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Evidence of Global Financial Shocks Transmission: Changing Nature of Stock Markets Integration during the 2007/2008 Financial Crisis

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The study aims to empirically examine the nature of integration among the Malaysian stock market with two of the world's biggest stock markets, namely the US and Japan, during the global financial crisis in 2007/2008. By assessing the changes in the nature of integration among these markets during the crisis, the study aims to find evidence on the international transmission of the financial shocks through the global stock markets. The study covers the period from September 1, 2006 to May 30, 2009. In efforts to capture the changing nature of integration among the stock markets, the sample period is divided into three sub-periods, namely the pre-crisis period, during crisis period I and during crisis period II. In methodology, the study relies on the recent empirical tests of cointegration, impulse response functions and variance decomposition analysis. The study finds that the nature of integration among the these markets changes over the three periods due to the crisis. In particular, the markets are shown to be highly integrated at the initial stage of the crisis. However, as information became clearer and it is evident that the crisis is prolonged, investors opt for other types of investment than the equity markets, resulting in all the markets to perform independently.

1. Introduction

Studies documenting increasing integration among the global financial markets are abundant, often focusing on the integration of the national stock markets. There seems to be a tendency towards a general consensus that the international links among the stock markets have been increasing over the past decades, particularly those in the major financial centers (see, for example, Goldstein and Michael, 1993; Blackman and Holden, 1994; and Hanna et al., 1999). This trend is

largely attributed to the increased efficiency in the financial markets that facilitate capital flows across the globe. As suggested by Blackman and Holden (1994), stock markets are more segmented in the 1970s compared to the 1980s due to restrictions in capital flows, high transaction costs and information difficulties in the earlier period. The study by Hanna et al. (1999) on the nature of integration among six developed equity markets, namely the UK, France, Germany, Italy, Japan and Canada in the 1990s further lend support to these findings as the results reveal that these stock markets are highly integrated with each other, thus fail to offer any diversification benefits to the investors.

While integration among the global stock markets has increased, deeper investigations reveal the time-varying aspect of the stock market integration. Many studies have shown that the nature of integration among the stock markets could be changing over different sample periods. The study by Bekaert and Harvey (1995) which focuses on twelve emerging stock markets finds the time-varying integration among these stock markets. In particular, the study finds that several of the stock markets are segmented in one part of the sample and become integrated in another part of the sample. The different nature of the stock market integration is attributed to the regulatory changes over the sample periods, including the lifting of capital market restrictions to foreign investors. In the case of the major ASEAN countries, Click and Plummer (2005) find that the stock markets of the major ASEAN countries become increasingly integrated in the post-1997 financial crisis compared to before the crisis period as member countries intensify their efforts towards financial sector integration in advent of the macro-economic integration.

The recent US 2007 sub-prime crisis has renewed the research interests to understand the impact of financial crisis on the stock market integration. For the case of the US 2007 crisis, to our knowledge, there are limited studies focusing on the impact of the US financial crisis on other stock markets due to the recent nature of the crisis. Against this backdrop, the objective of this study is to analyze the transmission of the US 2007 sub-prime crisis to other stock markets and determine how the nature of integration among these stock market changes due to the crisis. By focusing on the nature of integration among the Malaysian stock market with two of the world's biggest stock markets, namely the US and Japan stock markets during the 2007 US financial crisis, the study

aims to find evidence of the international transmission of the financial shocks through the global stock markets. In efforts to capture the changing nature of integration during this period, the whole sample period from September 1, 2006 to May 30, 2009 is divided into three sub-periods, namely, the pre-crisis period starting from September 1, 2006 to July 25, 2007; during crisis period I starting from July 27, 2007 to June 30, 2008, and during crisis period II from the period July 1, 2008 to May 30, 2009.

The rest of this study is organized as follows. The next section reviews selected studies on stock market integration with the intention of identifying major issues and area for further exploration. Section 3 deals with the methodology adopted by this study. Section 4 presents the results of the empirical tests. Section 5 concludes and highlights the implications of the major findings.

2. Stock Market Integration and Transmission of Financial Shocks

Stock market integration captures substantial research interests due to the many important implications that it conveys. First, information regarding stock market integration suggests the potential benefits that can be gained by diversifying investments in the markets under consideration. In a risk-return framework, an investor can increase return or reduce risk, or both, by diversifying his investment portfolio in stock markets that are segmented. A classic study by Grubel (1968) which analyzes the stock markets in ten developed countries show that an investor in the New York Stock Exchange can increase his annual returns by as much as 68 percent while keeping his risk constant by diversifying in the international stock markets. Similarly, Levy and Sarnat (1970) increase the sample to 28 markets, comprising of both the developed and emerging markets and discover that the inclusion of the emerging markets increases the diversification benefits substantially, particularly for the US investors. Thus, information about stock market integration is crucial to investors in capital budgeting and making investment strategy.

Second, the degree of stock market integration also signals the extent of financial sector integration, which reflects the vulnerability of the countries to experience “financial contagion”. Thus, information about stock market integration or segmentation is equally important to the

policymakers. The degree of stock markets integration signals the extent of financial sector integration, which reflects the vulnerability of the countries to experience "financial contagion". As two stock markets could be highly integrated due to strong economic ties such as trade and investment as well as due to macroeconomic policy harmonization, adverse development in the financial sector in one country could well be transmitted to the other country (a systemic shock). One such example of the financial contagion was the experience of the developing Asian countries during the financial crisis in 1997/1998. The crisis which started with the de-valuation of the Thai baht was transmitted throughout the region due to the strong trade and investment links among the countries during the period. Therefore, the need to understand clearly the nature of stock markets integration is crucial to the policymakers so that pre-emptive measures can be undertaken to prevent the systemic shocks.

Transmission of financial shocks through the global equity markets is a form of financial contagion. A study by Ibrahim (2005) shows that an increasing integration among the national stock markets implies that international financial instabilities are easily transmitted to domestic financial markets, a phenomenon called 'financial contagion'. The degree of linkages or integration among the stock markets provides important implications for the potential benefits of the international portfolio diversification and financial stability of a country. An increasing integration among the national stock markets further implies that international financial instabilities are easily transmitted to domestic financial markets. Highly open economies with extensive international trade are more vulnerable to external shocks than countries with large proportion of domestic demand.

Similarly, the efforts to liberalise the financial sector could result in the economy to be vulnerable to financial shocks. Indeed, some studies showed that financial sector integration facilitate the transmission of shocks across the countries during crises. Kaminsky and Reinhart (1999) show how the crisis in Asia spread during the second half of 1997 by using daily interest rate and exchange rate data for Indonesia, Malaysia, the Philippines, South Korea and Thailand. The study finds that the propagation of shocks across national borders during the crisis was attributed to the behaviour of foreign banks, which began to drastically curtail their lending to the affected Asian countries following the Thai

devaluation, thus spreading and amplifying the crisis throughout the region. The large exposure of European banks to South Korea and their subsequent retrenchment further deepens the regional liquidity crunch. In short, the study finds that a reversal in lending of Japanese and European banks, which were lending heavily to emerging Asia, as one of the main reasons for the spread of the crisis. In short, this study suggests that financial sector links between the emerging Asian countries have played an increasingly important role in the 1990s in transmitting disturbances across national boundaries.

The study by Dunis and Shannon (2005) examines the integration between the emerging markets in South East Asia (Indonesia, the Philippines and Malaysia) and in Central Asia (Korea, Taiwan, China and India) with the established markets (the United States, the United Kingdom and Japan). By employing the techniques such as VAR and Kalman filters, the results indicated that all seven emerging markets in South East Asia and Central Asia exhibit greater integration with the Japan stock market rather than with the other two established markets. Thus the influence of the United States stock market on the emerging economies seems to diminish over more recent years. Consistent with the findings of Dunis and Shannon (2005), another study by Mohd Yusof and Abd Majid (2006) find that between the United States and Japan stock markets, the latter seems to significantly lead Malaysia's stock market after the 1997 Asian financial crisis. By employing similar techniques such as cointegration, variance decomposition and impulse response function, they investigated the dynamic interdependence of Malaysia stock market in these two established stock markets. According to the authors, the reason for Malaysia stock market is more integrated with Japan stock market could be partly due to an increasing trend of bilateral trade between these two countries over the years.

It is important to note that, there is a good side of stock markets integration in the context of regional economic cooperation such as ASEAN. Theoretically, an integrated stock market is considered as more efficient than a segmented stock market since it enables investors in the member countries to allocate capital in markets that are highly productive. Integrated stock markets in the region allow for free capital flow facilitated by lower cost of capital and transaction cost, improve liquidity and increase economic activities among the member countries. This investment option is even more relevant as ASEAN member

countries are striving to reduce the dependency on bank loans following the Asian financial crisis 1997/1998 (Click and Plummer, 2005). A highly integrated stock markets in the context of the ASEAN economies will go a long way in supporting the effort of establishing the ASEAN Investment Area (AIA) by 2010 as envisioned by the ASEAN leaders in October 1998.

3. Methodology

In achieving the objective of assessing the changing nature of integration among the US, Japan and Malaysian stock markets, this study relies on several empirical tests. This section focuses on the empirical framework and data issues by providing justifications for the tests that are adopted and discussing their suitability in the context of this study.

3.1 Empirical Framework

The empirical approach of this study is based on the standard methods of co-integration and vector auto-regression (VAR) framework. These methods have been widely adopted by studies in financial economics since due to their simplicity, particularly in terms of the nature of the variables. In particular, the VAR does not require for the a-priori distinction between exogenous and endogenous variables. Since the distinction is often subjective, it is wise to treat similarly (Sims, 1980). Since the technique sets no restrictions regarding the structural relationships of the variables, the mis-specification problems can be avoided.

Co-integration Test

The test of co-integration is conducted to examine the existences of the long-run relationships among the variables. The results from cointegration tests enable us to model short run dynamic interactions among the variables within our VAR system. If the variables are found to be non-stationary and non-cointegrated, the dynamic interactions among the variables are assessed according to the standard VAR model with variables expressed in first difference. Conversely, if the variables are found to be co-integrated, error correction models should be employed and accordingly this justifies the use of VAR model in levels.

To test for the cointegration, the maximum likelihood approach of Johansen-Juselius (JJ) cointegration test is used in this study. Essentially, JJ is based on VAR model as follows:

$$\mathbf{Y_t} = \delta + \mathbf{\Pi_i Y_{t-1}} + \mathbf{\Pi_k \Delta Y_{t-k}} + \boldsymbol{\varepsilon_t} \quad (1)$$

where $\mathbf{Y_t}$ is an *n x 1* vector of non-stationary variables integrated of the same order, δ is an *n x 1* vector of constant, $\mathbf{\Pi_i}$ is an *n x n* matrix of coefficients, $\boldsymbol{\varepsilon_t}$ is an *n x 1* vector of white noise error term and **k** is the order of autoregression. As our study investigates market integration among three markets, therefore *n* is equal to three.

The long-run information matrix $\mathbf{\Pi}$ in this equation is the key to Johansen's cointegration test because its rank r determines the number of cointegrating vectors. If rank ($\mathbf{\Pi}$) = 0 returns to a VAR model in the first differences and the components in Y_t are not cointegrated. On the other hand, if $\mathbf{\Pi}$ is a full rank n, all component in Y_t are stationary. In a more general case when 1 < rank ($\mathbf{\Pi}$) < n, the number of cointegrating vectors is equal to r, the rank of matrix $\mathbf{\Pi}$. Since the rank of a matrix is equal to the number of eigenvalues λ_i (or characteristic unit roots) that are significantly different from zero, Johansen proposed two statistics to test the rank of the long-run information $\mathbf{\Pi}$, namely:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (2)$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (3)$$

where λ_i are estimated eigenvalues (characteristic roots) ranked from largest to smallest. The λ_{trace} in the equation (2) is called the Trace statistics, which is a likelihood ratio test statistics for the hypotheses that are at most *r* cointegrating vectors. The λ_{max} in the equation (3) is called the Maximal Eigenvalue statistic that tests the hypothesis of *r* cointegrating vectors against the hypothesis of r – 1 cointegrating vectors. The rank of $\mathbf{\Pi}$ is equal to the number of eigenvalues that are different from zero. If eigenvalues λ_i's are all zero, then the λ_{trace} and λmax will be zero. To test for the number of cointegrating vectors, this study employs Johansen and Juselius's (1990) and Osterwald-Lenum's (1992) λ_{trace} and λ_{max} statistics that are adjusted for the degree of freedom.

Since our model considers the possibility of the past level of parameters to have an effect on current changes in other parameters, the lagged values have to be incorporated in the models. In this study, the Akaike (1974) Information Criterion (AIC) is used to determine the lag length incorporation in all the tests of this study.

Impulse Response Functions and Variance Decomposition Analysis

The impulse response functions (IRF) and variance decomposition analysis (VDC) derived from VAR are relevant and suitable for this study in order to analyze the impact of the crisis on the selected stock markets. Conventionally, VAR studies such as Sims (1980) employ variables in log level. The problem is that the results from such a specification may be spurious and misleading if log level variables are non-stationary. Transforming the variables into first differences to render the variables stationary before running VAR, however, introduces misspecification problem in the case that the variables under consideration are cointegrated. For proper specification of the VAR model as to avoid spurious regression or misspecification problems, integration and cointegration tests out lined in the previous step are necessary. In particular, the findings that the variables are non-stationary and are not cointegrated suggest the use of VAR model in first differences. However, if they are cointegrated, a vector error correction model or a level VAR can be used (Engle and Granger, 1987). This study therefore uses the VAR model in first differences and level, respectively for cointegrated and non-cointegrated stock markets in its IRFs and VDCs analyses.

The IRFs allows for the analysis of the dynamic interaction among stock markets. A major concern when conducting the IRF analysis is the identification problem such that innovation in one market may be contemporaneously correlated to other markets, resulting in shocks in one stock market may work through the contemporaneous correlation with innovations in other markets. Since isolated shocks to individual market cannot be identified due to contemporaneous correlation, the responses of a stock market to innovations in another market cannot be adequately represented (Lutkepohl, 1991). The common approach in solving this identification problem is to employ Sims' (1980) empirical strategy by orthogonalizing the innovations by using the Cholesky factorization. The approach, however, requires a pre- specified causal

ordering of the markets which turn out to be its major disadvantage. The results from impulse response analysis may be sensitive to the ordering of the markets particularly when contemporaneous correlations of error terms in the VAR are high. To overcome this shortcoming, this study adopts the generalized IRF developed by Pesaran and Shin (1998). The generalized IRFs fully account for the historical patterns of correlations among the different shocks and are unique and invariant to alternative orderings of the stock markets.

Meanwhile, the VDC is used in this study to assess the dynamic interactions between the stock markets. This analysis would reveal the contribution of the US and Japanese stock indices in explaining the forecast error variance of the Malaysian stock indices, vice versa.

3.3 Data

Stock market data, namely the US Standard & Poors 500 Index for the US (SPX), the Tokyo Stock Price Index for Japan (TOPIX) and the Kuala Lumpur Composite Index for Malaysia (KLCI) are obtained from the *Bloomberg* database, www.econstats.com, *Datastream* database, and websites of the Malaysian, US, and Japanese stock markets. The study uses daily closing indices of the three stock markets, covering the period from September 1, 2006 to May 30, 2009. In line with the objective of empirically explore changes in the cross-market linkages among the stock markets due to crisis, the study divides the data into three sub-periods as follows:

(i) Pre-crisis period starting from September 1, 2006 to July 25, 2007;
(ii) During crisis period I starting from July 27, 2007 to June 30, 2008;
(iii) During crisis period II from the period July 1, 2008 to May 30, 2009.

4. Results and Discussions

4.1 Descriptive statistics

The results from the descriptive statistics show changing characteristics of the stock markets due to the US financial crisis. In the pre-crisis period, all the three stock markets recorded positive average daily returns as shown by the positive means for all three stock markets. Of

the three stock markets, the Malaysian stock market registered the highest mean of 0.001, followed by the US stock market at 0.0004, and the Japanese stock market at 0.0002. In terms of volatility, the Japanese stock market was the most volatile as reflected by its highest standard deviation at 0.0075, followed by the Malaysian stock market at 0.0072, and the US stock market at 0.005. In line with the convention "high risk, high return", the Japanese stock market recorded the highest maximum of and the lowest minimum during the period.

In the crisis period, all stock markets recorded negative average daily returns. In addition, all the markets are relatively more volatile during the crisis period compare with the pre-crisis period, with volatility is generally higher in crisis period II. The Malaysian market has been the most calm during the crisis period, registering the lowest standard deviations in both crisis periods I and II. In particular, in the crisis period I, the Japanese stock market is shown to be the most volatile as reflected by its highest standard deviation of all the three stock markets (Japan at 0.0144, US at 0.0108, and Malaysia at 0.0107). However, in the crisis period II, the results show that the US market has been the most volatile, recording the highest standard deviation of 0.025 (followed by Japan at 0.023 and Malaysia at 0.01). In general, the crisis has resulted in increased volatility of the US stock market.

The degree of peakedness is measured by kurtosis is shown in Table 1. All series displayed excess kurtosis, which indicate that the distribution of the stock markets is leptokurtic or there are more variances of the observations. This is further supported by the Jacque-Bera statistic which suggests that the distribution of stock returns cannot be adequately approximated by the normal distribution.

4.2 Correlation matrix

Table 2 shows the correlation matrix among the Malaysian, the US and Japanese stock markets in the pre- and during crisis periods. The correlation matrix provides useful information about the short-run integration or co-movements among the three stock markets. Given that the focus of the study is to assess any changes in the nature of the correlation due to the crisis, the table is extended to include the information regarding the correlation among the markets in the three periods under review.

Table 1: Descriptive Statistics of Stock Returns

		Mal	US	Japan
Pre-crisis	Mean	0.0011	0.0004	0.0002
	Median	0.000	0.000	0.000
	Maximum	0.0260	0.0189	0.0265
	Minimum	-0.0475	-0.0353	-0.0348
	Std. Dev.	0.0072	0.0054	0.0075
	Skewness	-1.363	-1.1963	-0.6581
	Kurtosis	12.176	10.7601	6.4964
	Jarque-Bera	1248.553	898.4821	190.1663
During crisis I	Mean	-0.0004	-0.0004	-0.0007
	Median	0.000	0.000	0.000
	Maximum	0.0426	0.0415	0.0459
	Minimum	-0.0998	-0.0325	-0.0587
	Std. Dev.	0.0107	0.0108	0.0144
	Skewness	-2.5805	-0.0583	-0.4441
	Kurtosis	26.0723	5.0569	5.006
	Jarque-Bera	7895.418	59.9519	67.9786
During crisis II	Mean	-0.0004	-0.0011	-0.0013
	Median	0.000	0.000	0.000
	Maximum	0.0406	0.1096	0.1286
	Minimum	-0.0368	-0.0947	-0.1001
	Std. Dev.	0.0099	0.0250	0.0228
	Skewness	0.2032	-0.0664	-0.0221
	Kurtosis	5.9537	6.6420	8.7153
	Jarque-Bera	119.2666	178.1933	438.277

As shown in Table 2, there are significant correlations between the Malaysian and US stock markets as well as the Japanese stock market in the pre-crisis period. However, there is no significant correlation between the US and Japanese stock markets. This result suggests that the Malaysian stock market is highly sensitive to the development in both the US and Japan stock markets in such a way that there is no significant diversification benefit in these markets. However, investors can enjoy the benefits of diversifying their portfolios in the US and Japanese stock markets in the pre-crisis period.

Table 2: Correlation of the Stock Returns

		Mal	US	Japan
Pre-crisis	**Malaysia**	1.000		
	US	0.187***	1.000	
	Japan	0.537***	0.078	1.000
During crisis I	**Malaysia**	1.000		
	US	0.007	1.000	
	Japan	0.459***	0.082	1.000
During crisis II	**Malaysia**	1.000		
	US	0.158***	1.000	
	Japan	0.538***	0.120**	1.000

Note: *, ** and *** denote significant at the 10%, 5% and 1% levels, respectively.

In the crisis period I, there seems to be a de-coupling effect between the Malaysian and the US stock markets since the correlation between the two markets has now turned insignificant. This could reflect the confidence of the investors on other stock markets in other parts of the world such as Malaysia and Japan at the initial stage of the crisis. Consequently, due to the insignificant correlation between the US-Malaysian and US-Japan stock markets, the Malaysian and Japanese stock markets provide diversification benefits for the US investors. The Malaysian and Japanese stock markets remained significantly correlated in crisis period I, possibly due to the geographical proximity. This finding concurs well with several studies that emphasize the importance of geographical proximity of the markets in influencing the integration of equity markets (see, for example, Abd. Majid et al., 2008; Ibrahim, 2000; Azman-Saini et al., 2002; Daly, 2003).

As the crisis deepened, in crisis period II, all the stock markets showed significant correlation among each other. The integration nature of the Malaysian stock market and those of the US and Japan have returned as in the pre-crisis period. In addition, there is also a significant correlation between the US and Japan stock markets. It could be implied that as information became clearer and the market participants are given more time to react to the crisis, investors realize that the prolonged financial crisis would gradually become an economic crisis which would continue to depress the equity market. Negative investor sentiment results in a

"flight to quality" from the equity market to saver investment options, resulting in a down market throughout the stock markets across the globe.

4.3 Cointegration Results

The co-integration results show the existence of long-run equilibrium relationship among the stock markets under review. The results indicate that the stock markets share a long-run equilibrium only during the height of the crisis, namely in crisis period I. As shown in Table 3, both the Max-Eigen Statistics and Trace Statistics tests results show that the null hypothesis of no co-integration is rejected at the 1 percent level of significance only in crisis period I, but not in the pre-crisis period or crisis period II. This suggests the aggregate behaviour of the investors who became vigilant in all stock markets following the news of the sub-prime crisis. However, the results show the non-existence of long-run equilibrium in the non-crisis period (pre-crisis) and in during crisis period II indicate that the stock markets do not share a long-run equilibrium.

Table 3: Cointegration Results

	Null Hypothesis	Trace Statistics	Max-Eigenvalue Statistics
Pre-crisis	$r \leq 0$	19.815	11.752
	$r \leq 1$	8.063	6.705
	$r \leq 2$	1.358	1.358
During crisis I	$r \leq 0$	41.784***	34.257***
	$r \leq 1$	7.526	5.540
	$r \leq 2$	1.986	1.986
During crisis II	$r \leq 0$	19.687	14.350
	$r \leq 1$	5.337	3.860
	$r \leq 2$	1.477	1.477

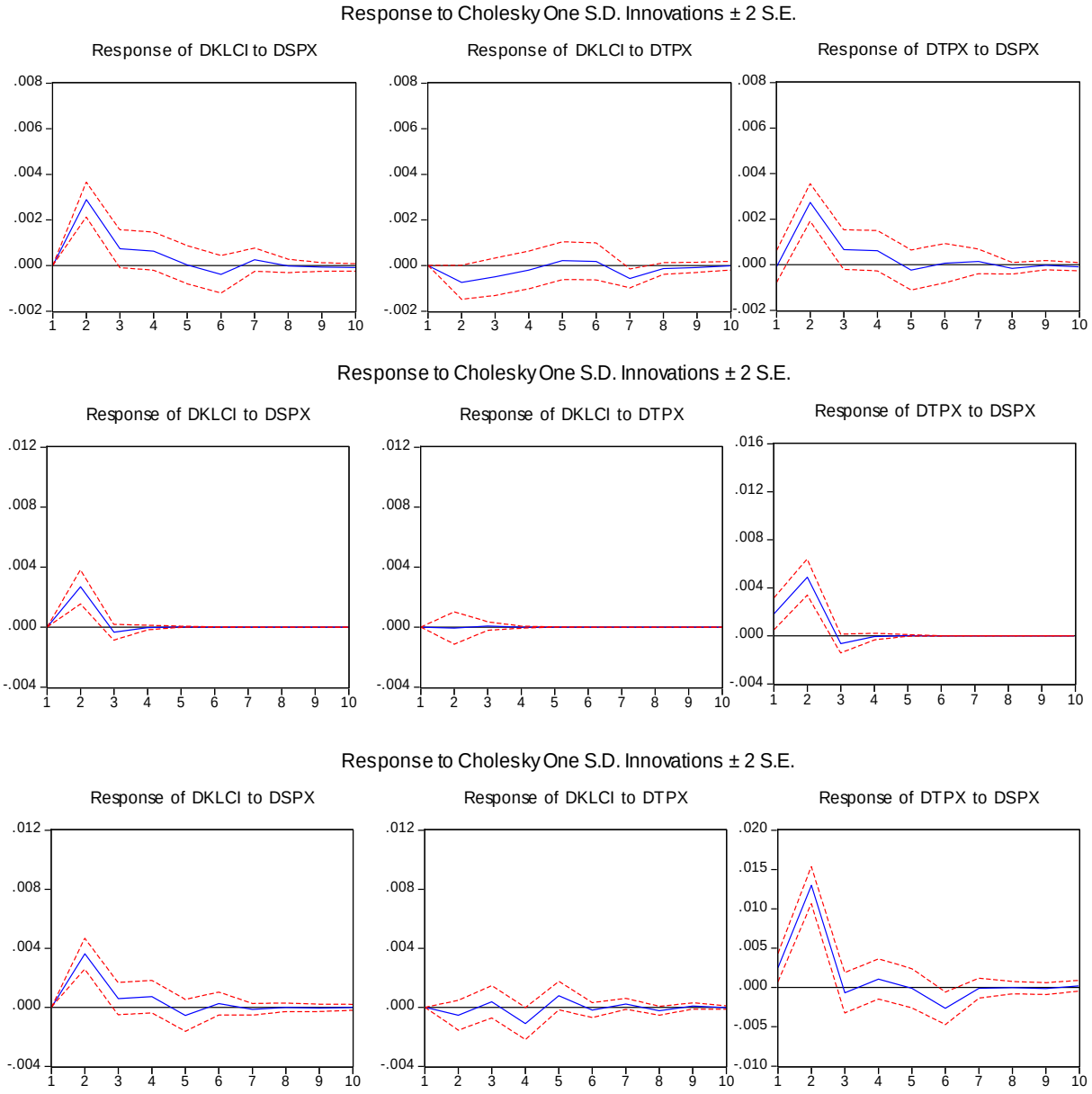
Notes: *, ** and *** denote significant at the 10%, 5% and 1% levels, respectively. r denotes the number of co-integrating vectors. The optimal lag length is determined based on the Akaike Information Criteria (AIC). Since the study utilizes daily data, the maximum lag-length considered in the study is 30.

4.4 Impulse Response Functions

To achieve the objective of determining the impact of shocks of the major stock markets on the Malaysian stock market, the impulse response functions (IRF) is a suitable test since it allows the analysis of the responses of one stock markets to shocks (or changes) in the other stock markets. An IRF measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamical system (Pesaran and Shin, 1998). The approach is well-suited because not only that it allows for the relative strength of various shocks to be quantified in terms of their contributions to variations in a particular variable of interest, but it also enables the pattern and direction of the transmission of shocks to be traced. To provide some idea of uncertainty surrounding the estimated response, based on Sims and Zha (1995), one standard deviation of confidence bands have been obtained by Monte Carlo integration methods with 1,000 replications.

The IRF results also suggest that the sub-prime crisis has significant impact on the integration nature of the stock markets. As shown in Figure 1, there are significant positive responses of the Malaysian stock market to shocks in the US market in all three sub-periods. However, the IRF results suggest that the Malaysian stock market responded negatively and significantly to shocks in the Japanese market in the pre-crisis period, and became insignificant in the crisis periods I and II. Meanwhile, the Japanese market is shown to respond positively and significantly to shocks in the US market throughout the three periods of analysis. It is also interesting to note that the magnitude of responses of the Japanese stock market to the shocks in the US market is getting bigger in crisis period II compared to in crisis period I.

Figure 1: Impulse Response Functions of the Malaysian, US and Japanese Stock Markets in Pre-Crisis, During Crisis I and II Periods



4.5 Variance Decompositions

Lastly, the VDC analysis is used to assess the dynamic interactions between the stock markets under consideration. In this study, we focus on the contribution of the US and Japanese stock markets in explaining the forecast error variance of the Malaysian stock market.

As reported in Table 4, the Malaysian stock market is relatively endogenous in the pre-crisis period and in the crisis period II. This is well-reflected by the VDC results which suggest that around 80 percent of the variations in the Malaysian stock market are explained by innovations in itself in both periods. In contrast, in crisis period I, the Malaysian stock market was highly exogenous as only around 35 percent of its variations are contributed by innovations in itself at the 24-month horizon. Innovations in the US market contribute more than 45 percent of the variations in the Malaysian stock market during the height of the crisis (crisis period I) and the Japanese market contribute about 19 percent. Both the US and Japanese stock markets exert significant impact on the Malaysian market at the initial stage of the crisis.

Another point to note is the contribution of the innovations in the Japanese market in explaining the forecast error-variance of the Malaysian stock market. The role of the Japanese stock market in influencing the Malaysian stock market has been rather subdued in the pre-crisis period and crisis period II. However, during the initial stage of the crisis (i.e. crisis period I), innovations in the Japanese market contribute significantly in explaining the forecast error variance of the Malaysian market.

In general, the VDC results suggest that as information became evident that the crisis will be sustained for quite some time, the market reaction returned to its earlier level.

Table 4: Variance Decompositions of Stock Markets

		Mal	US	Japan
Pre-crisis	1	100.000	0.000	0.000
	2	82.902	16.058	1.040
	4	81.081	17.382	1.537
	6	80.836	17.495	1.669
	12	80.183	17.489	2.328
	18	80.182	17.489	2.329
	24	80.182	17.489	2.329
During crisis I	1	100.000	0.000	0.000
	2	95.683	4.049	0.268
	4	88.999	9.438	1.564
	6	81.191	15.226	3.583
	12	58.997	30.571	10.432
	18	43.941	40.444	15.615
	24	34.643	46.371	18.985
During crisis II	1	100.000	0.000	0.000
	2	86.074	13.618	0.307
	4	84.299	14.033	1.668
	6	83.545	14.169	2.287
	12	83.438	14.166	2.397
	18	83.437	14.166	2.397
	24	83.437	14.166	2.397

5. Conclusions

This study aims to empirically examine the nature of integration of the Malaysian stock market with two of the biggest stock markets in the world, namely the US and Japan, during the 2007 US financial crisis. By assessing the changes in the nature of integration among these markets during the crisis, the study aims to find evidence of the international transmission of the financial shocks through the global stock markets. As such, the study focuses on three sub-periods, namely the pre-crisis period, during crisis period I and during crisis period II.

The study finds that the nature of integration of the three markets over the sub-periods under review changes due to the crisis, thus, providing the empirical evidence on the transmission of the US financial shocks throughout the global stock markets. In particular, the stock markets are shown to be highly integrated at the initial stage of the crisis. For example, as shown by the results of the cointegration test, the three stock markets are found to be cointegrated only during crisis period I. There are increased market activities in all three markets in the initial stage of the crisis. Market panic results in investors to shift their funds to the developing or the emerging countries' market to avoid the impact of the crisis on their investments. There are also evidence that geographical proximity is a relevant factor being considered by the investors during a financial crisis. However, as information later became clearer that the crisis will be prologed, activities in each market depends on the domestic factors. In addition, given more time, investors might opt for other types of investments than the equity markets, resulting in all the markets to perform independently.

Furthermore, the results highlight the vulnerability of a country to international financial shocks. As shown clearly by the variance decompositions and impulse response function results, shocks originating from the US are highly significant in explaining the variances in the Malaysian financial sector. This could be attributed to the strong trade and investment dependency of the Malaysian economy on the US. As a result of the strong ties, the Malaysian financial sector is highly susceptible to shocks from the US. This finding has important macroeconomic policy implications such that developing and highly open economies such as Malaysia should strive towards diversifying their export markets as well as investment sources so as to reduce the vulnerability of the economy from international financial shocks.

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