Interdependence of international stock markets: Malaysian case

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Abstract

The focus of this paper is to investigate the relationship between Malaysia's stock market and the five largest international markets. The methodology employed uses various unit root tests, and Johansen's cointegration test to determine if all variables move together in the long run. This is followed by the vector error correction modeling, variance decompositions, and impulse response functions to determine the direction of Granger-causality and relative exogeneity. Initial findings indicate limited benefits of international diversification for the Malaysian investor. Further analysis of the Granger-causal chain seems to point towards the European markets as bellwether indices for the Malaysian investor. While recognising the common fact that the US market is exogenous, as evidenced by various other studies, the Malaysian investor should monitor closely the French and German markets. Other than the US market, the French and German markets are likely to be more exogenous than the UK FTSE100 market, and therefore, should be considered as bellwether indices for the Malaysian investors

Keywords: stock market interdependence, VECM, VDC, Malaysia

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INTRODUCTION

Numerous studies have been undertaken over the past 30 years on the relationships among international stock markets, both by the academia and investment community. The study of market interdependence is meaningful as it has strong influence over the theory of financial economics, especially the extent to which markets are integrated and whether investors can benefit from diversification of investment portfolio.

Financial economics literature (De Santis, R. and Sarno, L. 2008) have long propagated international diversification of stock portfolios. Investment in less than perfectly positively correlated capital markets may result in gains for the savvy investor, based on the premise of reduction in overall systematic risk. However, investment barriers (restriction on capital movements, immature capital markets) have in the past, made it difficult for investors to capitalize on diversification of investment opportunities on a global basis.

It is only over the past few decades where "globalization" of financial markets have minimized these investment barriers; hence making it possible for diversification of asset portfolio on an international basis, especially for Malaysian investment funds. Despite such opportunities, the average Malaysian fund has 45% of assets allocated to local stocks, while another 20% invested in foreign equities. Such a scenario brings about two issues:

1. Average fund is not well diversified
2. Malaysian funds control more than 75% the local stock market value

(Dheshi, D. 2010)

Against this backdrop, this paper looks at the relationship between the Malaysian stock market and the five largest international markets (US, UK, France, Japan and Germany) for a ten-year period on a weekly basis. The aim of this study is to provide insights into the linkages between Malaysian and international stock markets to:

a. Determine if all the six markets are bound together by long-run equilibrium relationship.
b. Identify, among the stock markets of Malaysia, France, Germany, Japan, UK and US, which is the leading variable, being the most exogenous of all
c. Assess the benefits of international stock portfolio diversification for Malaysian investment funds

The findings hope to have clear policy implications for a Malaysian investment fund, especially when formulating long-term global investment strategies.

The remainder of the paper is organized as follows: Section II – contains a brief overview of existing literature on the field of interdependence, especially among the stock markets of emerging South East Asian countries (Malaysia included) and the developed economies.

Section III attempts to identify the Granger causal chain and relative exogeneity / endogeneity among the variables. Section IV discusses on the findings, and suggests some policy implications. Section V contains the summary, conclusions and limitations of this study.

SECTION II - LITERATURE REVIEW

Due to the increasing popularity of the co-integration techniques developed during late 1980s, there was renewed interest in the debate on stock market interdependence. The co-integration technique filled the gap between short-run dynamics and the long-run equilibrium relationship of financial time series by allowing an error correction mechanism to bring the series to its equilibrium. Many studies in the 1990s and early 2000s examined the impact of specific events in the interdependence of stock markets using co-integration technique. This review highlights the findings of some of the key research done, concluding with a discussion of contributions made on the interdependence of Malaysian and international markets.

In 1992, Kasa, K. tested and confirmed common trends in the following international stock markets: Canada, Japan, Germany, UK and US (from 1974 to 1990). Johansen's procedure confirmed a single common stochastic trend affecting the long-run movements of all the markets. The results suggest that gains derived from international diversification of portfolio were too presumption, especially for long holding periods.

In a study of Pacific Basin markets of Australia, Hong Kong, Japan, New Zealand and Singapore over a 20 year observation period, Corhay, Rad and Urbain (1995) revealed evidence of co-integration. Further analysis pointed towards some regional tendencies (Asian versus Pacific) in the relationship. The study by Masih and Masih (1999) confirmed evidence of geographical proximity supporting the co-integration of Asian markets and OECD markets separately. It can be implied that geographical proximity is an explanation as to why markets share common trends.

In another test of linkages among the international markets, Francis B. and Leachman, L. (1998) found positive co-integration results among the German, Japanese, UK and US markets through tests of super-exogeneity. The results nevertheless, rejected the super-exogeneity of Japan and the UK. They pointed out that the Japanese market was isolated and invariant to events over the period.

Looking at the Malaysian market, a study was done by Daly K. (2003) which examined the relationship of dynamic interdependence of the stock markets of Indonesia, Malaysia, the Philippines, Singapore, Thailand, and the advanced stock markets of Australia, Germany, and the United States for the period 1990 - 2003. Although there is evidence of co-integration between the South East Asian markets, the South East Asian markets were not significantly co-integrated with any of the developed stock markets.

The findings of Kasa, K. (1992), Corhay, Radd and Urbain (1995) and Masih and Masih (1999) all suggest that stock prices would be co-integrated if the underlying factors determining

stock prices were co-related. Geographical proximity is a factor. However, the contributions of Daly, K. (2003) generally found little evidence of long-term linkages between South East Asian markets and advanced markets.

The question is: since 2003, have the relationship patterns between stock markets changed? Is the Malaysian stock market now less co-integrated with the advanced markets, possibly due to geographical distance - therefore, there could be long-term stock portfolio diversification benefits for the Malaysian investor? This scenario justifies the rationale for this paper – to investigate the **linkages** between the Malaysian market and advanced markets and assess benefits of international diversification for the Malaysian investment fund.

SECTION III – APPLICATION AND ESTIMATION RESULTS

The interdependence of the stock markets is investigated from the viewpoint of a Malaysian investor. The stock markets of France, Germany, Japan, UK and US were chosen as these five countries belong to the G-7 group – the wealthiest nations. It is reported that the stock markets of the G-7 countries account for 75% of the world market capitalization. The influence of these countries on the performance of global economy and other stock markets round the world is constantly being watched.

The data used here are the weekly closing price of the stock market indices of France (SBF 120), UK (FTSE 100), Germany (DAX 30), Malaysia (Bursa Malaysia KLCI), Japan (Nikkei 225), and the US (NYSE Composite)for eleven years starting from 31 Dec 1999. There are in total 580 observations, and all data are derived from the Datastream software.

Step 1 – Testing the Stationarity / Non-stationarity of the variables

An Augmented Dickey-Fuller (ADF) test is being performed on each of the variable, in its original level form and its first differenced form. A summary of the results is captured in Tables A and B:

Table A

Variable	Test Statistic	Critical Value	Interpretation
Variables in their level form			
LFR (France)	-1.8682	-3.4198	Non stationary
LUK (UK)	-2.0554	-3.4198	Non stationary
LDE (Germany)	-2.0161	-3.4198	Non stationary
LMY (Malaysia)	-2.8930	-3.4198	Non stationary
LJP (Japan)	-2.0940	-3.4198	Non stationary
LNY (US)	-1.9181	-3.4198	Non stationary

Table B

Variable	Test Statistic	Critical Value	Interpretation
Variables in their differenced form			
DFR (France)	-9.4372	-2.8669	Stationary
DUK (UK)	-9.7158	-2.8669	Stationary
DDE (Germany)	-9.0370	-2.8669	Stationary
DMY (Malaysia)	-8.8600	-2.8669	Stationary
DJP (Japan)	-9.7199	-2.8669	Stationary
DNY (US)	-8.8792	-2.8669	Stationary

Based on the above summary of results, we can conclude that all the variables in their level forms are non-stationary, while the variables in the differenced form are all stationary. We shall move on to Step 2 below.

Step 2 – Determining the order of the VAR (Vector Auto Regression) model

The summary of results for the above step is reflected in the table below:

Table C

	AIC	SBC
Optimum lag corresponding to the highest values of AIC and SBC	1	0

We check for serial correlation for each variable and the following results are captured:

Table D

Variable	CHISQ	At 10% critical value - interpretation
DFR (France)	0.382	No serial correlation
DUK (UK)	0.419	No serial correlation
DDE (Germany)	0.130	No serial correlation
DMY (Malaysia)	0.000	Serial correlation
DJP (Japan)	0.912	No serial correlation
DNY (US)	0.351	No serial correlation

Based on the above results, auto correlation exists in one of the variables. If we choose a small lag term, we face the consequence of auto correlation. On the other hand, opting for too high an order may result in over-parameterization. As we have a total of 580 observations, we opt for 2 lags.

Step 3 – Testing for Co-integration

Taking the order of VAR model at 2, we obtain the following summary of results

Table E

Criteria	r (# of co-integrating relationships)
Maximal Eigenvalue statistics	1
Trace statistics	1

The result of 1 co-integrating relationship is in line with intuitive opinion that stock markets are generally "connected" and they all move in one direction in the long term. However, this finding diverges from Daly, K. (2003)'s evidence that there is minimal linkages between markets in South East Asia countries and the developed economies. Besides the different observation periods (between Daly, K.'s study and this paper), the other probable cause could be the intensification of "globalization" of markets (post 2002), making it easier for investors and traders to trade in stocks and other financial products on a real-time basis. This contributes to the co-integration of the Malaysian market and advanced markets.

The statistical meaning of the result suggests that the error term is stationary. Therefore, the variables are co-integrated. Co-integration implies that there is a theoretical relationship among the variables, and that they are in equilibrium in the long run. The economic implication for the Malaysian investor is as follows: the possibility of gaining abnormal profits in the long term, via international investment portfolio diversification, is **limited**. In the short run, the investor can still capitalise on returns via international diversification of portfolio. However, in the long run, it is not likely that the investor can consistently achieve abnormal profits. The Malaysian and advanced markets appear to be perfectly correlated in the long run.

Step 4 – Long Run Structural Modeling (LRSM)

We normalize the variable of interest the Bursa Malaysia KLCI (LMY), and the following exact identification results are obtained:

Table F

Variable	Coefficient	Standard error	t-ratio	Interpretation
LFR	7.9156	2.8020	2.82498	Significant
LUK	-5.9024	2.7702	2.13067	Significant
LDE	-0.92604	0.92386	1.0023	Not significant
LMY	-	-	-	-
LJP	-2.6125	1.0360	2.5217	Significant
LNY	-1.0164	1.0013	1.0150	Not significant

The LR statistic for three over identifying restrictions (A4=1; A6=0; A3 =0) conveys a CHSQ(2)= .95199[.621] result – pointing towards the acceptance of the null, i. e. the restriction holds. Therefore, the restricted co-integrating relation is estimated as:

8.08LFR -8.07LUK +LMY -2.95LJP $\_\_$ I(0)

(3.35) (3.12) (1.27)

Step 5 – Vector Error Correction Model (VECM)

Step 5 - VECM helps us discern the exogeneity or endogeneity of each of these variables and gives us an understanding of the direction of Granger causality within the sample period. The results for Step 5 are summarized in the table below:

Table G

Variable	Ecm p-value	Interpretation
LFR	0.026	Not significant – Variable is a leader
LUK	0.504	Significant – Variable is a follower
LDE	0.029	Not significant – Variable is a leader
LMY	0.151	Significant – Variable is a follower
LJP	0.615	Significant – Variable is a follower
LNY	0.302	Significant – Variable is a follower

Based on the above results, it would be apt for the Malaysian investment fund to pay attention to the French (SBF 100) market, as part of its international portfolio diversification. As the error-correction coefficient of the variable is insignificant, the dependent variable of the equation is 'exogenous'. That means the French market is a leading variable. It absorbs shocks and transmits them to other variables (British, Malaysian and Japanese markets) that are co-integrated in the long run.

Also, the error correction term of the Bursa Malaysia KLCI (LMY), i. e. 0.15, reflects the speed of short term adjustment to bring about long term equilibrium. Its economic interpretation suggests that if there is a shock to the Malaysian KLCI, it would take an average of 1/ 0.15 = 6.6 weeks for the index to get back into equilibrium viz a viz the other indices.

Step 6 – Variance Decomposition

The VECM tests can only indicate the endogeneity / exogeneity of a variable. For Step 6, we attempt to apply the generalised variance decomposition technique to discern the relative extent of endogeneity or exogeneity of the variables. The endogeneity or exogeneity of a variable can be identified by the proportion of the variance explained by its own past. The variable that is explained most by its own shock (and not by others) is considered as the most exogenous of all. The table below captures the effects of own shocks for each variable via the generalised variance decomposition technique.

Table H

	LFR	LUK	LDE	LMY	LJP	LNY
LFR	.90444	.063182	.6579E-3	.0041466	.018456	.0091123
LUK	.84341	.13993	.9095E-4	.0022627	.0073969	.0069112
LDE	.75315	.078618	.13994	.0018515	.018985	.0074570
LMY	.17503	.037501	.044184	.72932	.0083189	.0056470
LJP	.49734	.0043240	.0098029	.022182	.45137	.014988
LNY	.62474	.11280	.0038269	.2088E-3	.0084838	.24995

For effective comparison of the variance decomposition tests, we proceed to obtain the orthogonalised VDCs, where the proportions add up to 100%**.** The orthogonalised VDCs assume that when a particular variable is shocked, all other variables in the equation are switched off, whereas the generalized VDCs have no such assumptions. The below table are the results of the orthogonalised VDCs, with proportions adding up to 100%.

Table I

	LFR	LUK	LDE	LMY	LJP	LNY
LFR	54.6%	3.8%	39.7%	0.3%	1.1%	0.5%
LUK	44.2%	7.3%	47.6%	0.1%	0.4%	0.4%
LDE	75.3%	7.9%	14%	0.2%	1.9%	0.7%
LMY	17.5%	3.7%	4.4%	73%	0.8%	0.6%
LJP	49.7%	0.4%	0.9%	2.4%	45.1%	1.5%
LNY	51.7%	9.3%	0.5%	17.2%	0.7%	20.6%

From the above table, the diagonal figures (shaded in grey) reveal the relative exogeneity of the variables. The ranking of the indices according to degree of exogeneity is summarized in the table below:

Table J

Ranking according to degree of exogeneity	Variable
1 (most exogenous)	LMY
2	LFR
3	LJP
4	LNY
5	LDE
6 (least exogenous)	LUK

Comparing the causality results from tables J and G, they are rather contradictory. LMY, which is a follower in table G (Step 5), appears to be the most exogenous variable in table J. It is

implausible to accept that LMY (a proxy of the Malaysian stock market), is the most exogenous of all, as it is the smallest market, in terms of size, capital, depth and breadth. The theoretical and practical assumption is that LMY should be the least exogenous of all the variables, and either the LNY (American market) or the LDE (German market) to be most exogenous, taking into account the findings of Francis, B. and Leachman, L. (1998).

The apparent deviation from the fact that LMY should be the weakest of all markets, could be due to the limitations of the orthogonalised VDCs, which are:

- The orthogonalised VDCs are influenced by the order of the variables in VAR;
- The orthogonalised VDCs assume that when a specific variable is shocked, all the other variables in the equation are "switched off"

STEP 7 – Impulse Response Function (IRF)

When we apply the generalized IRFs, the results are aligned to the results in Table G, i. e. the French and German markets are leading variables. A shock on LFR triggers LMY to deviate from equilibrium by 0.01 standard deviation. Whereas shocks on LUK, LNY and LJP causes LMY to deviate from equilibrium by 0.005 or less standard deviation.

It is indicative from the results, that the French and German markets are leading variables, affecting significantly the Malaysian market, as revealed in table G, supported by the IRF graphs

STEP 8 – Persistence Profile

Finally, the application of the persistence profile test suggests that in the event of a system-wide shock, it would take 20 periods (20 weeks) for equilibrium to be restored.

SECTION IV- DISCUSSION OF RESULTS AND APPLICATION

This study reveals that the Malaysian equity market is perfectly correlated with major international markets, suggesting there is **little to gain** from international diversification of asset portfolio. The co-integration results are in tune with the findings of Kasa, K. (1992), Corhay, Radd and Urbain (1995) and Masih and Masih (1999) that theorise the co-integration of stock prices, based on common underlying factors. This is in stark contrast to Daly, K.'s (2003) proposition that South East Asian markets, such as Malaysia, and the developed markets may not be correlated in the long run.

The bottom line is "globalization" may not be promoting international diversification of assets, there is **little room for abnormal profits** to be made from imperfect markets, at least in the context of market interdependence between Malaysia and the developed markets.

From Table G (Step 5), it appears that the French and German markets are **bellwether indices,** in relation to the Malaysian index. The message to Malaysian fund investors is that they must

pay close attention to these markets, as sudden movements to these markets, will drive changes in other markets as well.

The US and Japanese markets, which are normally the more exogenous variables in studies of stock market interdependence in Asia Pacific, strangely are reported as follower variables in this study. The US market is nevertheless, in the personal view of the authors, a significant driver influencing not just the Malaysian market but also other major markets around the world due to its sheer size, depth and breadth.

The authors take a divergent view from the findings of this study that the US market is a follower market. In contrast, the US market remains an attractive area for investment because of its size and diverse market structure. The study's revelation that European markets like France and Germany, being exogenous factors, should also be monitored closely by the Malaysian fund managers. In this context, an earlier study by Cheung and Lai (1999) gave empirical evidence that the European markets are highly correlated. The Malaysian investor therefore, should view the European market as a single entity, in light of the region's efforts to maintain its economic and monetary union.

As for the Japanese market, the authors tend to concur with an earlier study by Bessler, D. A. and Yang, J. (2003) that Japan has not much influence on other Asian markets during non-crisis periods. A plausible explanation behind this assumption is that Japan is a relatively isolated market, under normal market conditions. A full recovery from its fundamental economic woes may one day see the Japanese market being a more exogenous market, viz a viz other major markets in the world.

CONCLUSION

Overall, the results suggest strong correlation among the Malaysian and developed markets. This has important implications for Malaysia's investment fund industry, especially when formulating long term, global investment diversification plans. These fund institutions should take note of the following findings of the study:

- There is **limited** long term stock portfolio diversification, as the Malaysian and developed markets are co-integrated in the long run
- While recognising the common fact that the US market is extremely exogenous, as evidenced by various other studies, the Malaysian investor should monitor closely the **French and German markets**. Other than the US market, the French and German markets are likely more exogenous than the UK FTSE100 market, and therefore, should be considered as bellwether indices for Malaysian investors
- The Japanese market, as an endogenous variable, appears a relatively stand-alone market, under normal conditions. It is unlikely to be an exogenous market until such time Japan emerges stronger from its economic moribund and returns as a world economic powerhouse.

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