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VOLATILITY AND CO-MOVEMENT: AN ANALYSIS OF STOCK MARKETS BEHAVIOUR OF SELECTED EMERGING AND DEVELOPED COUNTRIES.

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ABSTRACT

In this paper, we analyse historical stock market volatility and co-movement behaviour of three emerging markets and three developed economies from January 2001 to December 2012. We find evidence that the sample of emerging economies exhibits higher stock market volatility during the study period and these volatilities increases during the global financial crisis (GFC). There is also evidence that our sample of the emerging economies exhibit higher level of stock market co-movement behaviour during the study period, for example Indonesia and Malaysia exhibit higher R-square values during 2007-2012. However, we do not find any evidence of a statistically significant correlation coefficient between the volatility measures and the co-movement measures for our sample developed and emerging countries, except for Indonesia. Therefore, it is concluded that both these market models capture different aspects of stock market behaviour.

JEL Classification: G14, G15
Keywords: Historical volatility, Comovement, Emerging markets, GFC
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INTRODUCTION

Financial markets around the world suffered significantly during the Global Financial Crisis (GFC). Although the GFC is over in late 2010, the after-effects of the GFC are still visible and most developed and emerging economies are still suffering from the post GFC crisis. In the midst of the current credit crunch in financial markets, we have also seen the sovereign debt crisis in Europe and a number of European economies go through enormous structural change (Constancio 2011, Alter and Schüler 2011, Zhang et al. 2011). The World Bank also expressed its deep concern about this crisis and warned that a second crisis could be coming which might be more devastating in nature. Therefore, how the developed and emerging stock markets reacted to this crisis is a matter of considerable interest.

The focus of our study is to analyse the behaviour of stock markets during the GFC in terms of historical stock market volatility and co-movement in stock returns. We also investigate whether the stock market volatilities and co-movement behaviours are correlated and affected by the world stock markets. We studied three emerging Asian markets (total 2,018 listed companies) based on their recent market performance, growth rate and market capitalisation and, three developed markets (total 5,934 listed companies) based on their geographical location, size of the equity market and the availability of data from DataStream database. The study uses two different statistical models in order to analyse the stock market volatility and co-movement behaviour. The **first** model used in this study is the standard historical volatility model followed by Jones et al. (1998), Andersen and Bollerslev (1997) and Andersen and Bollerslev (1998); the **second** model is the stock market co-movement measures or the R-square metrics suggested by Alves et al. (2010), Khandaker and Heaney (2009) and Morck et al. (2000).

Our results find evidence that stock markets around the world were volatile during the GFC. There is also evidence that some of our sample stock markets exhibit higher R-square values during the study period suggesting higher stock return co-movement behaviour. The stock market time-series variables are stationary over the study period for most of our sample countries and there is evidence of a positive correlation coefficient between the samples of developed countries' stock markets. However, our research could not find evidence of a statistically significant correlation coefficient between the stock market's volatility and co-movement measures for the sample stock exchanges, except for Indonesia.

This article is divided as follows: The second section reviews some major literature on stock market volatility and co-movement behaviour. Section three and four discuss the data and research methodology. The

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Fifth section focuses on stock market analysis and results obtained from the statistical analysis. In the final section, concluding remarks has been presented with a brief discussion.

LITERATURE REVIEW

This section reviews the existing literature on stock market volatility and co-movement behaviour into two subsections. The first sub-section reviews the major literature on the stock market volatility and the second sub-section considers the literature on stock market co-movement behaviour.

Market Volatility Analysis

The expected future volatility of financial market returns is the main element in assessing asset or portfolio risk and plays a key role in derivatives pricing models. It is difficult to extract a coherent set of prescriptions concerning the most appropriate empirical procedure for volatility forecasting from the existing literature.

Figlewski (1997) finds evidence that the simple historical volatility model generally predict future volatility better than the complicated models, such as the popular GARCH (1, 1) model. He argues that, there is little gain using higher frequency return data when forecasting volatility for longer horizons which is consistent with Canina and Figlewski (1993).

However, researchers argue that the daily fluctuations in stock returns are vastly affected by macroeconomic announcements. For example, Bomfim (2003) found evidence that the US stock returns respond reliably to macroeconomic announcements and government monetary policy. He argues that the decisions regarding the target federal funds rate can influence market volatility in the United States.

There is also evidence in the academic literature that pre-announcements affect the stock market behaviour. For example, Jones et al. (1998), Li and Engle (1998), French et al. (1989) and Dasilas and Leventis (2011) argue that the treasury securities market and, agricultural futures market greatly affects by the pre-announcement information. They find that market participants are unwilling to trade securities just ahead of the release of a significant piece of information in order to secure their profit. In addition, Jones et al. (1998) state the need of developing a market microstructure model that explicitly allows volume, volatility, and information acquisition with pre-determined news arrival time that is very informative for the marginal investor. It is also found that policy surprises induce greater volatility that is consistent with other financial models (Harris and Raviv 1993, Foster and Viswanathan 1993, Black 1976, Nelson 1991, Berry and Howe 1994 and Mitchell and Mulherin 1994).

Dooley and Hutchinson (2009) show the changing nature of correlations between developed and emerging markets during their study period. They find evidence that emerging markets volatility change dramatically to the liberalisation economic policy, a result which is consistent with Jayasuriya (2005), Cunado et al. (2006) and Fidrmuc and Korhonen (2010). There is evidence that the onset of the global financial crisis, there have been much stronger links in GDP growth between the OECD countries and China and India. This changing nature of the business cycle relationship is indicative of the possibility of correlations between developed and emerging markets during the crisis (Fidrmuc and Korhonen 2010).

In addition, Narayan and Islam (2012) examine the stock market behaviour of 22 benchmark indices of developed and emerging countries during the GFC period. They find evidence that most countries behaved similarly during the GFC but experience a fall in the persistence of their volatility. In a similar study, Mun and Brooks (2012) investigate 17 financial markets of the world and argue that volatility plays an important role explaining the changing nature of stock market correlations during the GFC. The majority of the published literature suggests that stock market volatility increased during the global financial crisis and individual stock became more volatile during that period. There is also evidence that individual stock becomes more synchronous and market wide stock price swing increases during the financial crisis, which is more apparent in emerging economics (Hwang et al. 2013, John et al. 2010, Morck et al. 2000, Khandaker 2012).

However, there are few studies focus on stock market volatility and comovement behaviour during the GFC. Therefore, this paper focuses on the stock market volatility and co-movement behaviour of six selected emerging and developed countries during and post GFC.

Market Co-movement Analysis

Co-movement refers to the tendency of stock market prices to move in the same direction in a given week. It is argued that stock returns of the emerging countries move more closely together than that of the developed economies due to several factors; such as poor corporate governance mechanisms, poor investor protection rights, corruptions and low GDP per capita. Morck et al. (2000), Khandaker and Heaney (2008) and Khandaker (2011a) argue that stock returns move closely together in poor GDP (per capita) economies than that of the high GDP per-capita economies. The authors use the R^2 model to measure the stock return comovement behaviour in their sample countries. They suggest emerging countries tend to have synchronous stock return behaviour and;

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find that developed economies stock return changes are associated with firm-specific information with stronger investor property rights.

Campbell et al. (2001) contend that large investors are exposed to greater risk as stock return co-movement increases. They also state that larger stocks can manipulate the financial market and countries with fewer stocks listed on a stock exchange are more volatile in nature due to the size of the market. They argue that stock market co-movement behaviour is an important phenomenon for developed economies as well as for the emerging market economies.

Durnev et al. (2003) find that higher firm-specific stock return variation is associated with higher information content about future earnings. They find evidence that the information regarding future earning expectation is not always publicly traded and private information can play a vital role in emerging economies. They also suggest that stock return synchronicity is higher in more corrupted economies.

Piotroski and Roulstone (2004) state that stock return co-movement increase with analyst coverage and poor information disclosure policy. They argue that greater industry coverage by stock brokers and industry analysts and higher information (publicly traded information) disclosure requirements confront stock price volatility and comovement behaviour of emerging stock markets.

It should also be noted that corporate transparency and stock return co-movement are strongly correlated. Dasgupta et al. (2006) find that greater transparency indicates early and timely disclosure of firm specific information. So, stock return co-movement decreases as corporate disclosure and greater transparency increases. Chan and Hameed (2006) use the trading volume of stocks as a descriptive variable explaining stock return co-movement for individual firms. They find that the size of a firm has strong impact on market wide stock price swings. When the number of stocks within a stock market is relatively small a few large companies tend to dominate overall market behaviour.

In contrast, Alves et al. (2010) find that the R square measure is based on the implicit assumptions, such as the stability of a country, stronger corporate governance mechanisms and superior investor protection rights for their analysis, which cannot always be accessible to investors. They find conflicting results in their analysis for their sample countries using the R-square matrix and argue that R square measure provide valuable stock return information but in a limited extent. Xing and Anderson (2011) also find a similar result using the R square measure when using a different dataset for their sample countries.

DATA

This study employs three emerging and three developed stock market data from January 2001 till December 2012. The emerging markets are taken from the emerging Asian markets based on their recent market performance, growth rate, market capitalisation and availability of the DataStream database. The selection criteria for the developed economies include geographical location, size of the equity market and the availability of the stock return data. The following table illustrates the number of listed firms included in our analysis. The largest sample size is the NYSE, USA with 3,596 listed firms and smallest sample include Indonesia with 111 listed firms in its stock exchange.

TABLE 1: NUMBER OF LISTED FIRMS FROM THE SAMPLE STOCK MARKETS

Country	No of listed companies in DataStream
Australia	776
China	1,677
Indonesia	111
Malaysia	230
UK	1,562
USA	3,596
Total number of observed firms	7,952

RESEARCH METHODOLOGY

Our analysis of stock market behaviour and co-movement analysis includes the standard historical volatility model and R-square estimates. Econometric modelling of volatility clustering is a very active area of research in finance literature in recent years. Several studies have found that the simple GARCH(1,1) model provides a

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good first hand approximation of the market volatility (Baillie and Bollerslev, 1989; Bollerslev 1987 and Engle and Bollerslev, 1986).

In addition, Andersen and Bollerslev (1998) suggest that ARCH and stochastic volatility models provide a good volatility forecasts for market wide volatility. It is to note that we use the empirical standard volatility model to determine the market wide historical volatility followed by Jones et al. (1998), Andersen and Bollerslev (1997) and Andersen and Bollerslev (1998). As the main motivation of this research is to determine the market wide historical volatility rather than a better fitted volatility model for future forecasting, therefore the historical volatility model is important and useful for the analysis.

The market model of R-square estimates (co-movement model) use all available firms in a stock market. This approach captures levels of firm-specific information reflected in stock return as well as stock return comovement behaviour at the individual firm level, which is then averaged to give a country-level equal weight measure. This measures the correlation between a firm's stock return data and market return data for a given period. It is generally considered to provide an accurate picture of stock market co-movement behaviour. To calculate the R-square value or the co-movement behaviour of a selected stock index, we calculate individual firm annual co-movement using the equation (v) described in section 4.2. The annual co-movement of a stock market is calculated based on the average annual co-movement of all listed firms of that stock market. The study also uses the standard historical market volatility model for the volatility analysis. The following sub-sections illustrate two different market models used in this research

The Standard Historical Volatility Model

Please consider a set of historical prices for some underlying asset that follow the processes in equation (i):

$$\{S_0, S_1, ..., S_t\}$$

The analysis began by the log price relatives, i.e. the percentage price changes expresses as continuously compounded rates.

$$R_t = \ln\left(S_t / S_{t-1}\right)$$

The estimate of the (constant) mean μ of the R_t is the simple average:

$$\overline{R} = \frac{\sum R_t}{T} \qquad \text{(i)}$$

The variance of the R_t is given by:

$$v^2 = \frac{\sum \left(R_t - \overline{R} \right)^2}{\left(T - 1 \right)} \qquad \text{(ii)}$$

Annualising the variance by multiplying by N, the number of price observations in a year and taking the square root of the volatility:

$$\sigma = \sqrt{N v^2} \qquad \text{(iii)}$$

The above procedure gives the best estimates of the volatility that can be obtained from the available price data. This number then becomes the forecast for volatility going forward, over a time horizon of any length.

The Standard Co-movement Model

Our measures of stock co-movement follow Morck et al. (2000), Piotroski and Roulstone (2004) and Khandaker (2011a). This research estimates the following linear regression

$$R_{i,t} = \beta_{i0} + \beta_{i1} R_{m,t} + \varepsilon_{i,t} \qquad \text{(iv)}$$

Where $R_{i,t}$ is the firm i return for period t, $R_{m,it}$ is the market return of firm i for t period, $\varepsilon_{i,t}$ is the error term and β_i are estimated parameters. The R^2 measure is the percentage of variation in weekly return of stock i in country j explained by variations in country j 's market return; or it can be explained as:

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$$R_{it}^2 = \left(\frac{Cov(R_i\ R_m)}{\sigma_i\ \sigma_m} \right)^2 \qquad \text{(v)}$$

Where Cov($R_i R_m$) is the covariance between the stock returns and market returns and σ_i is the standard deviation of the asset. A high R-square indicates a high degree of stock return co-movement and a low R-square indicates a low degree of stock return co-movement for a given stock for a particular period of time.

It should be noted that, Roll (1988) and Piotroski and Roulstone (2004) include industry returns to explain stock returns in their analysis of U.S. stocks. However, including industry returns as an additional factor is problematic in emerging markets because most of the emerging economies dominated by a few large industries. Therefore, it is quite difficult to disentangle the industry effect from the market effect on emerging markets.

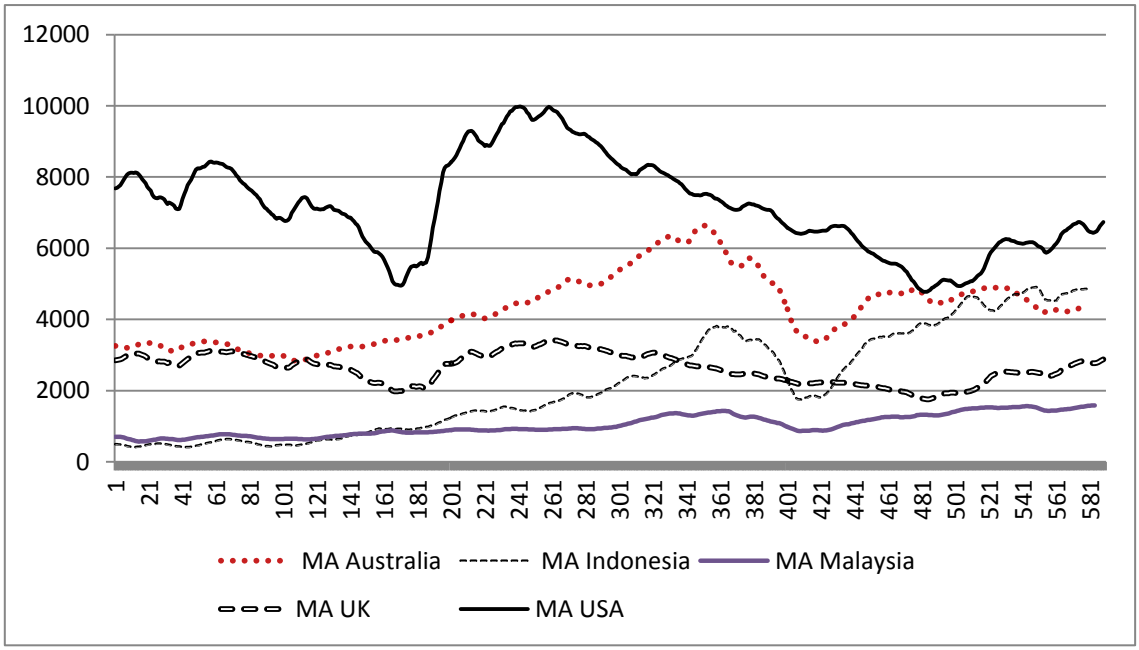
DATA ANALYSIS

Analysis of the Stock Market Trends

This section analyses stock market trends of the sample stock markets from January 2001 till December 2012. Figure 1 illustrates 10 weeks moving average models for the sample stock markets. It is found that Australia, Indonesia and the USA suffer significantly during GFC which started in week 312 till week 461.

FIGURE 1: STOCK MARKET TRENDS OF THE SELECTED STOCK MARKETS DURING THE OBSERVATION PERIOD.

The figure exhibits 10 weeks moving average model for five sample stock markets. The horizontal axis exhibits the number of weeks and vertical axis exhibits the moving average stock return for the five sample stock markets. It can be seen from figure-1 that Australia, Indonesia and the USA suffer significantly during the global financial crisis (2007-2009).



During this time, all major stock exchanges around the world were volatile and lost market capitalization significantly due to the sub-prime mortgage crisis and poor investor confidence (Constancio 2011, Zhang et al. 2011). The following table illustrates the market capitalization of the sample stock markets in the year 2012.

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TABLE 2: MARKET CAPITALISATION OF THE SELECTED STOCK MARKETS (US$)

Country	Market capitalisation	Date and year
Australia (ASX)	US$ 1.4 trillion	December 2012
China (SSE)	US$ 2.3 trillion	December 2012
Indonesia (IDX)	US$ 426.78 billion	December 2012
Malaysia (BURSA)	US$ 429 billion	December 2011
UK (FTSE)	US$ 3.2 trillion	December 2012
USA (NYSE)	US$ 14.242 trillion	December 2012

As stated earlier, the study includes 7,952 firm level data for the stock return co-movement analysis. The time series data includes 4.548 million weekly observations (firm level) for this research. The following table (table 3) illustrates the descriptive statistics of the stock market indices, of the sample six stock exchanges.

TABLE 3: DESCRIPTIVE STATISTICS OF THE OBSERVED STOCK MARKET DATA

	Australia	China	Indonesia	Malaysia	UK	USA
Mean	4272.85	41.01	2203.63	1034.31	2639.17	7183.32
Median	4266.10	36.93	1846.71	926.56	2680.10	7084.47
Maximum	6760.10	103.42	5202.72	1602.42	3478.99	10301.49
Minimum	2715.00	13.26	372.07	557.43	1685.04	4284.49
Std. Dev.	983.238	21.113	1487.04	303.75	426.576	1345.500
Skewness	0.503	0.360	0.406	0.326	-0.201	0.204
Kurtosis	2.445	1.919	1.792	1.786	2.082	2.364
Probability	0.000	0.000	0.000	0.000	0.000	0.001
Observations	590	591	591	594	600	599

Table 2 illustrates that the US and the Indonesian stock exchange exhibit higher levels of stock return volatility during this period with higher standard deviation, which is 1354.50 for the USA and 1487.04 in Indonesia. During this time NYSE all composite indexes rose to 10,301.49 points (2/12/2007) just before the GFC and it sunk to 4284.49 points in 2nd March, 2009. The same trend is also visible for Indonesian and Australian stock market during this period. The ASX stock rose to 6760.10 points during 2007 but sunk to 3300.01 points in 19th January, 2009. During this time Australian Stock Exchange (ASX) lost about AU$ 500 billion (US $450 billion) market capitalisation due to the GFC. However. SSE China shows a very low level of standard deviation during this observation period, compared to the other economies which is unexpected. SSE also exhibits lower mean and median values during this time.

Table 3 illustrates correlation coefficients for the sample countries' stock return data over the period (January 2001 to December 2012). The study finds evidence of considerable variation in correlation coefficient sign and significance at the 1 percent significance level across the countries, except for the UK with the Australia (significant at 5 per cent level).

TABLE 4: CORRELATION COEFFICIENT OF THE SAMPLE STOCK EXCHANGE (2001-2012)

*The values, including "**" indicate significance at the 1 per cent level and values including '*' indicate significance at the 5 per cent level.*

	Australia	China	Indonesia	Malaysia	UK
China	0.801**				
Indonesia	0.642**	0.910**			
Malaysia	0.715**	0.913**	0.973**		
UK	0.033*	-0.413**	-0.415**	-0.351**	
USA	0.118**	-0.369**	-0.434**	-0.382**	0.931**

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Table 5 exhibits, sample countries stock market comovement behaviour using R-square matrix. During this time all sample developing economies exhibit higher level of stock return co-movement behaviour. Indonesia, for example, exhibits the R-square value of 0.203 and Malaysia exhibits the R-square value of 0.167. The average R-square values for the developing countries is 0.1483, whereas for the developed economies the R-square value is only 0.0313. This finding suggests that stock market comovement behaviour is higher in emerging economies than that of the developed economies for our sample period, which is consistent with the work of Morck et al. (2000) and Khandaker (2011b).

TABLE 5 : STOCK MARKET CO-MOVEMENT OF THE SELECTED COUNTRIES

Year	Australia	China	Indonesia	Malaysia	UK	USA
2001	0.047	0.053	0.190	0.224	0.031	0.023
2002	0.026	0.039	0.231	0.166	0.025	0.031
2003	0.031	0.024	0.137	0.161	0.030	0.034
2004	0.029	0.064	0.221	0.170	0.038	0.032
2005	0.027	0.021	0.251	0.128	0.034	0.021
2006	0.029	0.031	0.183	0.134	0.025	0.022
2007	0.036	0.029	0.166	0.333	0.030	0.022
2008	0.026	0.101	0.288	0.287	0.027	0.024
2009	0.023	0.171	0.164	0.051	0.026	0.048
2010	0.032	0.165	0.156	0.025	0.023	0.020
2011	0.021	0.075	0.306	0.234	0.022	0.018
2012	0.069	0.129	0.143	0.089	0.059	0.065
Average	**0.033**	**0.075**	**0.203**	**0.167**	**0.031**	**0.030**

In addition, to check the possibility of changes in the level of stock market co-movement behaviour during the observation period from 2001 to 2012, the study divides the time series into four sub-periods, 2001-2003 (9/11 and post crisis), 2004-2006 (pre-GFC crisis), 2007-09 (during GFC) and 2010-2012 (post GFC and European debt crisis). Table A1 to A4 (see appendix) illustrate the comovement behaviour of the selected stock exchanges during these four sub-periods. We find evidence that during the GFC all sample emerging economies exhibit higher levels of stock market comovement behaviour. For example, the average emerging economies exhibit the R-square values of 0.176 in 2007, 0.225 in 2008 and 0.205 in 2011, whereas developed economies exhibit lower level of R-square value during this time.

To understand how the stock market comovement behaviour influences the overall stock market trends in our sample countries, Figure 2 illustrates the variation in stock return comovement behaviour evident from Australia, China, Malaysia and the USA. During 2007-2012 China and Malaysia exhibit higher R-square values compared to other developed economies. China exhibits R-square values of 0.111 (2007-2012) and Malaysia exhibits R-square values of 0.169 (2007-2012) which are significantly higher than other sample economics.

FIGURE 2: STOCK MARKET COMOVEMENT BEHAVIOUR DURING THE STUDY PERIOD

Figure 2 exhibits co-movement behaviours of four sample stock markets using the R-squared measure. The stock markets included in this observation are Australia, China, Malaysia and the USA. The horizontal axis exhibits, observation years and vertical axis exhibit the R-squared values of the sample stock markets. The figure provides evidence that China and Malaysia exhibit higher stock market co-movement behaviour during 2007-2012.

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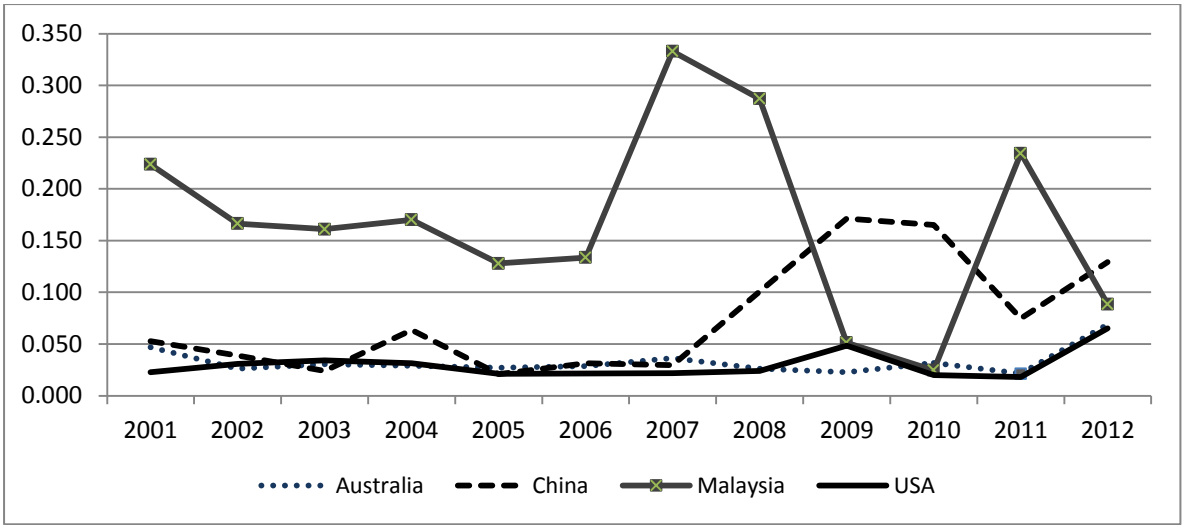

Further, to measure the stock market volatility of the selected markets, we use the simple historical volatility model following Jones et al. (1998), Andersen and Bollerslev (1997) and Andersen and Bollerslev (1998). Table 5 illustrates the standard volatility measure of the sample stock markets from 2001 to 2012. It is found that Indonesia (0.6561) and China (0.6592) exhibit higher levels of stock market volatility during the full period analysis. On the other hand, Australia exhibits a low level of market volatility during the sample period.

Table A5 to A8 (see appendix) illustrate stock market historical volatility of the selected countries for four sub-periods. There is evidence that China and Indonesia illustrate higher stock market volatility during all sub periods. The average stock market volatility in China is 0.6592 and Indonesia is 0.6561, which is considerably higher than the developed economies. Malaysia exhibits a considerably lower level of stock market volatility during the sample period than other emerging economies. The result is consistent with previous studies which suggest high GDP per capita economies tend to have well regulated capital markets and low level of stock market volatility (Campbell et al. 2001, Khandaker 2012, Li et al. 1998, Mun and Brooks 2012). Higher GDP per capita and the stronger economic growth rate might give Malaysia the competitive advantages over other selected emerging countries on stock return volatility. Nevertheless, all of our sample emerging and developed economies exhibit higher stock return volatility in sub-period three due to the GFC.

TABLE 6: STOCK MARKET VOLATILITY OF THE SELECTED COUNTIES

Year	Australia	China	Indonesia	Malaysia	UK	USA
2001	0.2214	0.7813	0.7649	0.4932	0.4655	0.4633
2002	0.2275	0.5039	0.9842	0.2845	0.4015	0.4149
2003	0.1976	0.5760	0.5649	0.2888	0.3415	0.3124
2004	0.1498	0.6617	0.6202	0.2905	0.1872	0.2306
2005	0.2274	0.3832	0.5190	0.1852	0.1947	0.2161
2006	0.2202	0.4644	0.4895	0.1780	0.2576	0.2426
2007	0.3353	0.8209	0.5930	0.4262	0.3281	0.3348
2008	0.6761	1.4752	1.2679	0.4804	0.8489	0.8632
2009	0.5045	0.8570	0.6655	0.5115	0.4897	0.5952
2010	0.3691	0.4491	0.4736	0.5370	0.3917	0.4198
2011	0.4230	0.6297	0.5920	0.2936	0.4590	0.5197
2012	0.1868	0.3076	0.3381	0.1224	0.2966	0.3265
Average	0.3116	0.6592	0.6561	0.3409	0.3885	0.4116

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Figure 3 is the graphical presentation of the selected stock market volatility data taken from table 6. The figure illustrates stock price volatility of Australia, China, Indonesia and the USA from 2001 till 2012. There is evidence that all of our sample stock markets exhibit higher level of stock return volatility during the global financial crisis. In addition, China and Indonesia exhibit very high level of stock return volatility during the sample period.

FIGURE 3: STOCK MARKET VOLATILITY OF THE SELECTED COUNTRIES DURING THE SAMPLE PERIOD

The following figure illustrates stock market historical volatility of four sample stock markets from 2001 to 2012. The stock markets included in this observation are Australia, China, Indonesia and the USA. The horizontal axis exhibits, observation years and, vertical axis exhibit standard volatility measures of the sample stock markets. The figure provides evidence that our sample stock markets exhibit higher level of volatility during 2007-2010.

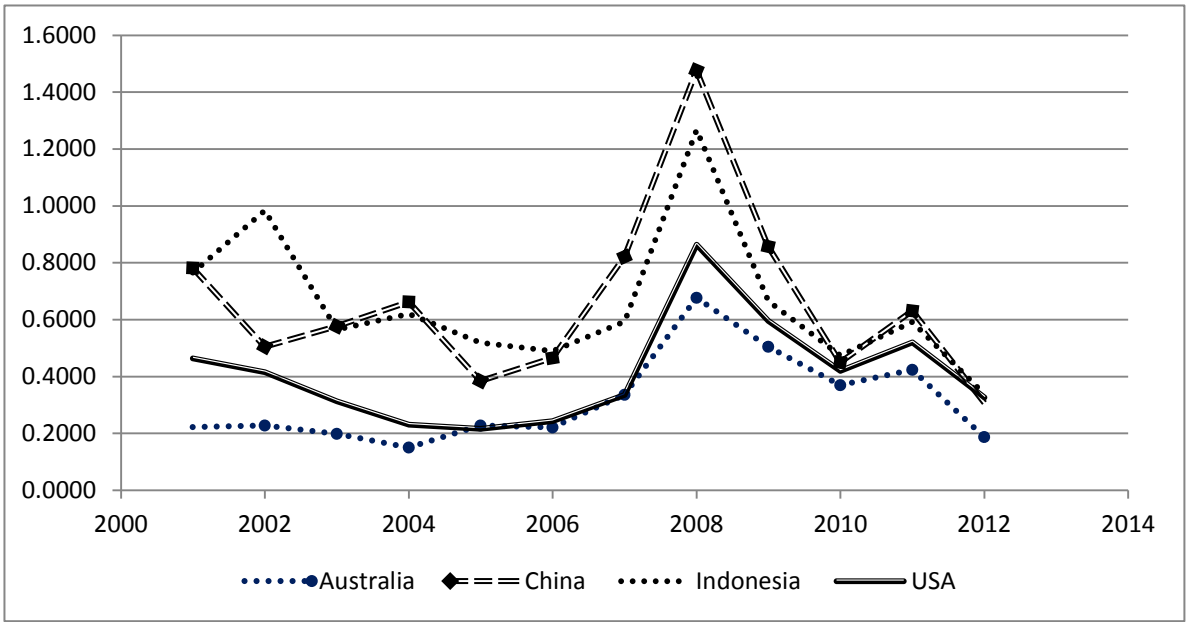

Table A9 (see appendix) exhibits correlation coefficients of the sample countries volatility measures from 2001 to 2012. We find no evidence of statistically significant correlation coefficients of the volatility measures among the sample countries. This suggests that volatility measures are independent across sample countries and are not influenced by external factors.

We also run Augmented Dickey Fuller test to determine whether the stock market indices are stationary over the sample period (Table 7). ADF test is an important test statistic for determining the quality of the time-series data. Table 6 reports the ADF test statistics which are statistically significant and consistent with the co-movement measures being stationary over the period of the study. This suggests that our sample period time series data has constant mean and constant mean variance.

TABLE 7: AUGMENTED DICKEY FULLER TEST STATISTICS FOR THE SAMPLE STOCK MARKER SERIES

Country	t-Statistic
Australia	-24.2277
China	-25.6460
Indonesia	-27.8439
Malaysia	-26.9797
UK	-25.6631
USA	-25.2971

Furthermore, to understand how stock market co-movement behaviour is affected by the volatility measure, Pearson correlation coefficients are also reported in table 8 for each of the sample countries. The study finds no evidence of statistical significant correlations between the volatility measures and the co-movement measures for the sample countries, except for Indonesia which is positively correlated at 10 percent significant levels. This

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is a significant result in this study as it is assumed that stock market comovement behaviours are associated with stock market volatility (Ramchand and Susmel 1998). There is evidence that stock return volatility and co-movement behaviour is not affected by each other as expected previously using our sample county data.

TABLE 8: CORRELATIONS BETWEEN VOLATILITY AND CO-MOVEMENT BEHAVIOUR

	Pearson Correlation	**Sig. (2-tailed)**
Australia	-0.404	0.192
China	0.137	0.670
Indonesia	0.546	0.066
Malaysia	0.121	0.708
UK	-0.348	0.268
USA	-0.041	0.899

DISCUSSION AND CONCLUSION

In this study, we examine the stock market behaviour of selected emerging and developed economies in terms of market volatility and comovement behaviour. The study presents empirical evidence that the sample emerging economies exhibit higher levels of stock return volatility and comovement behaviour during the study period (2001-2012) than that of the developed economies. By employing a standard historical volatility model, we determine the sample stock market volatility and find evidence that all of our sample stock markets exhibit higher level of stock market volatility during 2007-2009. This result provides evidence that the GFC accelerates the stock market co-movement behaviour and, due to the poor macroeconomic environment during the GFC, the stock markets of the sample countries behave unprecedentedly (Mun and Brooks 2012, Xing and Anderson 2011, Zhang et al. 2011). There is also evidence that the sample emerging economies were highly synchronous during the study period. For example, China and Indonesia exhibit higher stock return co-movement behaviour and, this behaviour increase during GFC.

However, we find no statistically significant correlation-coefficient between the stock market volatility measures and co-movement measures using our sample country data while running 'Pearson correlation-coefficient' test. The result is surprising and suggests stock market volatility measure and co-movement measures are not correlated to each other and are picking different aspects of stock market behaviour. Indonesia is the only sample country in our analysis to show a statistically significant correlation-coefficient between the volatility measures and the co-movement analysis at 10 per cent level. Our study provides two significant findings and contributes to the body of knowledge in the existing literature. First, our sample emerging countries' stock markets exhibit high levels of R-square values and also exhibit high levels of volatility during the sample period. There is also evidence that stock market volatility and co-movement increases during the GFC for emerging countries.

Second, stock market volatility and co-movement behaviour is not statistically correlated. It is found that emerging economics stock volatility and comovement behaviour are significantly correlated, but this effect is not statistically significant for the developed economies. Our result provides evidence that stock market comovement behaviour or the R-squared matrix captures somewhat different aspects of stock market behaviour other than the stock market volatility for the developed economies. Our result is consistent with the Morck et al. (2000) who suggest that macroeconomic variables plays an important role in the developed economies during the financial crisis, but these effects are insignificant for a country which does not have a strong investor protection right and have poor corporate governance mechanisms (La-Porta et al. 1998). Our research finds no published literature that compared the R-square measure and market volatility measure over the sample period. This is a very significant result and our study provides a new insight of emerging stock market behaviour during and after the GFC.

LIMITATIONS AND FUTURE RESEARCH AGENDA

A number of limitations also apply to this research. One of the major limitations is the study include data from six sample stock markets around the world. A larger sample size would provide a more robust result. The second limitation is the study performs time series analysis for analysing the stock market volatility and co-movement behaviour, a cross-country analysis of stock market behaviour and their determinant macro factors could provide a better result. However, these limitations would provide a valuable extension for our further research agenda.

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APPENDIX

TABLE A1 : STOCK MARKET COMOVEMENT BEHAVIOUR FOR THE SUB-PERIOD 1 (2001-2003)

	2001	2002	2003		2001	2002	2003
Australia	0.047	0.026	0.031	China	0.053	0.039	0.024
UK	0.031	0.025	0.030	Indonesia	0.190	0.231	0.137
USA	0.023	0.031	0.034	Malaysia	0.224	0.166	0.161
	0.034	0.027	0.032		0.156	0.145	0.107

TABLE A2: STOCK MARKET COMOVEMENT BEHAVIOUR FOR THE SUB-PERIOD 2 (2004-2006)

	2004	2005	2006		2004	2005	2006
Australia	0.029	0.027	0.029	China	0.064	0.021	0.031
UK	0.038	0.034	0.025	Indonesia	0.221	0.251	0.183
USA	0.032	0.021	0.022	Malaysia	0.170	0.128	0.134
	0.033	0.027	0.025		0.152	0.133	0.116

TABLE A3: STOCK MARKET COMOVEMENT BEHAVIOUR FOR THE SUB-PERIOD 3 (2007-2009)

	2007	2008	2009		2007	2008	2009
Australia	0.036	0.026	0.0227	China	0.030	0.101	0.172
UK	0.029	0.027	0.0263	Indonesia	0.167	0.288	0.165
USA	0.022	0.024	0.0484	Malaysia	0.333	0.288	0.052
	0.029	0.026	0.033		0.176	0.225	0.129

TABLE A4:STOCK MARKET COMOVEMENT BEHAVIOUR FOR THE SUB-PERIOD 4 (2010-2012)

	2010	2011	2012		2010	2011	2012
Australia	0.032	0.021	0.069	China	0.165	0.075	0.129
UK	0.023	0.022	0.059	Indonesia	0.156	0.306	0.143
USA	0.020	0.018	0.065	Malaysia	0.025	0.234	0.089
	0.025	0.020	0.064		0.115	0.205	0.120

TABLE A5: STOCK MARKET'S VOLATILITY FOR THE SUB-PERIOD 1 (2001-2003)

Year	Australia	China	Indonesia	Malaysia	UK	USA
2001	0.2214	0.7813	0.7649	0.4932	0.4655	0.4633
2002	0.2275	0.5039	0.9842	0.2845	0.4015	0.4149
2003	0.1976	0.5760	0.5649	0.2888	0.3415	0.3124
Average	0.2155	0.6204	0.7713	0.3555	0.4028	0.3969

TABLE A6: STOCK MARKET'S VOLATILITY FOR THE SUB-PERIOD 2 (2004-2006)

Year	Australia	China	Indonesia	Malaysia	UK	USA
2004	0.1498	0.6617	0.6202	0.2905	0.1872	0.2306
2005	0.2274	0.3832	0.5190	0.1852	0.1947	0.2161
2006	0.2202	0.4644	0.4895	0.1780	0.2576	0.2426
Average	0.1991	0.5031	0.5429	0.2179	0.2132	0.2297

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TABLE A7: STOCK MARKET'S VOLATILITY FOR THE SUB-PERIOD 3 (2007-2009)

Year	Australia	China	Indonesia	Malaysia	UK	USA
2007	0.3353	0.8209	0.5930	0.4262	0.3281	0.3348
2008	0.6761	1.4752	1.2679	0.4804	0.8489	0.8632
2009	0.5045	0.8570	0.6655	0.5115	0.4897	0.5952
Average	0.5053	1.0510	0.8422	0.4727	0.5556	0.5977

TABLE A8: STOCK MARKET'S VOLATILITY FOR THE SUB-PERIOD 4 (2010-2012)

Year	Australia	China	Indonesia	Malaysia	UK	USA
2010	0.3691	0.4491	0.4736	0.5370	0.3917	0.4198
2011	0.4230	0.6297	0.5920	0.2936	0.4590	0.5197
2012	0.1868	0.3076	0.3381	0.1224	0.2966	0.3265
Average	0.3263	0.4621	0.4679	0.3177	0.3824	0.4220

TABLE A9: CORRELATION COEFFICIENT OF THE VOLATILITY MEASURES FOR THE SAMPLE STOCK MARKETS DURING THE OBSERVATION PERIOD (2001-2012)

	USA	Australia	Chine	Indonesia	Malaysia
Australia	0.9054				
China	0.8219	0.7828			
Indonesia	0.7435	0.5784	0.7973		
Malaysia	0.6273	0.6130	0.6216	0.4326	
UK	0.9815	0.8636	0.8383	0.7862	0.6055