Comovement of stock markets of Singapore and its major Asian trading partners

Rahim, Adam Mohamed and Masih, Mansur

INCEIF, Malaysia, Business School, Universiti Kuala Lumpur, Kuala Lumpur, Malaysia

15 September 2018

Comovement of stock markets of Singapore and its major Asian trading partners

Adam Mohamed Rahim[1] and Mansur Masih[2]

Abstract:

Globalisation that resulted in increased interconnectivity across stock markets has brought implications towards the investment strategies of investors. Given the 2008 financial crisis and the 2011 Japan earthquake, it is unsure whether or not cointegration would still remain evident between markets. This study re-examines the cointegration between Singaporean stock markets with its major Asian trading partners (China, Japan and Malaysia) after the 2008 crisis but differs from other studies by incorporating the effects from the 2011 Japan earthquake by implementing standard time series techniques including Johansen test for cointegration followed by the vector error correction and variance decomposition method which determines the exogeneity and endogeneity of the stock markets. The study finds that the Singaporean stock market remains cointegrated with the stock markets of its major Asian trading partners including Japan that experienced the 2011 earthquake. Findings tend to imply that the long-run diversification benefits that can be earned by the investors in the Asian region tend to diminish. Therefore there is a necessity for the policy makers of Singapore and its major Asian trading partners to formulate policies to mitigate the impact of market fluctuations which would in turn facilitate the management of exposures to risk in the long run.

Keywords: comovement of stock markets, Singapore, major trading partners, VECM, VDC

---

[1] INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

2 **Corresponding author**, Senior Professor, UniKL Business School, 50300, Kuala Lumpur, Malaysia.

Email: mansurmasih@unikl.edu.my

1.0 INTRODUCTION :MOTIVATION

The revolution in today's world filled with advancements in technology coupled with the permeation of high speed broadband connectivity have led to a creation of a fast track information superhighway that is within global reach. The permeation of technology is occurring at relatively incredible speeds and is highly democratised so that the information is available to anyone at any place at any time at low cost. Stock indices highly thrive in information and the information revolution has transformed these markets world over. Investors can now keep track on a real time basis and can react to the flow of information around the world. The insulation of national economies towards global events no longer pertain or in other words, the repercussions of international events can actually influence the movement of shares and other investments (Menon et. al 2009).

Under this purview the fast information transmission to stock markets of the world is facilitated by economic globalisation. Due to the globalisation happening across stock markets around the world resulting from the emergence and liberalisation of new capital markets that resulted in a flow of capital across borders, a better network of communication has been established which has enabled investors to invest in international stock markets. Investors are driven more to invest outside their countries as geographic diversification generates superior risk adjusted returns while capturing the higher rates of returns by these overseas markets (Khan 2011).

From here, there is an aspect that concerns investors around the world and that is the co-movement or co-integration happening among various stock markets. The reason being is that one of the fundamental tenants of investing is holding a diversified portfolio or securities with the goal to reduce one exposure's to risk. Generally fund managers have always been on the go to look out for portfolios that do not correlate together to provide better opportunities to hedge risk. Although the increasing mobility of capital flows indicate that the all nations are moving towards a more financially and integrated world that intuitively tells us that a more efficient global financial sphere would arise, it may also mean that stock markets will impede themselves from exhibiting independent price behaviour but rather be more interdependent among each other (Khan 2011).The increasing interdependency among the stock markets suggests that stock markets move together with high correlations and subsequently make it impossible for the investors to reap benefits of the cross borders diversification. The benefits of diversification can then be only maximised if the stock markets exhibit low correlations of price behaviour (Karim et. al 2009).This situation is in

line with the international portfolio diversification theories. It is then essential for portfolio managers to examine the dependencies among international stock markets.

There has been a lot of happenings over the past two decades that has affected the global financial sector, which also had a substantial effect towards portfolio investment activity. One of the major events happening in the financial world was the market crash of October 1987 was a significant event not just because of the of the market decline that was severe, but also because it exposed the weaknesses of the trading systems themselves and how they could be strained and come close to breaking in extreme conditions(Carlson 2007). Later on in 1997 the Asian Financial Crisis came which was triggered by the distorted policies plus the market overreaction and herding that led to the plunge of exchange rates, asset prices and economic activity in the countries of the Asian region (Roubini et. al 1998). The most recent crisis which was the global financial crisis in 2008 actually indicated that the global financial system was far more interconnected than was previously recognised and the excessive risk taking that threatened the collapse of the financial system was far more pervasive than almost anyone realised coming from the subprime mortgage crisis along with the existence of Ponzi borrowers(Mishkin 2011).

Looking at the Asian region, specifically the tiny but influential nation of Singapore, Singapore strongly trades with other Asian countries such as China, Japan, Indonesia and Malaysia as of October 2013(Singapore Balance of Trade 2013).Following the Global Financial Crisis, Singapore's world merchandise exports had contracted by 23 per cent in 2009 and was the sharpest decline since World War II. Singapore's merchandise trade dropped by an even greater magnitude of 27 per cent in the first half of 2009 compared to the same period in 2008. Singapore's domestic exports were particularly hard-hit, falling by 29 per cent (Singaporean Ministry of Trade and Industry 2010). Referring to the current situation of 2013. Singapore's trade surplus increased to 6.69 billion SGD from 3.51 billion SGD a year ago in October 2013 (Singapore Trade of Balance 2013) .While global trade flows have recovered from the lows of the first half of 2009, it is useful to consider that the shock was brought about by the global recession that altered Singapore's export profile significantly(Singapore Ministry of Trade and Industry 2010). It is also important to see if the Singaporean stock market is still interconnected with the stock markets of its trading partners which would have an implication towards investors in terms of international portfolio diversification especially in the Asian continent.

With regard to the major Asian trading partners of Singapore like Japan, Japan experienced a massive Earthquake, Tsunami on March 11 2011, followed by a nuclear crisis and shortage of electricity which had an impact on the global and regional economy. The huge effect of these natural disasters were transmitted through globalized production chains, both in Japan and in the rest of the world. As a quasi-monopoly supplier of key technological products for the electronics and automotive industries, Japan has a strategic position at the heart of global production chains. The disaster caused production chain disruptions in those industries; the impact was particularly visible in the Asian countries which also includes Singapore, notably because Japan supplies those countries with a higher percentage of their imports of intermediate goods than other parts of the world. Even though there was a recovery in economic growth in Japan (Tresor Economics 2012) , it is again vital to study if Japan's stock market remains interconnected with Singapore's stock market after the disaster since Japan is one of Singapore's major Asian trading partners.

According to some previous empirical studies, such as Karim and Abd. Majid (2010) and Karim,Abd. Majid and Karim(2009) it was found that there exists a long run equilibrium relationship among the Malaysian stock market with its major trading partners that included Singapore, USA, Japan and China, following the 1997 Asian Financial Crisis. In fact the movements of Malaysia with its major trading partners were found to be more integrated after the 1997 financial crisis. Other studies from Meera et. al(2009) discovered that the stock markets in the South East Asian region were moving towards a greater integration particularly during the post 1997 financial crisis. Discussing with regards to Japan's 2011 earthquake based on Popp's (2006) study on the effects of natural disaster on long run growth, it was found that natural disasters certainly have an effect on long run growth which includes macroeconomic variables such as technology, human capital accumulation, physical capital accumulation and the natural resource stock. The net effects of the natural disaster in the long run depends on sound institutions that can ensure a healthy recovery following a disaster.

Despite the many studies carried out on the effect of financial crises towards stock market integration, not much study has been done regarding the particular post effects of the 2008 global financial crisis and in addition to that, there is no study that has infused the effects of natural disasters and the 2008 financial crisis towards stock market cointegration. Furthermore, most these previous studies mentioned made Malaysia as their focal variable and not Singapore which is an important market in the Asian region. Therefore, this paper

attempts to partially fill the gap in the literature and to provide recent empirical evidence on stock market cointegration between Singapore and its major Asian trading partners namely China, Japan and Malaysia by adopting a more recent sample of data. The findings of this paper stated that the Singaporean stock market is influenced by its major Asian trading partners and may have implications for investors and companies in the international level who wants to diversify their investments internationally and carry out capital budgeting decisions within this market.

The structure of this paper includes five chapters which are organised as follows. This current chapter explains the introduction together with the issues motivating the study,chapter two discusses about the main objective of this paper followed by chapter 3 that gives an overview of the theoretical framework related to the issues in this paper and then chapter 4 that reviews the related previous empirical literature. Chapter 5 describes the statistical data and elaborates on the methodology applied while chapter 6 discusses the empirical findings and interprets the results. Chapter 7 and 8 gives a summary about the paper and discusses about the policy implications that can be derived from the results, respectively. Lastly, chapter 9 talks about the limitations of the study and suggestions for further research

2.0 MAIN OBJECTIVE OF THE STUDY

Relating to the introduction part of this paper, it is now clear that the main objective of this paper is to study whether the Singaporean stock market remains cointegrated with its major Asian trading partners such as China, Japan and Malaysia after the 2008 global financial crisis since cointegration of stock markets is a direct consequence of globalisation and has important implications for investors(Khan 2011). Initially the Indonesian stock market was included in this study but unfortunately, no cointegration was found. Cointegration was only found when the Indonesian stock market was dropped from the study(refer to appendix 3B).Through this study of cointegration between Singaporean stock markets with the stock markets of its major Asian trading partner, it would be useful for policy makers in Singapore in a sense that if stock markets of Singapore are found to be closely related to its major Asian trading partners then there is a danger that shocks in one market may spill over to other markets and thus, calls for stronger cooperation among the authorities of these countries (Ali et. al 2011). Other than that, this study also has an aim to study whether natural disasters such as the earthquake has affected the degree of cointegration between the Japanese stock market and the Singaporean stock market.

Overall, this paper intends to contribute by filling the gap in the previous literature by reinforcing the situation that stock markets remain cointegrated even after a crisis has occurred. Not to forget, this paper too incorporates the effect of natural disasters when the study of cointegration is carried out between the stock markets.

3.0 THEORETICAL FRAMEWORK

The financial theory regarding the interest in stock market integration states that there is more efficiency in integrated regional stock markets compared to segmented national markets. Investors belonging to a particular region will be able to allocate locations in the region where it is most productive with the existence of an integrated capital stock market according to Click and Plummer(2005). Although there are advantages coming from integrated regional stock markets, it must be noted that a long run equilibrium is exhibited by the integration among stock markets which ties prices movements in national stock indices and could considerably reduce benefits from international portfolio diversification. Even international portfolio diversification theory state that if stock markets are interlinked, the long run benefit of diversification for international investors is diminished and therefore intensifies the need for this paper to examine the dependencies among international stock markets(Ali et. al 2011).

Another theory instilled in this paper is the efficient market hypothesis which states that the ideal market is the one that provides accurate signals for resource allocation whereby firms can investors can make investment decisions under the assumption that security prices at any time fully reflect all available in information. An efficient market is a market whereby the price always reflects the available information (Fama 1970)

The next theory that can be linked to this study is the Black Swan theory. The Black Swan theory was introduced in the year 2007 by Nassim Nicholas Taleb who was an investment fund manager and former trader. This theory argues that the human beings' tendency to dwell and reflect towards the past events in order to come up with a prediction of the future can limit one's understanding of the world and increases the vulnerability to extreme and unexpected events. In short, black swan events are unpredicted events that lie within the outliers of a bell curve which is beyond the realm of regular expectations. (Taleb 2007) Linking the theory towards the 2008 global financial crisis, Taleb himself argued that the crisis was not a Black swan event because there were distinct signs of the underlying flaws in the financial system, some of which analysts noticed earlier on such as failed risk analysis

interpretations, the high dependence on debt and the inability of governments to prevent such factors from imploding (Illgner et. al 2011). On the other hand, events such as natural disasters can be considered as Black Swan events since there are beyond the control of humans and despite the advancement of technologies that can detect such disasters, some disasters such as tsunamis can only be detected when it is starting to happen but cannot be predicted in advance.

The theories mentioned above have not been fully able to address the issue whether Singaporean stock markets remain cointegrated with its major Asian trading partners and it could not give a full insight on how natural disasters affect the interconnectivity of stock markets.

4.0 LITERATURE REVIEW

The connection between stock market cointegration with globalisation frequently is studied both theoretically and empirically. A substantial interest also exists among academics and policy-makers on the effects of the cointegration of stock markets regionally and internationally. Synthesis of a few selected studies is provided below in order to give readers a brief preview of this subject matter.

Karim at. Al (2009) found that the Malaysian stock market is integrated with the stock markets of the United States of America ,Japan and Singapore from January 1999 to May 2008,which was before the 2008 global financial crisis. In order to carry out this study, Karim et. al (2009) the Auto Regressive Distributive Lag(ARDL) approach was implemented regardless of the stationarity properties of the variables in the samples and allows for inference on long-run estimates. On top of that, ARDL model takes the sufficient number of lags to capture the data-generating process in a general-to specific modelling framework . since they included the bounds testing procedure. It can be implied that from the existence of cointegration in previously mentioned stock markets, a long run equilibrium relationship exists between them, therefore changes in the dependent variable are influenced by the deviations from this equilibrium in the short run in order to force movements towards long run equilibrium.

The following study done by Karim and Karim(2012) analysed the integration among stock markets but specifically among the ASEAN emerging stock markets (Malaysia, Thailand, Indonesia, Philippines and Singapore).This study actually divided the data into pre-and post

1997 Asian financial together including the post subprime crisis period which covers from January 2008 to December 2010 in order to avoid the disturbances from these crises on stock market integration analysis. Similar to the study done by Karim et. al (2009), Karim and Karim(2012) also applied the ARDL bound testing approach. Cointegration among the emerging ASEAN stock markets. The results of this study reveal that the ASEAN stock markets are moving towards more integration among themselves following the financial crisis.

Menon et. al (2009) also studied the cointegration between stock markets but differs from the previous two empirical literatures by having the Indian stock market as the focal variable and examining whether it is linked with major stock markets from China, Singapore, Hong Kong and America covering the period from 1 April 1997 to 10 May 2007. Another component that differentiates this study with the two other previous studies is that this study uses Engle Granger test of cointegration and not the ARDL bound testing approach .Results obtained from this study showed the absence of cointegration between the Indian stock market and the stock markets of America and Hong Kong. However, cointegration was present between the Indian stock market and the Singaporean suggesting a strong level of interdependency.

By the same token Rajwani and Mukherjee (2013) examined the emerging trends in financial integration from India's perspective but with the emphasis on Asian stock markets instead of including America by applying Lagrange Multiplier test statistics and the Gregory and Hnasen cointegration technique in the presence of endogenous structural breaks. In contrast to Menon et. al (2009), Rajwani and Mukerjee (2013) discovered that Indian stock markets are not integrated with any of the Asian markets either collectively or collectively which brings to the conclusion that Indian stock markets are insensitive to the dynamics in the other mentioned markets in the long run. The insufficient evidence to prove that Indian stock markets are interlinked with the Asian markets can be due to the difference in the macroeconomic structure .

Digressing a bit from the main issue which is about stock markets cointegration, a study about index futures markets was done Karim et. al(2011) to examine the effects the current global financial crisis on the co-movements of selected stock index futures markets. Karim et. al (2011) also divided the period of analysis into the pre-crisis period and during the crisis period without including the post-crisis period. From the tests carried out, Karim et. al (2011) found that there was an absence of cointegration among the stock index futures markets in

both periods which indirectly implies that investors still have potential benefits for international portfolio diversification and hedging strategies in the stock index futures markets even after the global financial crisis.

Last but not least, Bacon and Huang(2007) studied the relationship between the United States and China stock markets between 2000 and 2007 with the aim to shed the light on the event that happened on February 27,2007 whereby there was a nine per cent plunge in the Shanghai stock market which was followed by the $ 1.5 trillion global market shake out to is something irrational. Like most of the literatures under reviewed under this paper, Bacon and Huang(2007) found that the relationship between the US and China stock market has significantly increased since 2005 which could be probably attributed to the change in China's policy in 2005 to move towards a more free economy .

In summary, the literatures discussed above have been using stock markets within different groups based on regions and trade partnerships. As far as this literature review done for this is concerned, the post effects of the 2008 global financial crisis towards the stock market cointegration especially with the focus towards Singapore has not been studied much .Therefore, the emphasis in this paper will be on the impacts after the 2008 global financial crisis towards Singaporean stock market cointegration with its major Asian trading partners.

5.0 DATA AND METHODOLOGY

In this study , the data used are weekly stock indices spanning from September 2009 to October 2013.The reason for this beginning from September 2009 is to focus solely on the post effects of the 2008 global financial crisis because this paper used the study of Assidenou (2011) which stated that the 2008 global financial crisis was from September 2008 to August 2009.Weekly data is employed rather than higher daily frequency data in order to deter the situations of non-synchronous data since daily data contains too much noise which will subsequently lead to an erroneous conclusion in the lead-lags relationship among the variables. Furthermore, the transmission of shocks may take place within a few days and thus, monthly data is not employed in this study as it cannot fully capture the transmission of the shocks (Karim et. al 2010). The following indices are used to represent the markets, the Kuala Lumpur Composite Index (KLCI) for Malaysia, the Tokyo price Index (TOPIX) for Japan, the Singapore Straights Time Index (SSTI) for Singapore and the Shenzhen Stock Exchange Composite Index (SZSE). All indices are have been extracted from the Data Stream database. Initially, the study wanted to include the Jakarta Composite Index to

represent Indonesia but during the Johansen test which will be discussed in the results section, no cointegration was found so therefore we had to drop Indonesia(refer to Appendix 3B). Another important thing in the data used in this study is that dummy variable to represent the earthquake in Japan which is named as DMY is incorporated into the data from 11 March 2011 to 24 June 2011 to capture the immediate effect together with the post effect of the earthquake where Japan started to recover according to the Australian Department of Foreign Affairs and Trade(2011).

In terms of the methodology applied.it has almost become a standard procedure which is aided by standard software packages that any regression analysis should not begin by mechanical means but by testing the stationary and cointegration properties. It has also been well established that most economic time series are non-stationary in their original level form. If the variable are non-stationary, the conational statistical test such as the R square and t-test statistics are invalid. But if the variables are non-stationary but cointegrated , the ordinary regression without the error-correction term derived from the cointegrating equation will be mis-specified. However, an ordinary regression within "differenced variables" (which are stationary) can be estimated if the variables are non-stationary but cointegrated , but the conclusions that are drawn from such an analysis will be valid only in the short run and no conclusions can be made in the long run regarding the variables studied since the theory has typically nothing to say about the short run relationship, The reason being is that the 'differenced' time series variables do not contain any information about the long run relationship between the trend components of the original series since this long run trend has been removed implying that long run co-movement between the variables cannot be captured by differenced variables.

On the other hand if the variables taken are taken as their 'non-stationary' form at their original level forms, the conventional statistical tests are not valid because the variances are changing and the estimated relationship will be 'spurious'. In contrast to that, if the variables taken are transformed into their stationary form through 'first-differencing ' the long term trend contained in each variable has been removed causing the relationship estimated to only give the short run relationship between the variables and regression then does not test any theory.

Therefore the regression analysis that has been applied for many years in time-series studies is now considered to have either estimated a spurious relationship(if the original 'level' form

of the variables was non-stationary) or estimated a short-run relationship(if te variables were differenced to make the original variables stationary). This detrimental limitation of the traditional regression analysis has been addressed by the recent and on-going cointegration time series techniques with significant contributions made by time-series cointegration techniques starting with the publication of the seminal paper by Robert Engle and Clive Granger which are now well recognised. Although the recent time series techniques have a limitation whereby the error correction and variance decomposition are based on eatimeates of the cointegrating vectors which are 'atheoretical' in nature, this problem has been solved by the long-run structural modelling technique which estimates theoretically the meaningful long run relations by imposing on those long run relations and then testing both exact identifying and over identifying restrictions based in theories and a priori information of the economies (Masih and Algahtani 2008).

In short, by using this developed time series techniques, this study will try to find out whether the stock market of Singapore moves together with the stock markets of its major Asian trading partners(China, Japan and Malaysia) through the Johansen cointegration tests after examining the unit root tests and order of vector auto regression. The cointegrating estimated vectors will then be subjected to exact and over identification restrictions based on a priori information of the economy. The test of the vector error correction model(VECM) will then indicate the causal relationship between the cointegrating stock markets .In addition to that, the variance decomposition would determine the relative exogeneity and endogeneity of each variable. Next , the impulse response function will then map out the dynamic response path of a variable to a one period standard deviation shock to another variable. Finally the persistence profile step would estimate the speed with which the stock markets get back to equilibrium when there is a system wide shock.

6.0 RESULTS AND INTERPRETATION

Under this section of this paper, the eight steps of the time series techniques will be carried out and the empirical results obtained will be explained in further detail.

6.1 UNIT ROOT TESTS

For the unit root tests , two types of tests will be carried out which are the Augmented Dickey Fuller(ADF) test and the Phillips Perron(PP) tests and are described below.

6.1.1 AUGMENTED DICKEY FULLER (ADF) TEST

The empirical testing is started with the ADF test to test the stationarity of the variables in order to avoid the spurious regression (Karim and Karim 2008). Before really carrying out the ADF test, all the variables of the stock indices will need to in their level form or their natural logarithm form. After the ADF test is carried out in their level form, results reveal that all the stock indices used in the study contain a unit root which implies that the null hypothesis of the presence of a unit root at the level form cannot be rejected even since the test statistic is lesser than the 95% critical value. Since the stock indices are found to be stationary at level form, these stock indices are then transformed into their first differenced form for example, "DSSTI = LSSTI-LSSTI(-1)". The results of the ADF test show that all indices became stationary after first differencing since they are able to reject the null hypothesis of non-stationarity since the test statistics of the differenced variables are more than the 95% critical value.

Table 1: ADF Test

Variable	Test Statistic	Critical Value	Implication
Variables in Level Form			
LKLCI	-2.7242	-3.4323	Variable is non-stationary
LTOPIX	-1.0661	-3.4323	Variable is non-stationary
LSSTI	-2.9926	-3.4323	Variable is non-stationary
LSZSE	-2.8160	-3.4323	Variable is non-stationary
Variables in Differenced Form			
DKLCI	-10.3090	-2.8755	Variable is stationary
DTOPIX	-10.2636	-2.8755	Variable is stationary
DSSTI	-9.4141	-2.8755	Variable is stationary
DSZSE	-9.4073	-2.8755	Variable is stationary

By relying primarily on the AIC and SBC criteria, the conclusion that can be made from the results from above table is that all variables(stock indices) that are used in this analysis are I(1) and therefore, we can the proceed to the steps for testing cointegration. An important aspect to note under this test is that when determining which test statistic to compare with the 95% critical value for ADF test statistics, we have selected the ADF regression order based on the highest computed value for AIC and SBC.(See Appendix 1A to Appendix 1H)

6.1.2 PHILLIPS PERRON TEST

In addition to the ADF test, the PP test was used as an alternative nonparametric model to control for serial correlation. Using the PP test ensures that the higher order serial correlations in the ADF equation were handled properly(Valadkhani and Chancharat 2007). The null hypothesis for the PP test is that the variable is non-stationarity From the table below showing the results of the PP test, it can be seen that for the level form of all the variables, only the Singaporean Straights Time Index(SSTI) was the only one found to be stationary at 95% confidence level since the p-value was of 1.4% is smaller than the 5% significance level but in the end SSTI turned out to be non-stationary at 99% confidence level since the p-value is larger than 1% which caused the null hypothesis of the PP test to not be rejected. This was made possible through the adjustment of the truncation lags when carrying out the PP test for LSSTI (See Appendix 1I to1O).

Table 2: PP test

Variable	Test statistic(p-value)	Implication(5% significance level)	Implication(1% significance level)
Variables in Level Form			
LKLCI	0.0540	Variable is non-stationary	variable is non- stationary
LTOPIX	0.2520	Variable is non-stationary	variable is non- stationary
LSSTI	0.0140	Variable is stationary	variable is non- stationary
LSZSE	0.0570	Variable is non-stationary	variable is non- stationary
Variables in Differenced Form			
DKLCI	0.0000	Variable is stationary	Variable is stationary
DTOPIX	0.0000	Variable is stationary	Variable is stationary
DSSTI	0.0000	Variable is stationary	Variable is stationary
DSZSE	0.0000	Variable is stationary	Variable is stationary

It should also be brought to the attention of the readers that the level form of KLCI and SZSE were initially stationary at 5% significance level since the p-values were lower than 5%.But after making some adjustments towards the truncation lags, the level form KLCI and TOPIX became non-stationary at 5% significance level (See appendix 1I to 1P)

As for the differenced form of the variables, all of them were found to be stationary at 95% and 99% confidence levels since their p-values were smaller than 1% and 5% causing the null hypothesis(variable is non-stationary) to be rejected. Therefore overall results indicate that all variables are I(1) variables under the PP test.

6.2 DETERMINING THE ORDER OF LAGS OF THE VECTOR AUTO REGRESSION (VAR)

Another test needs to be done before actually moving on to the test for cointegration and that is the test to determine the order of the vector auto regression (VAR) which is the number lags that needs to be used in this study. Referring to the table below, results show that AIC and also SBC recommends order of 1.

.

Table 3: Order of VAR

	Choice Criteria	
	AIC	SBC
Optimal order of lags	0	0

However, if zero or even 1 lag is taken for the VAR, it would result in the Microfit software to not give full results for the vector error correction model whereby Microfit will only give the error correction term(Masih 2013).

On top of that, the problems of serial correlation for each variable is checked the results are shown in the table below. According to the table below, serial correlation does not exist in any of the four variables. Therefore if we adopted a lower order of lags, the effects of serial correlations may be encountered. On the other hand if a higher order of lag is taken, it leads to the disadvantage of risking over-parameterisation. As for our case, we have a relatively long time series(215 observations) ,the risk of over-parameterisation is not much of a concern (Kamil 2013).With taking into consideration about the trade-off of lower and higher orders, the higher VAR order of 2 is chosen for the purpose of this study.

Table 4:Tests for serial correlation of the variables

Variable	Lagrange Multiplier(P-value)	Implication at 10% significance level
DKLCI	0.671	There is no serial correlation
DTOPIX	0.746	There is no serial correlation
DSSTI	0.907	There is no serial correlation
DSZSE	0.907	There is no serial correlation

6.3 COINTEGRATION TESTS

After establishing that all the variables are I(1) and determining that the optimal order of VAR is 2, the study can move on to the step to test for cointegration. There are two type of tests for cointegration which is the Johansen test and the Engle-Granger test.

6.3.1 JOHANSEN TEST FOR COINTEGRATION

Using the Johansen method to test for cointegration, it was found that the trace statistic and HQC indicated that there is one cointegrating vector whereas the Maximal Eigen value and SBC shows zero cointegrating vectors, while the AIC shows 3 cointegrating vectors.

Table 5 :Johansen Test

Null	Alternative	Statistic	95% crticial value	90% critical value
Maximum Eigenvalue Statistics				
r=0	r≥1	26.90	31.79	29.13
r≤1	r≥2	17.77	25.42	23.10
Trace Statistic				
r=0	r≥1	59.49	63.00	59.16
r≤1	r≥2	32.58	42.34	39.34

Note: The statistics refer to the Johansen's log-likelihood based maximal eigenvalue and trace statistics based on cointegration with unrestricted intercepts and restricted trend in the VAR with an order of 2.From the above results,1 cointegrating vector is selected based on the trace statistics.

Table 6 :Number of Cointegrating Vectors

Type of test	Number of Cointegrating Vectors
Maximum Eigen value	0
Trace	1
AIC	3
SBC	0
HQC	1

From the results obtained, it can be seen that the maximum Eigen value is conflicting with the trace value. For the maximum Eigen value statistics, the statistic is below than both 95% and 90% critical value causing us to not be able to reject the null of non-cointegration whereas for trace statistics, the statistic is higher than the 90% critical value enabling the null of non cointegration to be rejected. In order to resolve this conflict, we refer to previous studies such as Karim and Majid (2010) which found that the Malaysian stock markets is cointegrated with stock markets of Singapore, China, Japan and the United States, even after

the1997 Asian financial crisis, together with the intuition that stock markets in the same region are interconnected and from here the study is continued by specifying one cointegrating vector. Cointegration implies that the relationship among these stock markets are not spurious which means that there is a theoretical relationship among the stock markets (Masih and Algahtani 2008).

As an important note, the Indonesian stock market was initially included in this study but since no cointegration was found when we included it, the Indonesian stock market had to be dropped from the study.

6.3.2 ENGLE GRANGER TEST FOR COINTEGRATION

As for the Engle Granger test for cointegration, many various linear equations were constructed but unfortunately all variations of linear equations resulted in no cointegration by referring to the Table Below. This implies that the null hypothesis of the Engle Granger test that is the error term is non-stationary is not able to be rejected since all t-statistics of all linear equations are lower than the 95% critical value(refer to Appendix 3C). When the error term is found to be non-stationary, cointegration does not exist (Kamil 2013). On top of that, the test went to the extent that some of the variables were omitted from the linear equation for the purpose to see whether the error term of the equation was stationary or not but unfortunately all of them were still non-stationary and the results can be seen appendix 3C to 3D.

Table 7: Engle Granger Test

EQUATION	T-stat	Critical Value	Implication
LKLCI CONS LTOPIX LSSTI LSZSE	-2.8246	-4.1517	No cointegration
LTOPIX CONS LKLCI LSSTI LSZSE	-1.4570	-4.1517	No cointegration
LSSTI CONS LKLCI LTOPIX LSZSE	-3.2934	-4.1517	No cointegration
LSZSE CONS LKLCI LTOPIX LSSTI	-2.8139	-4.1517	No cointegration

Although no cointegration is found in the Engle-Granger test, it is still concluded that there is one cointegrating vector as what was found under the Johansen test together with justification of previous studies from Bakri and Karim (2010).

An evidence of cointegration implies that the relationship among the Singaporean stock market with the stock markets of its Major Asian trading partners is not spurious meaning that there is a theoretical relationship among the variables and that they are in equilibrium in the long run. It implies that each stock market contains information for the prediction of others and will have implication for portfolio diversification by the investors since the possibility of gaining abnormal profits in the long term through diversifying investment portfolio is limited within cointegrated markets(Meera et. al 2009).

However, in order to make the coefficients of the cointegrating vector consistent with theoretical and apriori information of the economy, we applied the long run structural modelling procedure which is the next step after this (Masih and Algahtani 2008).

6.4 LONG RUN STRUCTURAL MODELING

Under the long run structural modelling procedure, it endeavours to estimate theoretically the meaningful long-run relations by imposing on those long run relations by imposing on those long run relations and then testing both exact-identifying and over-identifying restrictions based on theories and a priori information of economies (Masih et. al 2010)

Table 8:Long Run Structural Modeling

Variables	***Panel A***	***Panel B***	***Panel C***	***Panel D***
KLCI	-0.754* (0.335)	-0.443 (0.352)	-0.715* (0.255)	-0.579 (0.358)
TOPIX	-0.122 (0.081)	0.00 (*None*)	-0.1112* (0.053)	0.00 (*None*)
SSTI	1.000 (*None*)	1.000 (*None*)	1.000 (*None*)	1.000 (*None*)
SZSE	0.023 (0.131)	-0.123 (0.104)	0.00 (*None*)	0.00 (*None*)
Trend	0.001 (0.001)	0.000 (0.001)	0.001 (0.000)	0.001 (0.000)
Chi-Square	None	1.798 [0.180]	0.031 [0.861]	3.024 [0.220]

Note: The output above shows the maximum likelihood estimates subject to exactly identifying (Panel A) and over identifying (Panel B,C,D) restrictions. The Panel A estimates show that all variables are significant except TOPIX and SZSE(Standard errors are in parentheses). However, the overidentifying restrictions on TOPIX and SZSE equalling to zero was not able to be rejected (with p-values of 0.180 and 0.869 errors respectively while not rejecting the null) but we still proceed with Panel A for the remainder of this article since we intuitive believe that these two variables are crucial to achieve the objective of this study.* indicates significance at 1% level.

Table 9: Significance of variable at exact identification

Variable	**T-ratio**	**Implication**
LKLCI	-2.24	Significant
LTOPIX	-1.51	Insignificant
LSSTI	-	-
LSZSE	0.17	Insignificant

Since the cointegrating relationship is one, we imposed an exact identifying restriction of one towards the coefficient of SSTI(A3=1) since it is our interested variable. By exactly identifying the coefficient of SSTI, we initially obtained results shown under Panel A in the Table above(See appendix 4A) and it turns out that TOPIX and SZSE are statistically insignificant by observing their t-ratios that are lower than 2. The fact that TOPIX and SZSE are statistically insignificant towards SSTI is counter intuitive and is not in line with findings of Karim and Karim (2008) which stated that stock markets of China ,Japan, Singapore and Malaysia do affect each other. So from this point, we carry out over identification tests for both TOPIX and SZSE where we made these two variables equal to zero and the results are shown under Panel B and C. Surprisingly, it was found that both TOPIX and SZSE still remain insignificant even after over identification since the null hypothesis which states that each variable is equal to zero is not able to be rejected at 99% confidence level since p-value of the chi square for these variables are higher than 1%.

Table 10: Significance of variables after over-identification of LTOPIX and LSZSE (Panel B and Panel C)

Variable	Chi Square P-value	Implication
LKLCI	-	-
LTOPIX	0.180	Variable is insignificant
LSSTI	-	-
LSZSE	0.861	Variable is insignificant

In addition to the individual over-identifications done for TOPIX and SZSE, we made over-identifying restrictions all at once shown under Panel D that is testing the null hypothesis that TOPIX and SZSE were all insignificant but unfortunately, the null hypothesis was not able to be rejected since the p-value was more than 1%,meaning that the set of restrictions is correct.

Despite the fact that TOPIX and SZSE remained insignificant even after over-identifying them, we will still proceed with Panel A since by intuition, we strongly believe that TOPIX and SZSE cannot be economically ignored in this study as it will deter this study from achieving its main objective . Furthermore, the reason for proceeding with panel A is further strengthened by the findings of Karim and Karim (2008) showing that stock markets of Singapore, Japan,China and Malaysia are significant towards each other.

From the above analysis, we arrive at the following cointegrating equation(numbers in parentheses are standard errors).

$$\underset{}{\text{SSTI} - 0.75\text{KLCI} - 0.12\text{TOPIX} + 0.023\text{SZSE}} \longrightarrow \text{I(0)}$$
$$\underset{(0.34)}{} \quad \underset{(0.08)}{} \quad \underset{(0.13)}{}$$

6.5 VECTOR ERROR CORRECTION MODEL

The previous step only managed to show that these stock indices are cointegrated to a significant degree but it does not indicate the anything about the causality between the variables. Therefore, it is in this step which is constructing the vector error correction model that we are able to which index is leading and which one is following. It is essential for investors to know which indices are exogenous and endogenous as it enables them to come up with a better forecast on their investment decisions. For example, investors would keep an eye on the index which is the most exogenous since the exogenous index will influence the

movement other indexes which is under the investor's portfolio. In addition to this, the vector error correction technique is able to differentiate between short run and long run causality. The main principle of this techniques is the Granger causality which examines whether the past changes in one variable helps to explain the current changes in another variable (Gupta n.d.) .

By looking at the significance or otherwise of the error correction coefficients (see table 11on page 22 and appendix 5A to 5D), we found that there are two exogenous variables which are SZSE and KLCI and two endogenous variables which are SSTI and TOPIX.SZSE and KLCI are endogenous since their error correction terms are significant(p-value below 5% significance level).SSTI and TOPIX on the other hand are exogenous given the error correction terms that are insignificant(p-value above 5% significance level) . This tends to indicate that SSTI and TOPIX respond to SZSE and KLCI given that the error correction term in SSTI and TOPIX are significant. This then implies that the deviation of the exogenous variables(SZSE and KLCI) have a significant feedback effect on the SSTI and TOPIX that bear the burden of adjusting themselves in the short run to bring about the long-term equilibrium. The consequence of the results revealing SZSE and KLCI to be exogenous variables is that these indices would transmit the effects of the shock to other endogenous variables when they experience shocks from the market. Therefore, for instance, an investor whose investment portfolio includes SSTI may want to monitor the fluctuations within KLCI and SZSE as fluctuations in those indices are likely to influence the movements in SSTI .

However , the fact that SSTI and TOPIX are endogenous variable seems to be a surprising discovery but will be discussed later under variance decomposition analysis. The diagnostics of all equations of the error correction model tends to show positive results except for normality (Masih et. al 2010). Therefore, we must keep in mind that the equations of the error correction model are experiencing problems of non-normality which may affect the reliability of the results obtained under the vector error correction technique. This aspect would be used later for comparison if the results between the VECM and the variance decomposition in happen to be conflicting with each other.

On a side note, the p-value of the DMY variable which represents a dummy variable for the 2011 Japanese earthquake is lesser than 5% significance level. This means that this dummy variable is significant in the Japanese stock market which is represented by TOPIX.(Please refer to table 11 on the next page)

Table 11: Vector Error Correction Model

Dependent Variables	***dLKLCI***	***dLTOPIX***	***dLSSTI***	***dLSZSE***
dLKLCI(1)	-0.096 (0.084)	0.147 (0.182)	-0.088 (0.116)	0.05 (0.217)
dLTOPIX (1)	0.004 (0.032)	-0.208 (0.070)	-0.003 (0.045)	-0.037 (0.084)
dLSSTI (1)	0.067 (0.064)	0.338 (0.138)	0.158 (0.088)	0.092 (0.165)
dLSZSE (1)	0.056 (0.028)	0.006 (0.060)	0.048 (0.038)	-0.088 (0.071)
ECM(-1)	-0.015 (0.028)	0.179 (0.060)*	-0.098 (0.038)*	0.073 (0.071)
DMY	0.001 (0.004)	-0.017 (0.008)*	0.001 (0.005)	-0.011 (0.009)
Chi-sq SC(1)	0.102 [0.750]	1.608 [0.205]	0.0002 [0.987]	0.474 [0.491]
Chi-sq FF(1)	0.418 [0.518]	0.069 [0.793]	0.309 [0.578]	1.756 [0.185]
Chi-sq N(2)	18.927 [0.000]	657.065 [0.000]	13.86 [0.001]	5.503 [0.064]
Chi-sq Het (1)	0.276 [0.599]	1.4021 [0.236]	0.0579 [0.810]	0.654 [0.419]

Note: Standard errors are given in parentheses.*indicates significance at 5% level. The diagnostics are chi-squared statistics for :serial correlation(SC),functional form(FF),normality(N) and Heteroskedasticity(Het) and indicate that the equations suffer from the problem of non-normality.

Table 12: Exogeneity and endogeneity of variables

Variable	ECM(-1) t-ratio p-value	Implication
LKLCI	0.589	Exogenous
LTOPIX	0.003	Endogenous
LSSTI	0.011	Endogenous
LSZSE	0.310	Exogenous

Besides determining the absolute exogeneity and endogeneity of variables, the vector error correction technique is able to tell how long does it take for the variable to go back to long term equilibrium if the variable experiences a shock (Masih 2013). In the case of SSTI, the coefficient is 0.098 which implies that when a shock is applied to SSTI, it would take average about of 10 weeks (1/0.098) to get back into equilibrium with the other indices.

6.6 VARIANCE DECOMPOSITION ANALYSIS

Although the error correction model tends to indicate the exogeneity and endogeneity, the variance decomposition technique had to be applied in this study in order to determine the relative exogeneity or endogeneity of the indices. It is the proportion of the variance explained by its own past is the factor that determines the relative exogeneity and endogeneity. The most exogenous variable is the variable that is explained mostly by its own shocks (and not others). The variance decomposition technique is further broken down into the orthogonalized and generalized type.

Table 13:Orthogonalized Variance Decomposition

Weeks	ΔKLCI	ΔTOPIX	ΔSSTI	ΔSZSE
Relative Variance in ΔKLCI				
26	98.31%	0.05%	0.25%	1.39%
52	98.17%	0.03%	0.42%	1.38%
78	98.12%	0.03%	0.49%	1.37%
Relative Variance in ΔTOPIX				
26	6.79%	66.29%	26.73%	0.19%
52	6.42%	62.13%	31.24%	0.21%
78	6.29%	60.74%	32.75%	0.22%

Relative Variance in ΔSSTI				
26	60.66%	8.66%	30.23%	0.45%
52	71.56%	8.79%	19.25%	0.41%
78	76.45%	8.82%	14.35%	0.39%
Relative Variance in ΔSZSE				
26	3.52%	0.46%	12.25%	83.76%
52	3.49%	0.51%	14.15%	81.86%
78	3.48%	0.53%	14.83%	81.17%

Note: The output of the orthgonalized VDC shows the relative exogeneity and endogeneity of the variables. The elements along the principal diagonal tend to indicate that KLCI is the most exogenous variable.

Table 13 shows the results obtained from the orthogonalized variance decomposition for 3 time horizons(26, 52 and 78 weeks) in which the rows show the percentage of the variance of forecast error of each variable into proportions attributed to shocks from other variables coming from the columns, including its own while the columns are read as the percentage in which that variable contributes to other variables in explaining the observed changes. According to these results the ranking of indices by degree of exogeneity is as per table below. It is important to note that the ranking did not change for the three horizons.

Table 14: Ranking from Orthogonalized VDC after 78 weeks

Ranking	Index	% of variance of forecast error
1	KLCI	98%
2	SZSE	61%
3	TOPIX	14%
4	SSTI	81%

However, the result obtained looks baffling since from the previous VECM analysis, the SZSE was found to be the most exogenous index but over here, KLCI is the most exogenous. In the attempt to make some sense out of the results from the orthogonalized VDC, it is important to remember the shortcomings of the orthogonalized VDC whereby the orthogonalized VDC is not unique and depends on the particular ordering of the variables in the VAR. Under this matter , the first variable in the order would report the highest percentage and would likely be specified as the most exogenous variable which in this case

was the KLCI variable. Another weakness of the orthogonalized VDC is that it assumes all other variables are "switched off" when one particular variable is shocked.

Due to such weaknesses of the orthogonalized VDC, the generalized VDC is relied upon since it is invariant to the ordering of the variables and when a particular variable is shocked , the other variables in the system are not assumed to be switched off (Masih 2013). In obtaining the results for the generalized VDC, additional computations need to performed since the numbers given for each horizon that is generated by Microfit do not add up to 1.0. Therefore, for a particular variable, the numbers in the given row for each horizon are totalled up and we then divide for the number for that variable(which represents the percentage of variance explained by its own past) by the computed sum. Through this way, the number contained in each row will add up to 1.0 or 100%. The results of the generalized VDC are shown in table 15 below.

Table 15: Generalized Variance Decomposition

Weeks	ΔKLCI	ΔTOPIX	ΔSSTI	ΔSZSE
Relative Variance in ΔKLCI				
26	71.05%	2.07%	21.71%	5.17%
52	72.46%	2.03%	20.41%	5.10%
78	73.00%	2.02%	19.93%	5.06%
Relative Variance in ΔTOPIX				
26	4.86%	50.95%	40.76%	3.43%
52	4.61%	48.01%	43.70%	3.67%
78	4.53%	47.03%	44.69%	3.75%
Relative Variance in ΔSSTI				
26	35.96%	9.84%	49.28%	4.92%
52	42.66%	10.49%	42.39%	4.46%
78	45.79%	10.79%	39.18%	4.23%
Relative Variance in ΔSZSE				
26	3.03%	0.78%	13.56%	82.63%
52	2.98%	0.83%	14.95%	81.23%
78	2.97%	0.85%	15.45%	80.74%

Note:The output of the generalized VDC show the relative exogeneity and endogeneity of the variables. The elements along the principal diagonal tend to indicate that SZSE is the most exogenous variable.

Table 16: Ranking from Generalized VDC after 78 weeks

Ranking	Index	% of variance of forecast error
1	SZSE	81%
2	KLCI	73%
3	TOPIX	47%
4	SSTI	39%

From the results obtained from the generalized VDC, the results are in conformity with the results shown by the VECM whereby SZSE is an exogenous variable and is found to be the most exogenous one since it has the highest percentage of variance that is explained by its own past shocks whereas SSTI was found to be the most endogenous variable since it has the lowest percentage that is explained by its own past .Passing over the time horizons from 26 weeks up until 78 weeks, the rankings for relative exogeneity has not changed indicating stability of the rankings (observe the diagonal coloured lines of the matrix highlighted).Other information that can be obtained through the generalized VDC is that the difference in exogeneity between the indices is very substantial. For instance in the horizon of 52 weeks, the difference between the most exogenous and the most endogenous variable 38.84%.

Finding out that SZSE is exogenous towards SSTI is not much of a surprise as it is likely intuitive for our case. One of the reasons being so is that shares of the European countries and the United States in Singapore's merchandise trade declined from 25 % in 2003 to 18 % in 2012 Over the same period, China's share of trade with Singapore rose by 3.4 percentage points which could be connected to the situation where the boost in Singapore's merchandise trade with Asian countries that grew two-fold from S$349 billion in 2003 to S$694 billion in 2012 was due particularly by the rise in Singapore's trade with China (Lim 2013).

Prior to all these undertakings, The China-Singapore Free Trade Agreement (CSFTA) was signed after eight rounds of negotiations held over two years in both Singapore and Beijing. This is the first comprehensive bilateral free trade agreement that China has signed with another Asian country that covers trades in goods, services, technical barriers to trade, economic cooperation and dispute settlement (International Enterprise Singapore 2013)

While China's rapid growth has been a positive driving force for the nation of Singapore, a sustained slowdown in China's economy could prove to hurt the most for the Singaporean

sectors that have benefited the most from the boom. Singapore's overall economy could also suffer if China's moderating growth results in an Asia-wide slowdown. Excluding the European Union, China was Singapore's largest non-oil domestic export (NODX) in October 2013 whereby it increased by 21.8% (International Enterprise Singapore 2013) which is a significant increase from 3.6 percent in the year 2000.Plus,the global structural shift that has been occurring over the last two decades has seen this small and open economy leaning more and more towards China. According to the Singapore Tourism Board China has also been the second-largest tourism market for Singapore over the last decade. .As such, any slowdown in China would have a ripple effect in those sectors here(Lee 2013)..The above explanations clearly show that the Chinese stock market is clearly exogenous towards Singaporean market.

It was also quite surprising to find that. KLCI is found to be exogenous towards SSTI which means KLCI influences the movements of SSTI. This is not in conformity with previous literatures such as Karim and Majid(2010) and Karim and Karim (2008)which found that SSTI to be exogenous towards KLCI. Right after the 2008 Global Financial Crisis, Malaysia suffered capital flight since the second quarter of 2008 where banks from other countries including Singapore reduced their investments in Malaysia and focused on their home market causing a big drop in funds flowing into Malaysia (Khoon and Lim 2010) and it is from here it is evident that Singapore was exogenous towards Malaysia after the 2008 global financial crisis despite the condition that investment commitment in Singapore's manufacturing and services sectors fell for the first time four years.

Astonishingly ,Karim and Karim (2008) found results which indicated that Malaysia influences Singapore in the short run which partially conforms to our VDC results .Possible explanations for KLCI influencing SSTI as what was obtained from the VDC results can be closely related to the geographical proximity and historical ties between them. As we all know, Singapore is Malaysia's neighbouring country and based on history, Singapore used to be a part of Malaysia. Being geographically related and historically tied to Singapore, Malaysia would be more familiar with Singapore's trading and investment activities Malaysia's size is definitely larger than Singapore enabling to engage in more manufacturing activities to produce products such as palm oil and other agricultural products which will then be exported to Singapore (Malaysia Exports 2013). As a matter of fact, Malaysian companies use Singapore as a test bed for their products and services to ensure market acceptability, competitiveness and sustainability prior to venturing into other foreign markets (Borneo Post 2011).This explanation is in line with empirical study done by Janakiramanan and Asjeet

(1998) which discovered that countries that are geographically close should exhibit high levels of cointegration.

Other than that, on a year on year basis, oil domestic exports expanded by 1.7 per cent in October 2013, after the preceding month's 29.5 per cent growth. The year on year rise in oil domestic exports was mainly due to higher sales to Malaysia. This indirectly means that Malaysia influences Singapore by being its purchaser for oil (International Enterprise Singapore 2013). Malaysia is Singapore's largest trading partner and bilateral trade amounted to S$113.4 billion ($92 billion) in 2012, up from S$77.2 billion in 2003 (Adam 2013). Not to forget, Singapore and Malaysia are members of the ASEAN congress which aims to remove trade barriers between members causing stronger bilateral trade between them (Karim and Karim 2012). The increase of bilateral trade activities between Malaysia and Singapore over the years may have resulted in SSTI to be highly cointegrated with KLCI which is consistent with Masih and Masih(1999) and Bracker et. al (1999)

As for the relationship between TOPIX and SSTI after the global financial crisis, it is rather ambiguous since both of these markets turn out to be endogenous from the generalised variance decomposition technique but our intuition tells us that SSTI is exogenous towards TOPIX and also based on previous empirical literature by Karim and Karim (2008) which found that the Japanese stock market is influenced by the Singaporean stock market in the long run. Japanese investments in Singapore have steadily grown in sophistication whereby Japanese firms increasingly see Singapore as a platform to structure new solutions and globalize their businesses. Advantage is also taken on of Singapore's multiracial environment to modernize their management by attracting, training, and deploying managers of Japanese and non-Japanese backgrounds. It was the Japan-Singapore Economic Partnership Agreement (JSEPA) which came into force November 30, 2002 that pioneered all these interactions between Japan and Singapore. This was a key milestone in our bilateral relations with Japan. It was Japan's first bilateral economic partnership agreement and one of Singapore's earliest with a major trading partner (World Eye Reports 2008). But there is an exception for this case when the earthquake and tsunami hit Japan in 2011 which caused some of the Singaporean companies operating in Japan reported losses for that period (People's Daily 2011). Despite the occurrence of such natural disasters which affected Singapore, the inter linkage between Japan and Singapore do not seem to be interrupted badly. The earthquake and the tsunami which happened in Japan can be considered as black swan events since they cannot be predicted and they are contained within the outliers under bell curve.

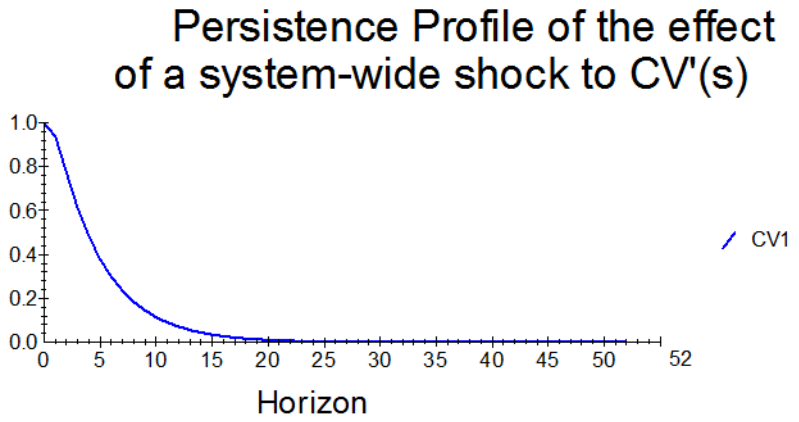
As the relative exogeneities and endogeneities of the Asian trading partners of Singapore have been discussed further, a clearer detail has been provided on how Singapore actually interacts with its major Asian trading partners after the 2008 global financial crisis. All the statistical results are just a form of benchmark and must not be blindly relied on so intuition and reasoning is important in this matter.

6.7 IMPULSE RESPONSE FUNCTION

In order to provide the dynamic response of the Singaporean stock market to innovations of its major Asian trading partners included in the system, the generalized IRFs developed by Pesaran and Shin(1998) are adopted . This approach is shown to be invariant to the ordering of variables and is useful for the study of stock markets which are in general, categorized by quick price transmission and adjustments(Ewing et. al 2003). Plus, it also enables us to examine whether more complex transmission mechanisms are involved (Hutson et. al 2008). Referring to appendix 7H, it shows that when the most exogenous variable which is the China stock market(SZSE) is shocked, the other variables do response fairly large while on the other hand in appendix 7G, in which the most endogenous variable which is the Singaporean stock market is shocked, other markets do not react that much by observing at the scale of the magnitude of the shocks in each variable . Therefore, the results of the impulse response functions essentially produce the same information as the ones in variance decomposition analysis.

6.8 PERSISTENCE PROFILE

The persistence profile estimates the speed with which the economy or the markets return to equilibrium owing to a system-wide shock on the cointegrating relations. It differs from the IRF in terms of having a system wide shock on the long run relationship rather than having variable specific shocks (Masih 2013). The chart below shows the persistence profile for the cointegrating equation of this study. The chart indicates that it would take approximately 20 weeks for the cointegrating relationship to return to equilibrium following a system wide shock.



7.0 CONCLUSION

This study examines the stock market cointegration between the Singaporean stock market and the stock markets of its major Asian trading partners namely, China, Malaysia and Japan that is possible in this globalized era. Weekly data spanning from September 2009 to October 2013 was used together with employing the Johansen and Engle Granger test for cointegration. The study found evidence that there exists a long-run equilibrium relationship between the Singaporean stock market with the stock market of its major Asian trading partners even after the 2008 global financial crisis. Thus, globalisation and even trade ties seems to have impacted the cointegration between these stock markets. These findings imply that there is limited room to gain benefits from international portfolio diversification in the Singaporean stock market. The vector error correction model discovered that the earthquake dummy variable happened to be significant in the Japanese stock market. Other than that, the variance decomposition analysis applied in this study tend to indicate that the Singaporean stock market(SSTI) is relatively more endogenous and the Chinese stock market(SZSE) to be relatively more exogenous. Overall the results of this study supports the previous empirical literatures that stock markets remain cointegrated after the crisis period resulting in lesser diversification benefits from participating in the market and trade does matter for stock market cointegration.

As far as the efficient market hypothesis is concerned, this study finds that the cointegration between the Singaporean stock market with its major Asian trading partners suggests that each stock price has information on the common stochastic trends and therefore the

predictability of one's country stock price can be enhanced drastically by utilising the information on other countries' stock prices (Ansari 2009).

8.0 POLICY AND IMPLICATIONS

For the purpose of policy making, any shocks in the major Asian trading partners should be taken into consideration by the Singaporean Authorities in order to formulate macro stabilisation policies that pertain to its stock market as ignorance to do so may result in a contagion effect. The extent of effectiveness of the Singaporean macroeconomic policies in dealing with its stock market imbalances will rely heavily on the extent of financial integration of each of its major Asian trading partners . Since the Singaporean market is interconnected with the markets of its major Asian trading partners , then Singapore's cannot be isolated or insulated from foreign shocks and thus, reduces the scope for independent monetary policy. Furthermore, the advantage of effective diversification among these Asian markets can no longer be achieved and the Singaporean market together with its major Asian trading partners are perceived as one market set by investors intending to invest in the long run period (Meera et. al 2009).In other words, Singapore cannot serve as a potential market for international portfolio diversification for those who have a long-run investment horizon.

Now it is evident that the cointegration of the Singaporean stock market with its major Asian trading partners reflects the limitation attributed to the pursuit of interdependent policy especially the financial policy. This limitation then brings about the need for policy coordination in Singapore to mitigate the impact of financial fluctuations . If Singapore intends to exploit the advantages of greater economic interdependence, trade and investment barriers would need to be lifted in addition to better policy coordination. Given this stock market cointegration of Singapore with is major Asian trading partners, policy makers may want to use this issue as a solid reason to establish a monetary union (Meera et. al 2009) among Asian countries which we think will not happen in the near future as Asian countries seem to be loyal when it comes to their currencies.

Regarding countries like Japan who experienced an earthquake and a tsunami back in 2011, the Japanese authorities may want to allocate some expenditure towards planning a policy that promotes a faster recovery process in the event that such natural disasters would take place again in the coming future. With an economic policy that promotes a faster recovery process, other countries interconnected with Japan, such as Singapore which is the country focused in this study, would not have to restructure much of its trading plans with Japan .

By the same token, the degree of cointegration between the Singaporean stock market with its major Asian trading partners will definitely have important bearings on the formulation of policies of multinational corporations. The reason being is that an idea of the exchange rate risks between these countries can be known through the identification of the long run relationship or co-movement among these stock markets. Acquiring such knowledge would enable the managers of these multinational companies to mitigate international risks and manage the economic, transaction and translation exposure of the corporation (Karim and Majid 2010).

9.0 LIMITATIONS OF STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

One of the caveats of this study is that more indices from other regions such stock markets in Europe and the Middle East could have been included in this study in order to provide a larger view about diversification benefits that can assist global investors. Other than that, the period selected for this study could be extended further back into the past which enables more significant past events such as the Dot-com Bubble to be incorporated into the study and hence, allows us to observe the long run trend of various stock markets which gives us a clearer picture.

Potential areas than be used for further research is attempting to quantify and compare the diversification benefits that can be gained by the diversification of securities across the Asian markets that covers a larger group of nations. Other than that, a more developed way of testing is needed to discover the existence of non-linear cointegration among the Singaporean stock markets and its major Asian trading partners (Karim and Majid 2010).

10.0 REFERENCES

Ali, S, Butt, B.Z, and Rehman, K (2011), Comovement between Emerging and Developed Stock Markets: An Investigation Through Cointegration Analysis, *World Applied Sciences Journal,* 12(4), 395-403.

Bracker, K, Dockling,DS and Koch, PD (1999), Economy Determinants of Evolution in International Stock Market Cointegration, *Journal of Empirical Finance*, 6, 1-27.

Carlson,M 2007, "A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response", *Finance and Economics Discussion Series, Division of Research and Statistics and Monetary Affairs*, Federal Reserve Board, Washington,DC.

Click, RW and Plummer, MG (2003), Stock market integration in ASEAN after financial crisis', *Working Paper Series, Vol. 2003-2006*.

Ewing,B.T, Forbes S.M and Payne,J.E (2003) , The effects of macroeconomic shocks on sector-specific returns, *Applied Economics*, 35, 201-207.

Fama, E (1970), Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, 25, 383 - 417

Huang,YJ and Bacon,FW (2009), Can the US stock market be Shanghaied? Evidence of the impact of China's emerging stock market, *Management Research News*, 32(5), 469-476.

Hutson, E, Kearney, C and Lynch,M (2008), Volume and skewness in the international equity markets, *Journal of Banking and Finance*, 32(7),. 1255-1268.

Janakiramanan,S and Asjeet, SL (1998), An empirical examination of linkages between Pacific Basin stock markets, *Journal of International Financial Markets, Institutions and Money,* 8, 155-173.

Karim,BA, Jais,M, and Karim,SA (2011), The subprime crisis and stock index futures markets integration, *The Journal of Risk Finance* ,12(5), 400-408.

Karim,Z.A and Karim B.A (2008), Stock market integration: Malaysia and its major trading partners, *Munich Personal RePec Archive No.* 26976.

Karim,B.A and Majid,M.S (2010), Does trade matter for stock market integration , *Studies in Economics and Finance*, 27(1), 47-66.

Karim, B.A and Karim,Z.A (2012), Integration of Asean-5 Stock Markets: A revisit, *Asian Academy of Management Journal of Accounting and Finance,* 8(2), 21-41.

Karim,BA, Majid,MS, and Karim,SA (2009), Cointegration of Stock markets among Malaysia and its Major Trading Partners, *FEB Working Paper Series No. 0903,Universiti Malaysia Sarawak*. .

Masih, A.M.M. and Masih, R. (1999), Are Asian Stock Market Fluctuations Due Mainly to Intra-Regional Contagion Effects? Evidence Based on Asian Emerging Stock Markets, *Pacific-Basin Finance Journal*, 7, 251-282.

Masih, M, Elg, A. and Madani, H. (2010), Causality between financial development and economic growth: an application of vector error correction and variance decomposition methods to Saudi Arabia, *Applied Economics*, 41(13), 1691-1699.

Masih, M and Algahtani, I. (2008), Estimation of long-run demand for money: An application of long-run structural modeling to Saudi Arabia, *Economia Internazionale*, 61(1), .81-99.

Meera,A.K, Omar,M.A, Aziz,H, Majid,M.S (2009), Dynamic linkages among ASEAN-5 emerging stock markets, *International Journal of Emerging Markets*, 4(2), 160-184.

Menon,NR,Subha,MV and Sagaran,S. (2009), Cointegration of Indian stock markets with other leading stock markets, *Studies in Economics and Finance*, 26(2), 87-94.

Mishkin, FS. (2011). Over the Cliff: From the Subprime to the Global Financial Crisis., *Journal of Economic Perspectives*, 25(1), 49-70.

Pesaran,MH and Shin,Y (1998), Generalized impulse response analysis in linear multivariate models, Economics Letters, 58, 17-29.

Rajwani,S and Mukherjee,J (2013), Is the Indian stock market cointegrated with other Asian markets?, *Management Research Review*, 36(9), 899-918.

Roubini, N, Pesento,P and Corsetti,G (1998), "What Caused The Asian Currency and Financial Crisis? Part1: A Macroeconomic Review" ,*National Bureau of Economic Research (NBER) Working Paper No.* w6833.

Singaporean Ministry of Trade and Industry (2010), *Economic Survey of Singapore: First Quarter.*

Valakati, A. and Chancharat, S. (2008), Dynamic Linkages between Thai and International Stock Markets, *Journal of Economic Studies*, 35(5), 425-441.