.Zimmermann (1992), The Structure Of European Stock Returns, Financial Analysts Journal, July/August, pp. 15 - 26.

Dwyer, G.P. and R.W.Hafer (1988), Are National Stock Markets Linked?, Review: The Federal Reserve Bank Of St. Louis, Vol. 70, No. 6, November/December, pp. 3 - 14.

Erb, C.B., C.R.Harvey and T.E.Viskanta (1994), Forecasting International Equity Correlations, Financial Analysts Journal, November-December, pp. 32 - 45.

Errunza, V.R. (1977), Gain From Portfolio Diversification Into Less Developed Countries' Securities, Journal Of International Business, Fall/Winter, pp. 83 - 99.

Errunza, V.R. (1983), Emerging Markets: A New Opportunity For Improving Global Portfolio Performance, Financial Analysts Journal, September/October, pp. 51 - 58.

Errunza, V.R. (1994), Emerging Markets: Some New Concepts, The Journal Of Portfolio Management, Spring, pp. 82 - 87.

Errunza, V.R. and P.Padmanabhan (1988), Further Evidence On The Benefits Of Portfolio Investments In Emerging Markets, Financial Analysts Journal, July/August, pp. 76 - 78.

Eun, C.S. and S.Shim (1989), International Transmission Of Stock Market Movements, Journal Of Financial And Quantitative Analysis, Vol. 25, No. 2, June:, pp. 241 - 256.

Fong, C.O. (1990), The Economic Challenges In The 1990s In Kok, W.K. Et Al. (Ed.), The Malaysian Challenges In The 1990s, Pelandok Publications, Petaling Jaya, Malaysia.

Granger, C.W.J. and O.Morgenstern (1970), The Predictability Of Stock Market Prices, D.C.Heath and Co., Lexington, Massachussetts.

Grinold, R., A.Rudd And D.Stefek (1989), Global Factors: Fact Or Fiction?, The Journal Of Portfolio Management, Fall, pp. 79 - 88.

Grubel, H.G. (1968), Internationally Diversified Portfolios: Welfare Gains And Capital Flows, The American Economic Review, Vol. 58, December, pp. 1299 - 1314.

Grubel, H.G. and K.Fadner (1971), The Interdependence Of International Equity Markets, The Journal Of Finance, Vol. Xxvi, March, pp. 89 - 94.

Halpern, P. (1993), Investing Abroad: A Review Of Capital Market Integration and Manager Performance, The Journal Of Portfolio Management, Winter, pp. 47 - 57.

Heston, S.L. and K.G. Rouwenhorst (1994), Does Industrial Structure Explain The Benefits Of International Diversification, Journal Of Financial Economics, Vol. 36, pp. 3 - 37.

Hilliard, J.E. (1979), The Relationship Between Equity Indices On World Exchanges, The Journal Of Finance, Vol. Xxxiv, No. 1, March, pp. 103 - 114.

Hunter, J.E. and T.G.Coggin (1990), An Analysis Of The Diversification Benefit From International Equity Investment, The Journal Of Portfolio Management, Fall, pp. 33 - 37.

Jeon, B.N. and G.M.Von Furstenberg (1990), Growing International Co-Movement In Stock Price Indices, Quarterly Review Of Economics And Business, Vol. 30, No. 3, pp. 15 - 30.

Jorion, P. (1989), Asset Allocation With Hedged And Unchanged Foreign Stocks And Bonds, The Journal Of Portfolio Management, Summer.

Kanji, G.K. (1993), 100 Statistical Tests, Sage Publications Ltd., London.

King, M. And S.Wadhwani (1990), Transmission Of Volatility Between Stock Markets, Review Of Financial Studies, Vol. 3, pp. 5 - 33.

Koutmos, G. and G.G.Booth (1995), Asymmetric Volatility Transmission In International Stock Markets, Journal Of International Money And Finance, Vol. 14, No. 6, pp. 747 - 762.

Lessard, D.R. (1973), International Portfolio Diversification: A Multivariate Analysis For A Group Of Latin American Countries, The Journal Of Finance, Vol. XXV111, No. 3, June, pp. 619 - 633.

Levy, H and M.Sarnat (1970), International Diversification Of Investment Portfolio, American Economic Review, Vol. 60, September, pp. 668 - 675.

Lin, W.L., R.F.Engle And T.Ito (1994), Do Bulls And Bears Move Across Borders? International Transmission Of Stock Returns And Volatility, The Review Of Financial Studies, Vol. 7, No. 3, Fall, pp. 507 - 538.

Lofthouse, S. (1994), Equity Investment Management: How To Elect Stock And Markets, John Wiley & Sons, Chichester.

Longin, F. And B.Solnik (1995), Is Correlation In International Equity Returns Constant: 1960 - 1990? Journal Of International Money And Finance, Vol. 14, No. 1, pp. 3 - 26.

Makridakis, S.G. and S.C.Wheelwright (1974), An Analysis Of Interrelationships Among The Major World Stock Exchanges, Journal Of Business Finance & Accounting, Vol. 1, No. 2, pp. 195 - 215.

Maldonado, R. and A. Saunders (1981), International Portfolio Diversification And The Inter-Temporal Stability Of International Stock Market Relationships, 1957 - 78, Financial Management, Vol. X, No. 4. Autumn, pp. 54 - 63.

Markowitz, H.M. (1952), Portfolio Selection, The Journal Of Finance, Vol. V11, March:, pp. 77 - 91.

Meric, I. and Meric, G. (1989), Potential Gains From International Portfolio Diversification And International Inter-Temporal Stability And Seasonality In International Stock Market Relationship, Journal Of Banking And Finance, Vol. 13, pp. 627 - 640.

Michaud, R.O., G.L.Bergstorm And R.D.Frashure (1996), Twenty Years Of International Equity Investing, The Journal Of Portfolio Management, Vol. 23, No. 1, Fall, pp. 9 - 22.

Murphy, J.J. (1991), Intermarket Technical Analysis: Trading Strategies For The Global Stock, Bond, Commodity And Currency Markets, John Wiley & Sons, Inc., New York.

Neiderhoffer, V., S.Gibbs and J.Bullock (1970), Presidential Elections And The Stock Market, Financial Analysts Journal, March/April, pp. 111 - 117.

Othman Yong (1993), Inter-Relationship Between Malaysian And Selected Stock Markets In The Far East And New York: Parametric Versus Nonparametric Approach Revisited, Journal Pengurusan, Vol. 12, pp. 65 - 84.

Panton, D.B. and V.P.Lessig And O.M.Joy (1976), Co-Movement Of International Equity Markets: A Taxonomic Approach, Journal Of Financial And Quantitative Analysis, Vol. 11, September, pp. 415 - 432.

Philippatos, G.C., A.Christofi and P.Christifi (1983), The Inter-Temporal Stability Of International Stock Market Relationships: Another View, Financial Management, Vol. 12, No. 4, Winter, pp. 63 - 69.

Phylaktis, K. (1997), Capital Market Integration In The Pacific-Basin Region: An Analysis Of Real Interest Rate Linkages, Pacific-Basin Finance Journal 5, pp. 195 - 213.

Roll, R. (1992), Industrial Structure And The Comparative Behaviour Of International Stock Market Indices, The Journal Of Finance, Vol. XLV11, No. 1, March, pp. 3 -41.

Solnik, B. (1990), Pacific Basin Stock Markets And International Diversification, Working Paper, Group Hec, Cr379, Cdced, Paris.

Solnik, B. (1996), International Investment (Third Edition), Addison-Wesley Publishing Company, Inc.

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

Stoodley, K.D.C., T.Lewis And C.L.S.Stainton (1980), Applied Statistical Techniques, Ellis Horwood, Chichester.

Tapley, M. And M.Simmonds (1982), International Diversification In The Nineteenth Century, The Columbia Journal Of World Business, Vol. Xvii, No. 2, Summer, pp. 64 - 69.

Tobin, J. (1958), Liquidity Preference As Behaviour Towards Risk, Review Of Economic Studies, Vol. Xxv, February, pp. 65 - 86.

Watson, J. (1980), The Stationarity Of Inter-Country Correlation Coefficient: A Note, Journal Of Business Finance & Accounting, Vol. 5, No. 2, Summer, pp. 195 - 205.

Wei, K.C.J., Y. Liu And C.C.Yang (1995), Volatility And Price Change Spill Over Effects Across The Developed And Emerging Markets, Pacific-Basin Finance Journal, Vol. 3, pp. 113 - 136.

Wheatley, S. (1988), Some Tests Of International Equity Integration, Journal Of Financial Economics, Vol. 21, pp. 177 - 212.