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The Financial Market Stability: Southeast Asia, BRIC and Latin America

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ABSTRACT

This research aims to first, determine the correlation between the stock market and financial stability. Second, to determine the correlation between stock market and liquidity availability. Both are conducted in the implementation period of quantitative easing of US in 2008. The research is conducted in eight countries: United States, Indonesia, Malaysia, Thailand, Brazil, Russia, India, and Latin America. The national composite index for each country was used to capture the condition of stock market as a dependent variable. The VIX was used as a proxy o financial market stability in the US, and TED spread as a proxy for liquidity availability. Sample will be divided into three different periods based on the implementation of QE1, QE2, and QE3. The DCC model was employed in this research to capture the dynamic movement between variables studied. Results show there are stronger significant influence on VIX correlation with stock indexes in US, Indonesia, Thailand, Brazil, India, and Latin America rather than the correlation on TED spreads, which is only found significant in Russia in the QE1 period. This indicates financial stability affecting investor choice of investment.

Keywords: Crisis, dynamic, QE, TED spread, VIX

INTRODUCTION

Financial markets cannot avoid the impact of a crisis. A crisis can have a contagious impact on the markets. A crisis should be handled as soon as possible, which can be done by identifying the source of the crisis. As pointed out in previous studies, the decline in performance in one market may affect the decline in performance in others,

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hereinafter referred to as the contagion effect (King & Wadhwani, 1990). Financial stability is described in the literature as a condition where there is no evidence of increasing exposure to common shocks (Baur & Schulze, 2009). One of the biggest crises ever was the 2008 global financial crisis. The 2008 crisis began with the failure of the subprime mortgage lending in the United States. This failure subsequently led to the collapse of major banks in the United States, preceded by the fall of Lehman Brothers, a global financial services firm, on September 15, 2008.

The subprime mortgage crisis was handled by unconventional monetary policy implementation carried out in three different periods. Unconventional monetary policy was then known as quantitative easing (QE) introduced by policy makers to encourage activity in the real economics sector. Increased activity in the real economic sector is expected to lessen the impact of the crisis. Previous research has pointed to the influence of QE in aspects of liquidity, portfolio rebalancing, and confidence channels in developing countries (Lim & Mohapatra, 2016).

Research has also found that investors view how to distribute their assets based on the risks in special circumstances. As an example, in the subprime mortgage crisis era, investors preferred to move their assets to those that were less risky, from stocks to bonds. Kenourgios, Naifar and Dimitriou (2016) found that *sukuk* and bonds can provide a cushion for investment at the beginning of a crisis. Investors see that in a crisis era, the volatility of stock return is higher. It is possible that an investor sees the crisis based on the fluctuating structure of stock returns. When the stock returns get more volatile, they move their stocks to bonds, which is less risky. In times of crisis, investors tend to choose to switch investment options from high-risk to lower-risk investment options; e.g. from stocks to bonds (Mustafa, Samsudin, Shahadan, & Yi, 2015). Based on this finding, it is hypothesised that financial market stability can be affected by stock return volatility and investing preference.

This research discusses the correlation between the national stock market in the three regions (Southeast Asia, BRIC, and US), with fundamental economic variables related to the subprime mortgage crisis and the implementation of QE. These three regions were chosen to see if there is a contagion or spill over effect. The fundamental variables used in this study are the VIX index that illustrates the stability of financial markets in the United States, and TED spreads that illustrate the availability of liquidity. The use of these two fundamental variables is in line with previous studies (Duca, Nicoletti, & Martinez, 2016; Kim, Kim, & Lee, 2015; Lim & Mohapatra, 2016).

LITERATURE REVIEW

Gilk and Rose (1999) found that currency crises tend to affect countries with geographical proximity. The crises referred to in the data are the crises of 1971, 1973, 1992, 1994, and 1997. Results from research

conducted in 161 countries indicate that strong trade links influence currency contagion in the five periods of the crisis, while economic factors are not closely related.

The 2008 crisis was triggered by the fall of Lehmann Brothers in 2008. One of the characteristics of the crisis is how quickly a crisis in one country spreads to the financial markets and to the world (Bianconi, Yoshino, & de Sousa, 2013). The subprime mortgage crisis in 2008 affected almost all the countries in the world, causing considerable economic turmoil. Many studies have suggested a significant positive correlation coefficients that increase after a crisis, which point to the contagion factor.

Besides, a crisis is also defined as a circumstance in which the global financial market is not in a stable condition. Financial stability in the literature is described as a condition where there is no evidence of increasing exposure to common shock (Baur & Schulze, 2009). The crisis itself channels through several proxies, depending on how the activities undertaken by one country affect the other, whether through trading or investment activities in the free market.

The crises do not always have the same characteristics, which is related to the origins of the crisis, such as currency crisis, sovereign debt crisis, crashes, corporate bankruptcies, and crises of confidence (Brière, Chapelle, & Szafarz, 2012). In addition, there is flight to quality and flight from quality, which is influenced by the source of current crisis.

In addition to the crisis of 2008, the crisis in Russia in 1998, as discussed by (Saleem, 2009), showed different crises will have different reach and scope for the emergence of contagion effects. Aizenman, Pinto and Sushko (2013) stated that the economy is broadly influenced by the financial cycle, where the financial sector has a strong influence on other sectors. Islam (2014) divided the contagion channel by virtue of the transmitters into first-degree markets and second-degree markets; the second-degree market is described as a country hit by the crisis in the first-degree market and found that the crisis in Asian countries stemmed from the US equity market.

Min and Hwang (2012) states that there is an increase in the contagion between the first phase of the crisis in the United States and the second phase of the crisis in the three OECD Countries (UK, Australia and Switzerland), but the next OECD country, Japan, is limited to correlation in the first phase. The method used is DCCX-MGARCH, which allows simultaneous estimation of DCC against its contagion channels (VIX index, TED spread). Morales and Bernadette (2014) states that the impact of a global economic crisis has different effects based on regional factor and spill over transmitted and disseminated by several key countries (Singapore to Asia, and UK to Europe). The study was conducted on 58 countries, divided by region.

Okubo, Kimura and Teshima (2014) discussed the impact of the global economic crisis of 2008 on Japan's trade as well as

the economic fragility of Asia during this period. It was found that the risks were shared between Asian countries leading to strong trade relations.

METHODS

Data

Data used in this study is daily data from national composite index obtained from Datastream. Countries examined in this study are shown in the following table:

Table 1
Countries by region

South East Asia	BRIC	US
Indonesia JCI	Brazil Bovespa	FTSE Latin America
Malaysia KLCI	Russia MICEX	US NYSE
Thailand SET	India NIFTY500	

Three different periods were examined in this study based on the time of implementation for QE 1, QE 2, and QE 3. Using daily data, the three periods are as follows:

- QE 1: 1 November 2008 – 1 April 2010
- QE 2: 1 October 2010 – 1 July 2011
- QE 3: 1 August 2012 – 1 January 2013

Dynamic Conditional Correlation (DCC) Model

The Dynamic Conditional Correlation (DCC) model is used here because unlike other multivariate econometrics model, the DCC has some restrictions which are useful for analysing the results. The DCC model has non-negative scalar matrix, so that the matrix output within the DCC equation comes out as a positive number. This model can also estimate the correlation coefficient. The correlation coefficient can be analysed to indicate the impact of the crisis. The DCC-GARCH model directly accounts for heteroscedasticity and has no volatility bias based on estimating the correlation coefficients of the standardised residuals (Chiang et al., 2007)

The DCC (Engle, 2002) model is estimated where the DCC-MGARCH model can be seen as a generalisation of the constant conditional correlation (CCC) estimation (Bollerslev, 1990), where the matrix of conditional covariance H_t is as follows:

$$H_t = D_t R_t D_t, \quad (1)$$

Where, D_t is diagonal matrix, $D_t \sqrt{diag\{H_t\}}$ and R_t is time-varying correlation matrix.

H_t formulation can be used as standardised parameter for return, $\varepsilon_t = D_t^{-1} e_t$

$$E_{t-1}\varepsilon_t \varepsilon'_t = D_t^{-1} H_t D_t^{-1} = R_t = [\rho_{i,j,t}] \quad (2)$$

Engle proposed the next mean-reverting conditional on GARCH (1,1) specification:

$$\rho_{i,j,t} = \frac{q_{i,j,t}}{\sqrt{q_{i,i,t} q_{j,j,t}}} \quad (3)$$

Where,

$$q_{i,j,t} = \bar{\rho}_{i,j}(1 - \alpha - \beta) + \alpha \varepsilon_{i,t-1} \varepsilon_{j,t-1} + \beta q_{i,j,t-1}$$

$\bar{\rho}_{i,j}$ is unconditional correlation between $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$. Non-negative scalar α and

β assumed to fulfil the stationarity terms, $\alpha + \beta < 1$. In the form of matrix:

$$Q_t = \bar{Q}(1 - \alpha - \beta) + \alpha\varepsilon_{t-1}\varepsilon'_{t-1} + \beta Q_{t-1} \quad (4)$$

Where $\bar{Q}$ is unconditional correlation matrix from ε_t. R_t produced by:

$$R_t = (Q_t^*)^{-1/2} / Q_t (Q_t^*)^{-1/2} \quad (5)$$

Where Q_t^* = diag(Q_t)

Engle proposed two steps estimation from DCC model. When k=2, the function of log-likelihood is:

$$\begin{aligned}\mathcal{L} &= -\frac{1}{2}\sum_{t=1}^{T}(2\log(2\pi) + \log|H_t| \\ &\quad + e'_t H_t^{-1} e_t) \\ &= -\tfrac{1}{2}\textstyle\sum_{t=1}^{T}(2\log(2\pi) + \log|D_t R_t D_t| \\ &\quad + e'_t D_t^{-1} R_t^{-1} D_t^{-1} e_t) \\ &= -\tfrac{1}{2}\textstyle\sum_{t=1}^{T}(2\log(2\pi) + \log|D_t| \\ &\quad + \log|R_t| + e'_t R_t^{-1} e_t)\end{aligned} \quad (6)$$

Add and minus $e'_t D_t^{-1} D_t^{-1} e_t = \varepsilon'_t \varepsilon_t$, log-likelihood is rewritten as a sum of volatility component ($\mathcal{L}_v$) and correlation component ($\mathcal{L}_c$). θ shows a vector from parameter D_t and ϕ to be another parameter of R_t, then:

$$\mathcal{L}(\theta, \phi) = \mathcal{L}_v(\theta) + \mathcal{L}_c(\phi) \quad (7)$$

Where:

$$\begin{aligned}\mathcal{L}_v(\phi) &= -\frac{1}{2}\sum_{t=1}^{t}\sum_{i=1}^{2}\left(\log(2\pi)\right. \\ &\quad \left. + \log\left(h_{i,i,t}\right) + \frac{e_{i,t}^2}{h_{i,i,t}}\right) \\ \mathcal{L}_v(\phi) &= -\tfrac{1}{2}\textstyle\sum_{t=1}^{T}(\varepsilon'_t R_t^{-1}\varepsilon_t - \varepsilon'_t\varepsilon_t \\ &\quad + \log|R_t|)\end{aligned} \quad (8)$$

One can find the estimation for parameter θ by maximising $\mathcal{L}_v(\theta)$.

RESULTS AND DISCUSSION

The data stock was converted into a return form and has been stationary in the first order. The results using DCC, the correlation between stock data with VIX that describes the financial stability of the US stock market in the eight countries studied, can be seen in Table 3. Similarly, the correlation between TED spreads that describe the availability of liquidity in the period of QE 1 in the stock markets of the eight countries studied can be seen in Table 3.

In the QE1 study period, as can be seen in Table 3, it was found that TED spreads that showed the availability of liquidity were not significant in seven of the eight countries studied. The stock market affected by the availability of liquidity is found in

Table 2
Summary statistics – Returns

	RINDONESIA	RMALAYSIA	RTHAILAND	RBRAZIL
Mean	0.000409	0.000184	0.000299	5.32E-05
Median	0.000523	8.72E-05	4.94E-05	0
Maximum	0.076231	0.042587	0.075487	0.136794
Minimum	-0.10954	-0.099785	-0.110902	-0.120961
Std. Dev.	0.013994	0.007774	0.012736	0.017897
Skewness	-0.636597	-1.160409	-0.647381	0.036308
Kurtosis	10.79126	17.797	10.48203	9.231035
	RINDIA	RLATIN_AMERICA	RRUSSIA	RUS
Mean	0.000278	-0.00024	3.81E-05	4.63E-05
Median	0.000247	0	0	0.000239
Maximum	0.15034	0.375876	0.252261	0.115258
Minimum	-0.115922	-0.402432	-0.206571	-0.102321
Std. Dev.	0.014519	0.025677	0.021236	0.014069
Skewness	-0.181876	-1.028174	-0.099044	-0.38707
Kurtosis	13.09327	85.63134	26.3905	12.39964

Table 3
DCC estimation – Stock price return in QE1 (11/01/2008 – 04/01/2010)
GARCH: $\boldsymbol{Q}_t = \overline{\boldsymbol{Q}}(1-\alpha-\beta) + \alpha\boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}'_{t-1} + \beta\boldsymbol{Q}_{t-1}$
DCC: $h_{i,t} = \boldsymbol{\omega}_i + \alpha_i e^2{}_{i,t} + \beta_i h^2{}_{i,t-1}$

		NYSE	LATIN	BOVESPA	MICEX	NIFTY	JCI	KLCI	SET	PSEi
ARCH	α	0.0858***	0.4829*	0.0486	0.0155	0.1239*	0.0652**	0.0365**	0.0544**	0.0627
		(0.0096)	(0.0767)	(.2565)	(0.3415)	(0.0654)	(0.0099)	(0.0187)	(0.0265)	(0.2641)
GARCH	β	0.9064**	0.5742**	0.9381***	0.9855**	0.8881**	0.9190**	0.9526**	0.9189**	0.8971**
		(0.0000)	(0.0002)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
DCC	VIX	-0.7869*	-0.3503*	-0.5615***	-0.3539	-0.2960*	-0.1054*	-0.2188	-0.2063*	-0.0539
	TED	-0.1141	-0.0977	-0.0922	-0.0413*	-0.0268	-0.1271	-0.1271	-0.0843	-0.0363

Significant 10%; ** Significant 5%; *** Significant 1%

the Russian stock index (MICEX) at the 10% significance level. This means that among the 8 (eight) countries studied, the implication of the finding only can only be applied to Russia. The finding indicates that in QE1 period, investor's choice of investment was affected by availability of liquidity.

This is unlike the case with VIX proxies that show the stability of financial markets in the US. It was found that the VIX correlation in the six out of eight countries studied was significant. The 1% significance level on the correlation between VIX and national stock indexes is found in the US (NYSE), Thailand (SET), Brazil (Bovespa), India

(NIFTY500), and Latin America (FTSE) countries. The 5% level of significance is found in the correlation between VIX and Indonesian stock index (JCI). Therefore, liquidity of availability affects investor's choice of investment in US, Thailand, Brazil, India, Latin America and Indonesia in QE1 period.

In the QE2 implementation period, as can be seen in Table 4, TED spread is not significant in any of the eight countries studied. The VIX is strongly significant in 1% level for all stock markets studied, except the Philippines, which is not significant. This finding suggests there is a decrease of significance level from correlation between stock market and availability of liquidity in QE2 period, but the significance level of correlation coefficient between stock market and financial stability is increasing. This indicates that in QE2, the investors focus on the financial stability of all 8 (eight) countries studied except the Philippines. This finding is supported by (Bianconi et al., 2013) who found that financial market stability spreads from one country to the rest. In terms of the coefficient correlation between stock market and liquidity availability, and between Philippine's stock market and financial stability, investor's choice of investment cannot be determined because the correlation coefficient is insignificant.

The findings of QE3 and QE2 implementation period are similar as shown in Table 5. It can be seen TED spread is insignificant in all eight countries studied, and explains why the correlation between availability of liquidity and stock market cannot be determined. But the VIX is found to be significant in six of the eight national stock markets studied. The two insignificant correlations are between VIX and PSEi (Philippines) and VIX and JCI (Indonesia). This result indicates that in QE3, the investors focused on the financial stability in all 6 (six) out of 8 (eight) countries studied, but the correlation coefficient in terms of financial stability in Indonesia and Philippines is not conclusive because the coefficient correlations are insignificant.

Table 4
DCC estimation – Stock price return in QE2 (10/01/2010 – 11/01/2011)
GARCH: $h_{i,t} = \boldsymbol{\omega}_i + \alpha_i e^2{}_{i,t} + \beta_i h^2{}_{i,t-1}$
DCC: $\bar{\boldsymbol{Q}}(1-\alpha-\beta) + \alpha \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}'_{t-1} + \beta \boldsymbol{Q}_{t-1}$

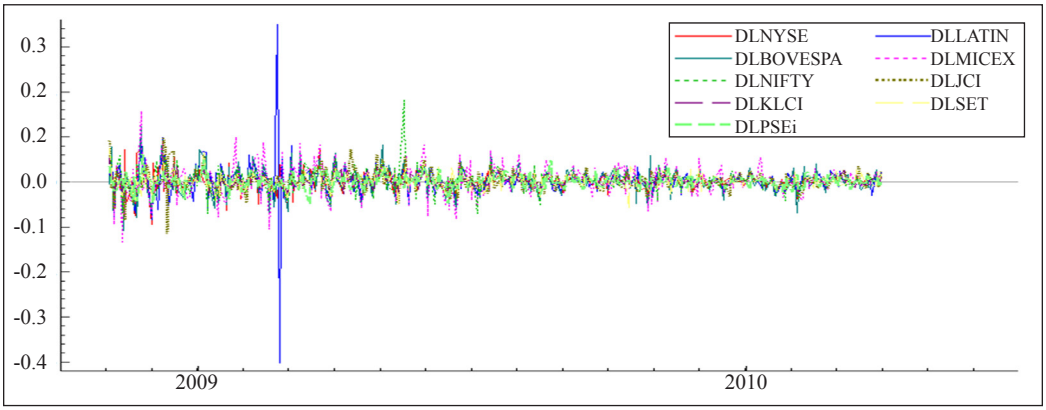
		NYSE	LATIN	BOVESPA	MICEX	NIFTY	JCI	KLCI	SET	PSEi
ARCH	α	0.1645**	0.1349**	0.0839	0.0998	0.0428*	0.1933**	0.0546**	0.1553**	0.1983**
		(0.0280)	(0.0360)	(0.1208)	(0.1977)	(0.0654)	(0.0373)	(0.0373)	(0.0124)	(0.0087)
GARCH	β	0.8198**	0.7849**	0.9185***	0.8982**	0.9395**	0.9483**	0.9483**	0.7640**	0.6073
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
DCC	VIX	-0.8487*	-0.2402*	-0.6207***	-0.4076*	-0.2188*	-0.1901	-0.1901*	-0.2210*	-0.0875
	TED	0.0094	-0.0255	0.0379	-0.0669	-0.0081	0.0099	0.0099	-0.0092	0.0228

Significant 10%; ** Significant 5%; *** Significant 1%

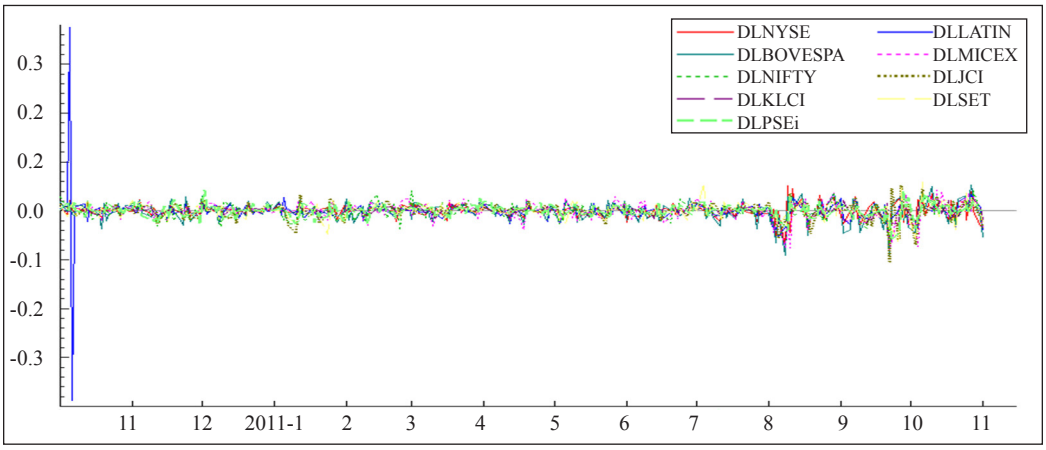
Table 5
DCC estimation – Stock price return in QE3 (08/01/2012 – 08/01/2014)
GARCH: $h_{i,t} = \boldsymbol{\omega}_i + \alpha_i e^2{}_{i,t} + \beta_i h^2{}_{i,t-1}$
DCC: $\boldsymbol{Q}_t = \overline{\boldsymbol{Q}}(1-\alpha-\beta) + \alpha \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^{'} + \beta \boldsymbol{Q}_{t-1}$

		NYSE	LATIN	BOVESPA	MICEX	NIFTY	JCI	KLCI	SET	PSEi
ARCH α		0.1251	0.0326**	0.0369**	0.0337*	0.1195**	0.2699**	0.2394	0.1404**	0.1513
		(0.1301)	(-0.1584)	(0.0304)	(0.0572)	(0.0001)	(0.0001)	(0.5580)	(0.0349)	(0.4793)
GARCH β		0.6006**	0.9354**	0.9479***	0.9276**	0.8327**	0.7259**	0.6294*	0.8630**	0.8575**
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0926)	(0.0000)	(0.0004)
DCC	VIX	-0.7765*	-0.2792*	-0.3446	-0.2063*	-0.1429*	-0.0833	-0.0892*	-01195*	-0.0897
	TED	0.0427	0.0342	-0.0159	0.0402	0.0594	-0.0026	0.0017	-0.0150	-0.0310

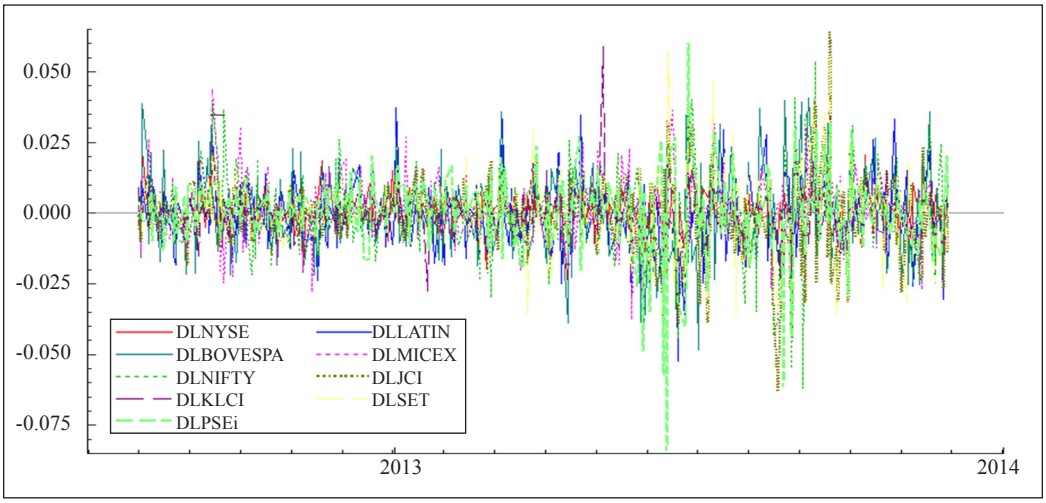
Significant 10%; ** Significant 5%; *** Significant 1%



(a)



(b)



(c)

Figure 1. DCC plot: (a) QE1; (b) QE2; and (c) QE3

The plot for DCC output can be seen in Figure 1. This plot provides clearer dynamics. As can be seen, QE2 is the most tranquil period.

Limitations of the Study

There are several limitations in this study. Only DCC model was used with stock returns as an input. The error bias in the result should be considered here. The model of DCC can be executed if there is preliminary model that can capture all the errors and present the common factor as an input to be processed as DCC. Additionally, the study divided the countries in three groups, but did not distinguish the effect between them.

CONCLUSION

The results estimated using DCC show insignificant correlation between almost all of the national stock market studied in three different implementation period and TED spread, which acted as a proxy for liquidity availability. The only significant correlation between TED spread and national stock market can be found in the QE1 period between TED spread and Russia (MICEX). The VIX is found to be significant in almost all QE periods studied for almost every national stock market researched, except Philippines (PSEi) in QE2, and Philippines (PSEi) and Indonesia (JCI) in QE3. Min and Hwang (2012) found VIX as one of the channel of contagion effect and act as financial market stability proxy. The interesting finding is that when the TED spread is found significant between the correlation of TED spread and MICEX in QE1 period, the VIX is found insignificant. The proxy of financial stability (VIX) was found highly significant in QE2 period, and this indicated investor's choice of investment was affected by financial stability in QE2 implementation period. It

cannot be conclusive proven that liquidity availability affects stock market because of the insignificant coefficient correlation.

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