

The Impact of the Global Financial Crisis on the Integration of the Chinese and Indonesian Stock Markets

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Abstract

The study investigates the integration of Chinese stock market with Indonesian stock market after the 2008 global financial crisis, by considering volatility spillover between the two countries. The study also considers the volatility spillovers effects of Japan and the U.S on Indonesian and Chinese stock markets. Exponential generalized autoregressive conditional heteroskedasticity model is employed for analyzing data series covering January 4, 2002 to December 20, 2011. The results indicate that Indonesian and Chinese stock markets have bidirectional return spillover effects before and after the 2008 global financial crisis. The results of volatility spillover effects provide evidence that Chinese stock market has unidirectional effect on Indonesia stock market after the financial crisis. We also found evidence of volatility spillover effect of the Japanese stock market on Indonesian stock market before and after the crisis, but we do not find volatility spillover evidence from the U.S to Indonesian stock market after the financial crisis. This finding indicates that besides Japan, China has increased its influence on Indonesian stock market after the global financial crisis, whereas the U.S has become less influential than before the crisis. This strong integration of the Chinese stock market in Indonesia market implies limited gains for portfolio diversification from the international portfolio investors.

Keywords: stock market, integration, spillover, volatility

1. Introduction

Chinese economy has, of recently, been playing an important role in the Asian region as well as across the globe following the impressive growth and large economic size. The economy overtook Japan and became second largest to United States (U.S) in 2010 (IMF, 2011). This made the Chinese stock market to equally take an important role in the world equity markets. Moreover, after the 2008 global financial crisis, the Chinese stock market became a large recipient of world investments, thereby, expanding its links with the Asian stock markets among world emerging stock markets (Kang, Kim and Yoon 2011). The impressive growth of the Chinese economy also opened up economic opportunities for Indonesian investors in terms of trade and investment. According to Chandra and Lontoh (2011) study, China became Indonesian's second largest trading partner behind Japan after overtaking the U.S in 2010. Similarly, Indonesian economy became China's fourth largest trading partner in the Asian region in 2010. This recent increase of trade ties between China and Indonesia has also deepened the investment relations between the two countries; as such Indonesian and Chinese stock markets have become important targets by investors of the two countries for their portfolio diversification. Besides that, the Indonesian stock market has for the past few years been one of the targeted markets in Asia by international portfolio managers including Chinese portfolio investors for investment following the impressive growth of the Indonesian economy (Hung and Cheung, 1995).

Given these recent economic developments between China and Indonesian, it is important to analyze whether the recent global financial crisis has played a role in China's economic integration with Indonesia. Particularly, it is worth investigating on whether the Indonesian financial market is sourcing new market information from the Chinese stock market taking into account that China is now the world's second largest economy and the largest in Asia. The underlying question is whether the Chinese financial market has become powerful in distributing and sourcing market information from other Asian markets, and in particular Indonesia, as the economy is growing its global importance. Currently, there are few studies that have analyzed the influence of Chinese stock

market on other stock markets within or outside the Asian region despite the significant role the Chinese economy is playing across the globe, and on Indonesian financial market in particular (Kang and Yoon, 2011; Kang, Kim and Yoon, 2011). The few studies present have only included Indonesia and China as part of their broader sample when analyzing stock market integration in the Asian region (Janakiramanan and Lamba, 1998; Ng, 2002; Gee and Karim, 2010; Joshi, 2011). This study, therefore, aims at examining the integration of the Indonesian and Chinese stock markets before and after the 2008 global financial crisis taking into account that China became Indonesia's world's second largest trading partner after this period. The study also considers volatility spillover effects from Japan and U.S stock markets to Indonesia and China as Japan still remains Indonesia's and China's largest trading partner while U.S is still the largest economy in the world.

Investigating and understanding the integration of the Indonesian stock market with Chinese stock market is important and interesting for a number of reasons. First, the Chinese economy has been growing impressively for the past 30 years, thereby becoming the world second largest economy after the U.S. in 2010; in turn, the Chinese stock market became one of the major world stock markets in terms of market capitalization and investments inflow (World Exchange, 2012). Considering these developments in the Chinese stock market, it is important to analyze and understand how the market is interacting with other markets in the world and particularly within the Asian region, such as Indonesian stock market. Secondly, it is believed that regional integration is strong when countries share common cultural aspects, business conditions and trade policies (Gebka and Serwa, 2007). China shares these characteristics with most regional counterparts, including Indonesia, such that the analysis of the volatility spillover effects within the Asian region should also be taking into account spillovers from China as one of the major stock market operating within the region. Thirdly, China is now the world's second-largest economy and the largest in Asia and a key trading partner of Indonesia indicating that the Chinese economy is now playing a key important role in Indonesian economy. Fourthly, the Chinese stock market is ranked among the five major world stock markets; indicating that the market is powerful in distributing and sourcing new market information in the region and also across the globe (World Exchanges, 2012). It is, therefore, interesting to know whether Indonesian stock market has developed a strong link with Chinese stock market taking into account the growing importance of the Chinese economy, especially after the 2008 global financial crisis, and also evidence provided by pre-crisis empirical literature which suggests that the Indonesian stock market was isolated from other Asian stock markets (Palac-McMiken, 1997; Roca et al, 1998; Janakiramanan and Lamba, 1998; Ibrahim, 2005). Such strong linkage between Chinese and Indonesian economies may have impact on financial markets thereby reducing their insulation as such any financial instability from one stock market may easily be transmitted to the other stock market, subsequently decreasing the benefits from portfolio diversification. Therefore, analysis of the Indonesian and Chinese stock market integration provides international portfolio managers with powerful information for the portfolio diversification and hedging strategies, and also policy makers to formulate appropriate policies when dealing with adverse economic events within the region.

However, it should also be noted that the Japanese stock market remains one of the most important international market across the globe and has strong economic ties with most economies within the Asian region. According to World Exchanges (2012), the Japanese stock market is ranked third among the top major world stock markets; hence, discussion of integration between Indonesia and China stock markets should take into account their co-movements with Japan as it provides important information to portfolio managers. In addition, studies have shown that the U.S stock market is influential in the Asian stock markets; however, after the global financial crisis, some studies indicate that the U.S influence in the Asian stock markets is becoming less dominant (Kang, Kim, Yoon, 2011). For these reasons, inclusion of Japan and the U.S stock markets when examining the integration of the Asian regional stock markets after the global financial crisis becomes indispensable. This analysis will contribute to the literature on the role that Chinese economy is playing on Indonesian economy. The rest of the paper is structured as follows: Section 2 provides a brief overview of literature related to stock markets in the Asian region. Section 3 provides methodology and Section 4 describes the data and empirical results. Section 5 concludes the paper.

2. Literature Review

The literature on stock market integration for both developed and developing countries is vast. Earlier studies show that national stock markets had lower interactions among themselves which suggested potential gains in international portfolio diversification (Grubel, 1968; Levy and Sarnat, 1970 and Solnik, 1974). Later after 1987 stock market crash, studies found evidence of increased interaction in international stock markets, especially in stocks traded actively on the major financial centers (Goldstein and Michael, 1993). More studies by Arshanapalli et al. (1995); Francis et al. (2002); Yang et al. (2003); Ibrahim (2005) Yu et al. (2007) and Majid et

al. (2008) followed and confirmed the cointegration of the stock markets after 1987 crisis.

On the Asian region, most studies have concentrated on analyzing the integration of emerging stock markets of the Asean countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) either among themselves or with the Japanese and the U.S stock markets and most of them focus on the period before or after 1997 Asian financial crisis. Earlier regional studies show that the Indonesian stock market was isolated from the Asean stock markets and integrated to the U.S and the Japanese stock markets. For instance, Palac-McMiken (1997) found that all Asean stock markets are linked to each other with exception of Indonesia. Moreover, Roca et al (1998) study found that there were short-run linkages among the Asean stock markets except with Indonesia. Further, Janakiraman and Lamba (1998) study provide evidence that the Indonesian stock market was not linked to other regional Asian markets. In 2005, Ibrahim also analyzed the international linkages of the Indonesian stock market with Asean markets before and after 1997 Asian financial crisis by using cointegration approach and vector autoregressive (VAR) model. The results found no cointegration evidence between the Indonesian stock market and the other Asean stock markets, including the Japanese and the U.S stock markets for both periods. The results, further, indicated that the Indonesian stock market was responsive to Japanese and the U.S stock markets but was segmented from Asean stock markets after the crisis.

In contrast, McCauley et al. (2002) investigated the East Asian bond and loan market integration in the post crisis period of 1999-2002. The study results provide evidence of integration of both bond and loan market during this period. Ratanapakorn and Sharma (2002) examined the short-run and long-run relationships of the Asian regional stock prices during the pre and post Asian financial crisis. The results indicate the degree of linkages between the stock markets during and after the crisis. In 2004, Hsin examined the same market which was investigated by Engle and Susmel (1993) and found regional transmission effects are stronger than international effects especially for Europe and Asia. Similar results were found by Gebka and Serwa (2007) who investigated stock markets of the Central and Eastern Europe, Latin America and South East Asian. Worthington and Higgs (2004) also investigated the transmission of equity returns and volatility for the three Asian developed stock markets of Hong Kong, Japan and Singapore and six Asian emerging stock markets of Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand by using weekly returns for the period between January 1, 1988 and October 6, 2000. MGARCH-BEKK model was employed to identify the source and magnitude of spillover effects. The results suggest that there was no homogenous mean return spillover effects from developed to emerging markets. Moreover, the volatility spillover were higher from own market volatility than cross market volatilities indicating weak integration. Gee and Karim (2010) also investigated return and volatility spillover effects among the five Asian stock markets and their interaction with the U.S and Japan after the Asian crisis. They employed exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model using daily observations from March 1, 1999 to December 31, 2007 to investigate the intraregional and interregional spillover effects. Their results show that the returns of the Asean-5 stock markets highly depend on own past returns. The results further indicate that the Asean-5 stock markets are more influenced by the U.S stock market as compared to the Japanese stock market. The results also show evidence of intra-regional linkage among the Asean-5 stock markets.

In 1997, Liu and Pang examined the Japanese and the U.S equity markets influence on the four Asian markets and the study found that the return and volatility spillovers from the U.S. market are more influential in transmitting information in the four countries. Michelfelder and Pandya (2005) support Liu and Pang (1997) results after finding that the U.S market has dominant influence in the Asian region comparing to the Japanese stock market. However, Ghosh et al (1999) using cointegration theory investigated the influence of the Japanese and the U.S stock markets on the Asian-Pacific stock markets. The results show that Indonesia, Philippines and Singapore stock markets co-move with the Japanese market, while Hong Kong, India, Korea and Malaysia co-move with the U.S stock market. Ng (2000) collaborates this finding after investigating return and volatility spillover effects between Japan, the U.S and Asian stock markets using generalized autoregressive conditional heteroskedasticity (GARCH) model. The results show that Japan and U.S have unidirectional volatility spillover effects on the Asian stock markets. In 2002, Johnson and Soenen investigated the degree of integration of 12 Asian-Pacific stock markets with Japan. The results indicate that there is high integration between Australia, China, Hong Kong and New Zealand and the Japanese stock market. Mulyadi and Anwar (2012) also investigated the volatility spillovers between Indonesia, U.S and Japan capital markets from January 1, 2004 to December 31, 2008. The study employed GARCH (1,1) model for the analysis and the results indicate bidirectional volatility spillover between Indonesia and Japan stock markets, while the U.S has unidirectional volatility spillover effect on the Indonesian stock market. The results suggest that volatility spillover is not just one way from developed stock market to emerging market but can also be a two way system.

On the other hand, literature shows few studies that have investigated the interaction of the Chinese stock market with regional Asian counterparts. The few studies presented mainly focus on the co-movements and return spillovers within Mainland China and fewer on return and volatility spillover effects between China and the regional Asian stock markets. For instance, Laurence, Cai and Qian (1997) examined the causal relationship among the Chinese stock markets and the results show a strong causal relationship from the Shanghai B-share to other Chinese markets whereas there was feedback causal relationship between Shanghai A- and Shenzhen B-share markets. However, Kim and Shin (2000) study found Shanghai A-share market leading the Shenzhen B-share market before 1996, but such relationship was found to be disappearing or reversing after 1996. Chan, Lo and Cheung (1999) also found that there was a lead-lag stock market return transmission among the Chinese stock markets of Shanghai and Shenzhen and also with stock markets from Hong Kong and Taiwan.

In 1998, Chakravarty, Sarkar and Wu analyzed cross return correlations among the Chinese stock indices (A- and B-share) with those from Hong Kong, Japan, and the U.S and results provide evidence of bivariate cross return correlations among the Chinese market, and also with market indices from Hong Kong, Japan, and the U.S. However, Greenewold, Tang and Wu (2004) study found that the Mainland China stock markets are relatively isolated from regional markets of Hong Kong and Taiwan. Furthermore, Cheng and Glascock (2005) found that the Chinese stock markets are not cointegrated among themselves or with Japan and the U.S markets. Li (2007) also analyzed the linkages between Shanghai and Shenzhen stock markets within China with Hong Kong's Heng Seng and the U.S S&P500 market using Multivariate GARCH-BEKK (MGARCH-BEKK) model (named after Baba, Engle, Kraft and Kroner) for daily observations between January 4, 2000 and August 17, 2007. The study results indicate weak integration between Heng Seng and the two China stock markets (Shanghai and Shenzhen) as there was unidirectional volatility spillovers from Heng Seng to the two Mainland Chinese stock markets. The results further indicate no evidence of volatility spillovers between the Chinese and the United States stock markets suggesting that the two markets are not integrated. In 2009, Yi explored the information transmission among the Chinese, Japanese and Korean stock markets. The results indicate no evidence of volatility spillovers between China and Korean stock markets. Kang and Yoon (2011) also investigated the volatility spillovers effects among five Asian stock markets of China, Hong Kong, Korea, Singapore and Taiwan and how the 2008 global financial crisis influenced return and volatility transmission among the markets. They employed a VAR (1)-bivariate GARCH-BEKK model using daily series between January 2, 2006 and January 31, 2011. Their results show that China has stronger linkages with the other four Asian stock markets after the 2008 global financial crisis; suggesting that the stock market integration within the region has been intensified.

Kang, Kim and Yoon (2011) also examined the volatility spillover effect between Chinese and Korean stock markets after global crisis using VAR (1)-bivariate GARCH-BEKK model. The study data covered the period from January 2, 2006 to September 30, 2010. The study results indicate bi-directional volatility spillover effect before the crisis and uni-directional effect from the Chinese to Korean stock markets after the crisis. The findings suggest dominance of the Chinese stock market over the Korean stock market after the global financial crisis. Joshi (2011) also examined the return and volatility spillover among India, Hong Kong, Japan, China, Jakarta and Korea stock markets using multivariate GARCH-BEKK model from January 2, 2007 to February 29, 2010. The study findings show that most of the stock markets have bi-directional return, shock and volatility spillover effects. The results further indicate that cross-market spillover are lower than own volatility spillover suggesting weak integration of the Asian stock markets.

Thus, the examined literature suggests stock market dependency among some Asian countries. Besides, the literature has shown that Asian stock markets are also integrated with developed countries stock markets. However, the literature also indicates that it is difficult to decide about strict segmentation or perfect integration among the markets. On the Asian region, literature review suggests availability of few studies that focus on integration of the Indonesian stock markets with China despite strong economic ties the two countries share in terms of trade and investment besides sharing of similar cultural aspects. The few available pre-Asian financial crisis studies suggest that the Indonesian stock market is isolated from other Asian stock markets. On the other hand, the post 1997 Asian financial crisis studies suggest that the Asian stock market are intensifying their integration among themselves and also with Japanese and the U.S and stock markets. However, there is need to investigate further on the Asian stock market integration with China after 2008 global financial crisis when the Chinese economy became world's second largest and largest in the Asian region.

3. Methodology

One of the interesting features of financial time series data is that 'bad' news has more pronounced effect on volatility than 'good' news. As a result, current return volatility has a strong negative correlation with the future return volatility (Sheu and Cheng, 2011). This asymmetric response is often called 'leverage effect'. It is

important, therefore, to have a model that can capture such leverage effects in the time series data. Autoregressive Conditional Heteroskedasticity (ARCH) model is perhaps the most popular as it pertains to financial time series data. ARCH models were introduced by Engle (1982) and later generalized as GARCH (Generalized ARCH) by Bollerslev (1986) and Taylor (1986). Multivariate Exponential GARCH (EGARCH) model as proposed by Nelson (1991) and Threshold GARCH (TGARCH) model as proposed by Glosten, Jaganathan and Runkle (1993) are two relevant models that reflect the leverage effect.

The multivariate EGARCH model is adopted in this analysis of volatility spillovers effects of Indonesian, Chinese, Japanese and the U.S. stock markets. The model is important as it captures the contemporaneous correction between the stock prices. The model is also able to improve the efficiency and the power of the tests for the volatility spillovers across the countries (Koutmos and Booth, 1995). The EGARCH modeling is also important in our analysis as it copes with the situation of asymmetry in the volatility transmission mechanism as the effect of stock market volatility in the given market is divided into local market and cross market innovations (Gee and Karim, 2010). The model also captures the asymmetric effect of bad and good news on the conditional variance and hence allowing the evaluation of bad and good news generated in the domestic stock market to the next trading market (see Koutmos and Booth, 1995; Gee and Karim, 2010; Rafaget and Muhammed, 2012). Moreover, EGARCH models allow inclusion of dummy or explanatory variables in the conditional mean and variance equations depending on the study objectives (Kanas, 2000; Miyakoshi, 2002; Olowe, 2009; Rafaget and Muhammed, 2012).

The specification of EGARCH model used in this analysis is expressed as:

$$R_{i,t} = \alpha_{i,0} + \sum_{k=1}^n \beta_{i,k} \varepsilon_{k,t-1} + \varepsilon_{i,t} \quad \text{for } i, k = 1, 2, \dots, n \text{ and } i \neq k \quad (1)$$

$$\varepsilon_{i,t} / \Omega_{t-1} \sim iid \quad N(0, h_t) \quad (2)$$

where equation (1) is the mean equation containing dependant variable returns ($R_{i,t}$) for index i at time t which depends on $\alpha_{i,0}$ standing for drift term; $\beta_{i,k}$ for $i=k$ is for spillovers across markets and $\beta_{i,k} \varepsilon_{k,t-1}$ is for autocorrelation in the returns resulting from non-synchronous trading (Hamao et al, 1990). This conditional mean equation is the first empirical analysis step. Equation 2 is a mathematical expression for error term which is independently and identically distributed with mean zero and constant variance.

Following, Koutmos and Booth (1995), Antoniou et al (2003) and Gee and Karim (2010), we model the conditional variance of the EGARCH as:

$$\sigma_{i,t}^2 = \exp[\alpha_{i,0} + \sum_{k=1}^n \alpha_{i,k} f_k(z_{k,t-1}) + \delta_i \ln(\sigma_{i,t-1}^2)] \quad \text{for } i, k = 1, 2, \dots, n \text{ and } i \neq k \quad (3)$$

In this equation (3) $\sigma_{i,t}^2$ is the traditional variance in market i and k expressed as an exponential function of the past standard innovation ($Z_{k,t-1} = \varepsilon_{k,t-1} / \sigma_{k,t-1}$) from own market and cross markets. The coefficient $\alpha_{i,k}$ for $i, k = 1, 2, \dots, n$ and $i \neq k$ is a volatility spillovers across markets and a positive and significant $\alpha_{i,k}$ together with a negative δ_k means that negative news of market i has a greater effect on the volatility of market k as compared to the positive news. The persistence in volatility is given by δ_i where unconditional variance is finite if $\delta_i < 1$ and does not exist if $\delta_i = 1$ and in such a case conditional variance is believed to have followed an integrated process of order one. Asymmetric transmission shock from one market to other market is expressed in equation (4) where relative asymmetry is measured by covariance $\sigma_{i,k,t} = \rho_{i,k} \sigma_{i,k} \sigma_{i,t}$ for $i, k = 1, 2, \dots, n$ and $i \neq k$.

$$f_k(z_{k,t-1}) = (|z_{k,t-1}| - E(|z_{k,t-1}|) + \gamma_k z_{k,t-1}) \quad \text{for } k = 1, 2, \dots, n \quad (4)$$

In equation (4), asymmetry is estimated by partial derivative and can be derived as

$$\begin{aligned} \partial f_k(z_{k,t}) / \partial z_{k,t} &= 1 + \gamma_k \quad \text{if } z_k > 0 \\ \partial f_k(z_{k,t}) / \partial z_{k,t} &= -1 + \gamma_k \quad \text{if } z_k < 0 \end{aligned} \quad (5)$$

Asymmetry is said to be present if γ_k is negative and significant in equation (4) above. The term $|z_{k,t}| - E(|z_{k,t}|)$ measures the magnitude of the impact. If $\alpha_{i,k}$ in equation (3) is assumed to be positive, the effect of $z_{k,t}$ on σ^2 will be negative if the magnitude of $z_{k,t}$ is smaller than its expected value $E(|z_{k,t}|)$. The magnitude effect of $z_{k,t}$ is

reinforced or offset depending on the sign of the innovation, whereas the relative importance of the leverage effect is measured by $|-I+\gamma_k|/(I+\gamma_k)$ ratio.

Assuming there is normal conditional joint distribution of the returns of all the stocks markets; the multivariate EGARCH model estimated using a maximizing log likelihood function is expressed as:

$$L(\varphi) = -0.5(NT) \ln(2\pi) - 0.5 \sum_{t=1}^T \left(\ln |H_t| + \varepsilon_t' H_t^{-1} \varepsilon_t \right) \quad (6)$$

where φ is the parameter vector to be estimated; N is number of the equations; T is the number of observations in the sample; H_t is N x N time-varying conditional variance covariance matrix and ε_t is the vector of innovations at time t.

4. Data and Preliminary Analysis

The study uses daily closing indices of Jakarta Composite Index (JCI) of Indonesia; Shanghai Stock Exchange (SSE) of China, Nikkei 225 (N225) of Japan, and Standard and Poor's 500 Stock Index (S&P500) of the U.S from January 4, 2002 to December 30, 2011. This period is selected to account for market tranquility after the Asian Crisis in 1997 which devastated the Indonesian's economy and September 11, 2001 attack of the U.S which had adverse effect on world stock markets. The daily closing indices of the stock market index have been chosen due to the nature of the stock transaction on a daily basis. The day to day transaction is able to capture the movement of the stock index in comparison with the monthly data. It is not an absolute judgment that the daily data is the best but it is relatively better to some extent. The daily data represents the movement of the daily stock index fluctuations which could not been captured clearly by the monthly index. The stock returns in this analysis are expressed as first differences of natural logarithm index of prices:

$$R_t = \ln P_t - \ln P_{t-1} \quad (7)$$

where R_t represents stock return at time t , $\ln$ stands for natural logarithm, P_t represents the closing stock market index at time t and P_{t-1} is stock market index at time $t-1$.

The data series is drawn from the Bloomberg Information Network. In order to examine the impact of 2008 global financial crisis, our full sample is divided into two sub-samples of pre-crisis period covering January 4, 2002 to August 30, 2008 and post-crisis period covering September 16, 2008 to December 30, 2011. The periods were chosen with consideration of the evidence that September 15, 2008 was known as the day when Lehman Brothers declared their bankruptcy.

Figure 1 shows the time plot of the price series of the four stock markets for the whole sample period. All the stock markets exhibit a decline in the price series around 2007. The series also depict similar movement and are trending upwards from around 2009. Figure 2 presents the returns of the share price indices during the sample period, the indices show that large (small) volatilities are followed by large (small) volatilities indicating volatility clustering characteristics in the four markets.

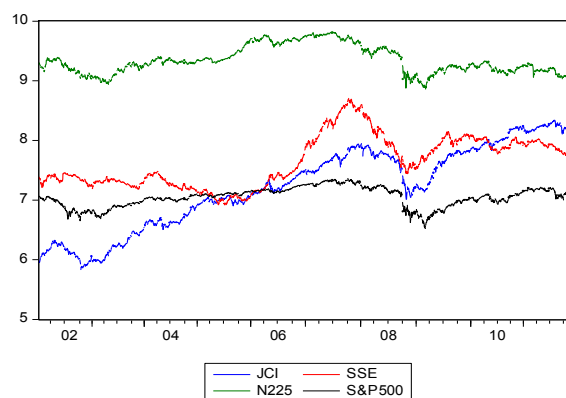


Figure 1. Stock price indices from 2002 to 2011

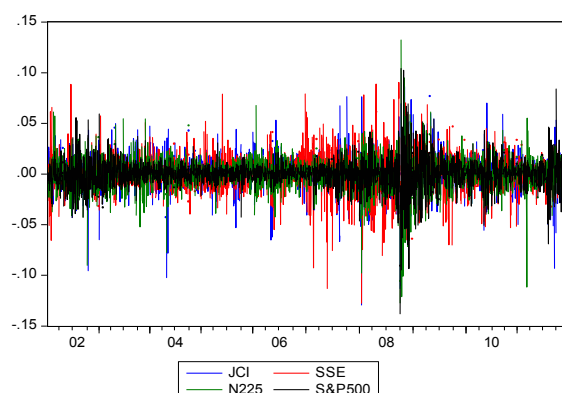


Figure 2. Stock market returns of the share price indices

Table 1 presents the descriptive statistics of the returns for our data series before and after the 2008 global financial crisis. The table shows that all the mean returns for the countries under study are positive before the crisis with the Indonesian stock market earning higher returns. In the post-crisis period, Indonesia has positive mean returns where China, Japan and the U.S have negative stock returns. The standard deviations in the pre-crisis period ranges from 1.1 percent in U.S to 1.8 percent in China indicating that Chinese market was most volatile during this period. The post crisis standard deviations range from 1.88 percent in Indonesia to 2.1 percent in Japan indicating that Indonesia was least volatile as compared to China, Japan and U.S. This analysis suggests that emerging countries offer higher returns than developed markets; however, the markets are characterized by higher volatilities.

The values of skewness show that the return series are skewed negatively demonstrating that asymmetry prevails in all the stock returns. The kurtosis values of stock returns for both periods are greater than 3 indicating thicker tails and a higher peak than a normal distribution. The Jarque-Bera (JB) statistics are highly significant at 1 percent level indicating rejection of normal distribution for all returns. The Ljung-Box (LB) Q test statistics with 36 lags rejects the null hypothesis of no serial correlation at 1 percent significance level. Similarly, the Ljung-Box Q^2 (36) confirms the presence of serial correlation of squared returns as the null hypothesis of no serial correlation is rejected at 1 percent significance level. The four return series are heteroscedastic as evidenced by the significance of ARCH effects with 12 lags as shown in Table 1 indicating that the variance of residuals are not constant, but time varying, and therefore, we cannot assume that $u \sim N(0, \sigma^2)$ as in the ARMA model. This, then, favours the GARCH model which deals with ARCH/GARCH features. Table 2 reports the correlation matrix results of the four countries under investigation. The results show that the returns in both periods are positively correlated with each other. The results also indicate that the degree of correlation became stronger in the period after the crisis as compared to period before the crisis. The matrix further highlights that in both periods there exist a highest correlation between the Indonesian and the Japanese stock markets.

Table 1. Summary of statistics for daily market returns

	<i>Pre-Crisis Period</i>				<i>Post-Crisis Period</i>			
	JCI	SSE	N225	S&P500	JCI	SSE	N225	S&P500
Mean	0.0010	0.0006	0.0020	0.0001	0.0006	-0.0060	-0.0007	-0.0001
Std. Dev.	0.016	0.018	0.015	0.011	0.018	0.019	0.021	0.020
Skewness	-0.949	-0.302	-0.437	-0.127	-0.419	-0.154	-0.685	-0.499
Kurtosis	10.76	8.544	6.8212	6.013	9.139	5.433	10.935	9.745
J-B	3539.56	1725.17	852.21	506.96	1204.48	188.68	2034.63	1458.86
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LB(36)	38.013	52.269**	50.328*	57.628**	41.533	33.218	63.368**	34.95
LB ² (36)	163.83*	226.37**	187.64**	1279.8**	378.85**	291.91**	1167.7**	1008.6**
ARCH(12)	11.350**	6.252**	6.815**	20.915**	13.212**	4.964**	45.064**	22.197**

Note: ** and * indicate significance at 10% and 5% levels.

Table 2. Correlation matrix for the stock market returns

	JCI	SSE	N225	S&P500
<i>Pre-Crisis Period</i>				
JCI	1.00000			
SSE	0.18371	1.00000		
N225	0.42149	0.18486	1.00000	
S&P500	0.09259	0.02103	0.17796	1.00000
<i>Post Crisis Period</i>				
JCI	1.00000			
SSE	0.35050	1.00000		
N225	0.57388	0.35695	1.00000	
S&P500	0.30375	0.12113	0.29082	1.00000

5. Empirical Results

Table 3 presents results of the exponential GARCH (EGARCH) model for the mean and volatility spillover equations for the pre-crisis and post-crisis period based on the maximum likelihood estimation. The mean spillover equation results for Indonesia show that during the pre-crisis, the current stock returns are predicted by the past stock returns as the coefficient β_{11} is significant at 1 percent level. The results also indicate that during the period, there was cross-market return spillover influence from China and Japan stock markets to Indonesian stock market as evidenced by the significance of β_{12} and β_{13} coefficients at 1 percent level. However, we found that the U.S stock market has no influence on the Indonesian stock market return as the coefficient β_{14} is not significant. The post crisis period results show that apart from the own past innovations effect, the Indonesian stock market returns are also affected by the return spillovers from the Chinese, Japanese and the U.S stock markets.

The mean spillover equation results for the Chinese stock market show that the current mean returns are not predicted by own market return either in pre-crisis or post-crisis period as the coefficient β_{22} is insignificant at 1 percent level in both periods. Our results corroborate findings of Chang (2010), Kang and Yoon (2011) and Joshi (2011) on the influence of the Chinese stock market in Asian countries. The results also indicate that Chinese stock returns are not influenced by the U.S stock market returns in both pre and post-crisis periods; however, there are cross-market return spillover effects from Indonesia and Japan to the Chinese stock market during these periods. The statistical significance of β_{12} and β_{21} at 1 percent level suggest that the Indonesian and Chinese stock markets have bidirectional return spillover effects between them before and after the crisis. Further, the results indicate that the Japanese stock market is more influential in the regional Asian countries after the 1997 Asian financial crisis. Thus, the improvement in the Japanese return earnings led to upward adjustments of earnings in Indonesia and China.

The results of volatility spillover equations indicate that the current stock market volatility in the Japanese and the U.S markets have effects on the future volatility of the Indonesian stock market before the 2008 financial crisis. In the period after crisis, we found evidence of significant transmission of volatility from the Chinese and the Japanese stock markets to Indonesian stock market; though, there are no cross-market volatility spillovers from the U.S to the Indonesian market as the coefficient α_{14} is found to be statistically insignificant at either 1 percent or 5 percent level. On the Chinese market, we found cross market volatility spillover effects from the Japanese market in the pre-crisis period, but we do not find the volatility spillover effects from Indonesia and the U.S stock market. In the post-crisis, the coefficients of the past innovations for Indonesia, Japan and the U.S stock markets are insignificant indicating that the past stock markets volatilities shocks do not have effects on the current volatilities of the Chinese stock market. This suggests that the Chinese stock market has a weak linkage with international stock markets despite the rapid economic growth.

The insignificance of α_{12} and significance α_{21} at 1 percent level after the crisis suggests that the Chinese stock market has unidirectional volatility spillover effects on the Indonesian stock market after the 2008 global financial crisis. This indicates that news about shocks in the Chinese stock market affects the volatility of the Indonesian stock market. On the contrary, the U.S stock market has less influence on the Indonesian market during the post-crisis as shown by the insignificance of α_{14} at 1 percent level. The results indicate that the Indonesian stock market is integrating more with the Chinese and the Japanese stock markets than the U.S stock market in the aftermath of the 2008 global financial crisis. The findings are consistent with previous studies of Kang and Yoon (2011) and Kang, Kim and Yoon (2011) who found an increase of the Chinese stock market influence on the Asian regional economies after the 2008 global financial crisis.

The values of the parameters (δ_i) for the persistence of volatility for both Indonesia and China are highly significant in both periods indicating that volatility persistence takes a long time to die out. We calculated the half-life of a shock by using $\ln(0.5)/\ln(\delta_i)$ formula. The calculated half-life values for Indonesia are 1.52 days and 12.39 days in pre and post-crisis period respectively, suggesting that the market adjustment from the cross market shocks was relatively efficient before than after the crisis. The stock market efficiency in the pre-crisis period may be attributed to the tranquility of major stock markets across the globe during this period. On the other hand, the Chinese market has half-life values of 49.88 days before the financial crisis and 41.92 days after the crisis, indicating that volatility was taking long time to decay during the period before the crisis. The Chinese efficiency estimates are consistent with the fact that Chinese stock market remain less integrated from the international markets, hence, the previous day own market information is a good predictor of next day's market transactions. The findings are consistent with Johansson and Ljungwall (2009) and Wang (2010) who found that the Chinese stock markets have a weaker interaction with the international markets before the 2008 global financial crisis. However, the decrease in the number of days after the global financial crisis suggests the intensification of integration of the Chinese market with other markets.

The asymmetry parameters (γ_i) are negative and only significant for Indonesia for both pre and post-crisis periods. The negative sign indicates that bad news have more pronounced effect than good news. We compute asymmetry ratio for both countries using $|-1+\gamma_i|/|1+\gamma_i|$ formula. The results demonstrate that the bad news impact is 1.64 times larger than the good news impact in Indonesia during the period before the crisis and 1.2 times after the crisis. For China, the negative news impact is 1.01 times as big as the positive news impact during the pre-crisis period and 1.04 times in the post-crisis period. The findings are consistent with the finance theory as the investors' reaction to bad news tends to be more pronounced than the good news.

The p-value of Q-statistics up to 36 lags are all insignificant indicating that the conditional mean equations are correctly specified and provide an adequate description of the data series as there is no autocorrelation problems.

Table 3. Return and volatility spillovers models

	JCI ($i=1$)	SSE ($i=2$)	JCI ($i=1$)	SSE ($i=2$)
	<i>Pre-Crisis Period</i>		<i>Post-Crisis Period</i>	
<i>Price spillover parameters</i>				
β_{i0}	0.001[0.0004]**	0.0001[0.0004]	0.001[0.0004]**	-0.001[0.001]
β_{i1}	0.111[0.032]**	0.088 [0.027]**	-0.007[0.008]**	0.296[0.041]**
β_{i2}	0.056[0.015]**	-0.026 [0.028]	0.179[0.025]**	0.020[0.040]
β_{i3}	0.372[0.019]**	0.093 [0.028]**	0.397[0.022]**	0.167[0.039]**
β_{i4}	0.012 [0.024]	0.015 [0.034]	0.139[0.022]**	0.008[0.029]
<i>Volatility spillover parameters</i>				
α_{i0}	-3.422 [0.408]**	-0.234[0.046]**	0.677[0.119]**	-0.209[0.057]**
α_{i1}	0.426 [0.052]**	1.369[0.860]	0.261[0.042]**	-2.134[1.283]
α_{i2}	0.891 [1.149]	0.161[0.019]**	-5.352[1.484]**	0.101[0.022]**
α_{i3}	-7.761 [1.880]**	-4.231[0.967]**	-4.977[1.418]**	2.362[1.662]
α_{i4}	6.761 [1.843]**	2.483[1.515]	0.894[1.692]	-1.270[1.644]
<i>Other parameters</i>				
δ_i	0.6432 [0.046]**	0.9862[0.005]**	0.9456[0.012]**	0.9836[0.005]**
Half-life	1.52	49.88	12.39	41.92
γ_i	-0.2437 [0.032]**	-0.002[0.009]	-0.0844[0.023]**	-0.0201[0.013]
Relative asymmetry	1.64	1.01	1.18	1.04
<i>Diagnostic tests</i>				
Q (36) statistic	30.089 (0.704)	42.777 (0.172)	42.805 (0.143)	28.893 (0.716)
Q ² (36) statistic	24.432 (0.910)	20.805 (0.973)	34.526 (0.443)	31.787 (0.577)

Note: (i) $i=1, 2, 3$ and 4 which stands for JCI, SSE, N225 and S&P500 (ii) Values in [] are standard errors and (iii) p-Values are reported in () (iv) ** and * indicate significance at 1% and 5% levels respectively.

6. Conclusion

The study examines the integration of the Indonesian and Chinese stock markets. In particular, we investigate return and volatility spillover effects between the two stock markets before and after the 2008 global financial crisis using the exponential GARCH (EGARCH) model. The analysis also takes into account return and

volatility spillovers effects from the Japanese and the U.S stock markets. The inclusion of the Japanese and the U.S stock markets was to determine their level of influence in the Indonesian stock market in the aftermath of global financial crisis.

The empirical results have shown that Indonesia and China have bidirectional return spillover effects before and after the crisis. We also found strong cross-market return spillover effects from Japan to Indonesia and China in both periods. However, our results have revealed that the Chinese stock market returns are not influenced by the U.S stock market. The volatility spillover results provide no evidence of volatility spillover effect from China to Indonesia during the pre-crisis period, but such volatility spillover evidence is found after the crisis. The results also show less dominance of the U.S stock market in influencing Indonesian stock market in the post-crisis period than before the crisis. On the part of China, our results have shown that the Chinese stock market is not influenced by return and volatility spillovers from Indonesia, Japan and the U.S in the post-crisis period suggesting less influence of international stock markets on the Chinese stock market. Our volatility transmission results imply that besides Japan, China is becoming one important source of market information for Indonesia after the global crisis. On the contrary, we found less dominance of the U.S stock market on Indonesian and Chinese stock markets after the global financial crisis than before it.

Our results have clearly shown that the Chinese stock market has increased its linkages with the Indonesia market after the global financial crisis indicating the important role the global financial crisis has played in integrating the two economies. This increased integration of the Chinese and Indonesian stock markets implies that portfolio diversification using these two markets has limited gains for portfolio investors as the Indonesian market is no longer insulated from Chinese stock market shocks. Thus, portfolio investment decisions in the Indonesian stock market, and possibly other regional Asian stock markets, should be taking into consideration the volatilities signals from Chinese stock market. The results also provide important information for development of hedging strategies to the portfolio investors in the two countries as well as policymakers when formulating policies for safeguarding their financial markets.

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