The Influence of Market, Interest Rate, Exchange Rate Risks on Bank Stock Returns in ASEAN-5*

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Abstract

This paper investigates the role of three risk factors, including market rate, interest rate and foreign exchange rate risk on bank stock returns in ASEAN-5 (Indonesia, Malaysia, the Philippines,Singapore, and Thailand).The generalized autoregressive conditionally heteroscedastic (GARCH) methodology was employed from the period of January 1997 to December 2015 by using monthly data. The results identified the market rate was a greater risk factor than the interest or the exchange rate on the bank stock returns of all five countries. Furthermore, the interest rate and foreign exchange risks were more pronounced significant effects (positive and negative) on the bank stock returns in some countries. The estimation based on the GARCH approach, showed strong evidence of time-varying volatility in bank stock returns. Lastly, autoregressive conditionally heteroscedastic (ARCH) effect was smaller than the GARCH effect. This referred that the explaining that past shock was less sensitive than own lagged volatility.

Keywords: Bank Stock Returns, Interest Rate Risk, Exchange Rate Risk, GARCH

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Introduction

After the liberalization of the financial markets, a commercial bank became one of the most important parts of financial systems. In terms of the risk factors in commercial banks' investment, it concerns the great influence of interest rate and foreign exchange rate. A change in interest rates can directly affect bank stock returns. The interest rate risk has attracted the interest of bank managers, investors, regulators, and academics. A number of existing papers have examined the relationship between equity return and interest rate risk by using the two-index factor, in which market index and interest rate factors are included (Bae, 1990; Booth & Officer, 1985; Chance & Lane, 1980; Elyasiani & Mansur, 1998; Flannery & James, 1984; Song, 1994; Stone, 1974). Their findings suggest that interest rate risk can shock both magnitude and direction for many reasons. For instance, in the United States, the effect of interest rate volatility has played a leadership sensitive effect on bank stock returns(Elyasiani & Mansur, 2003).

Furthermore, the unexpected movement of foreign exchange rates may create profitability and expected cash flows of banks. Because of these reforms, a greater role movement in both of local and foreign drives is very important in bank stock returns. The amazing exposure to the fluctuation of the exchange rate might bring vulnerability to gains and losses from their net currency positions of commercial banks (Hooy, Tan, & Nassir, 2004). As a result, a positive risk premium should be included to compensate for exchange rate fluctuations. However, few studies have examined the relationship between foreign exchange rate risk and bank stock returns or have found a significant relationship only in some stock markets (Chamberlain, Howe, & Popper, 1997; Chance & Lane, 1980; Choi, Elyasiani, & Kopecky, 1992). Their studies present empirical results against the existence of a relationship between exchange rate risk and stock returns.

As the financial liberalization system unfolds, a number of studies have suggested that both interest and exchange rate risk premiums have an impact on bank stock returns. For instance, Choi et al. (1992) showed that a three-factor risk model namely market, interest, and exchange rate between the pre- and post-1979 financial crisis affected the bank stock returns in the U.S. stock market. In addition, the sensitivity of the three risk factors (Wetmore & Brick, 1994)extended from Choi's model has suggested that the impact on the movement of banks' stock returns may be differentiated based on various bank types. Hence, it is beneficial to

focus on the sensitivity of the interest and foreign exchange rate risk of commercial banks, which could provide useful implications for policymakers and the regulators on the financial stability of the country.

Moreover, banking institutions have often been affected by the financial crisis, which imposed a tremendous shock on the interest rates and foreign exchange systems and has caused bank runs. Therefore, commercial banks should be serious and monitor risks at all times. The objective of this paper is to contribute to the existing literature by studying three risk exposures namely market, interest, and exchange rate to examine their effects on the bank stock returns in Association of Southeast Asian Nations (ASEAN). This group, which represented emerging markets, was more often faced with the contagion financial crisis similar to the crisis of 1997. The lessons from the crisis suggested that the fluctuation in exchange rate was the key indicator triggering contagion banking failure in the financial system.

The rest of the paper includes data that is based on a monthly period that started in the Asian financial crisis in 1997, using time-varying framework by estimating Generalized Autoregressive Conditional Heteroscedastic (GARCH) Model introduced by Bollerslev (1986) was estimated for analysis. This methodology enables the researcher to explain the dynamics of the bank stock return generating process. Lastly, the collected data of forty-four commercial banks in five countries represent the ASEAN group that just started in ASEAN Economic Community (AEC) at the end of year 2015. The remainder of the paper is structured as follows; Section 2 provides the literature review; methodology and data are presented in Section 3; and Section 4 and 5 discuss the results and the conclusion, respectively.

Literature Review

Beginning with the theory discussed by Merton (1973), he explained that the fluctuation in interest rates can shift the investment opportunity set, the so-called Intertemporal Capital Asset Pricing Model (ICAPM). It means that common factors, i.e. market return and interest rate risk, can affect returns. Moreover, the arbitrage pricing theory (APT) model developed by Ross (1976) further extended the model to include other factors that affect stock returns and that are related to the conditional variance of returns (Sharpe, 1964).

In terms of the present literature review on interest rate risk, previous research exhibited that the change in interest rate plays an important role in the financial institutions, as evidenced in the U.K. (Dinenis & Staikouras, 1998). Their results showed a negative significant relationship between common stock returns and interest rate changing. The U.K. financial institutions consist of five groups, which are banks, insurance companies, investment trusts, property investment companies, and finance firms.

In addition, in the two-index model, which included market and interest rate risk, there are the empirical results (Bae, 1990; Booth & Officer, 1985; Chance & Lane, 1980; Flannery & James, 1984; Lloyd & Shick, 1977; Lynge & Zumwalt, 1980; Song, 1994; Stone, 1974; Vaz, Ariff, & Brooks, 2008). For instance, Flannery and James (1984) presented cash flow in U.S. bank stocks on market rate fluctuations in the large banks that had no effective impact on the costs and profits using the data of stock savings and loan associations. On the other hand, some authors argued that interest rate sensitivity has a weak effect on the return-generating process of financial institutions, as reported by Chance and Lane (1980).

Regarding foreign exchange rate risk, previous research showed very few studies on this issue. After the liberalization of the financial system, the exchange rate is a very sensitive factor in the stock market and may originate contagion financial crisis. Moreover, the unexpected movement of the foreign exchange rate can alter profitability of the banks and investors might take the fluctuation of exchange rate into consideration when making the decisions to invest in the bank stocks. Earlier work (Hamao, 1988; Jorion, 1991) suggested that the stock market of either the US or Japan may not be exposed to the exchange rate change. On the other hand, it has been argued by (Prasad & Rajan, 1995) that the exchange rate risk has affected the U.S., the U.K., and Japan's stock markets. This was confirmed by the work of Chamberlain et al. (1997), which concluded that the exposure to the exchange rates has had a significant impact on the U.S. market; though, they found a weak relationship for the Japanese market.

There are results of two-index model between interest and exchange rate in commercial banks exhibited by Hahm (2004). This paper found that both interest rate and exchange rate risks were exposed to the change in the profitability of commercial banks in pre-crisis Korea, especially, exchange rate, which dramatically decreased, but interest was increased in bank stocks at the end of the crisis. Subsequently, Hooy, et al (2004) presented

the sensitivities of commercial banks' stock returns to risks in Malaysia during the Asian financial crisis. Their results revealed that there were no significant differences in the pre-crisis and during that crisis; moreover, the risk exposures of the Malaysian bank stocks were raised in both interest and exchange rate, which affected both large and small commercial banks stocks.

The previous studies have examined the impact of the three-index model in the first moment of the distribution of returns, in which market return, interest rate, and exchange rate are included. A paper of Choi et al., (1992) found that interest rate risk plays a more vital role in explaining U.S. bank stock returns than exchange rate volatility. Furthermore, Wetmore and Brick (1994) also employed the model of Choi et al. (1992) using U.S. bank stocks from 1986 to 1991. Their results showed that the estimated coefficients of the three factors were time dependent. Therefore, the assumptions limited by an unconditional multi-factor Asset-Pricing Model represented by these studies may yield biased results. Additionally, in the role of three-index risks on stock returns were studied by Tai (2000) who estimated by using the three different econometrics methodologies in both of unconditional and conditional framework. This paper exhibited that the interest rate risk premium played a greater role in explaining the dynamics of U.S. bank stock returns during the sample period.

Following key methodology in the literature, Song (1994) began using Autoregressive Conditional Heteroscedasticity (ARCH) to estimate the bank stock returns. He explained that the ARCH is an appropriate model for explaining market and interest rate factors, which vary significantly over time. Therefore, this paper relaxes the assumption on the time-varying process for explaining the return of data. It is a suitable model and specifications should be employed for explaining the data.

Later, GARCH estimation was employed by Choi et al. (1992), Wetmore and Brick (1994) and Tai (2000) to investigate the US bank stock returns. Their results explored strong evidence on the effect of time-varying interest rate and exchange rate on the US bank stock returns. Moreover, the GARCH framework confirmed a suitable model in the Japanese stock market(Koch & Saporoschenko, 2001) and Turkey stock markets (Kasman, Vardar, & Tunç, 2011). This paper contributes to the existing literature using the three-index model, which examines the effects of market rate, interest rate, and exchange rate on bank stock returns.

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Methodology and Data

1. Methodology

The first step before examining the data is to conduct the unit root test. It is important to show that all variables must be stationary to avoid the spurious regressions problem. Hence, to check whether this is the case, I performed unit root tests using the augmented Dickey-Fuller (ADF) to check the stationary of data. This result shows in Table1.

There are 44 commercial banks in five countries. The bank stock prices were computed by taking the first difference of the natural logarithm in the bank stocks by following the equation.

$$r_{i,t} = ln\left(p_{i,t}/p_{i,t-1}\right) \quad (1)$$

Where $r_{i,t}$ is the continuously compounded returns of bank *i* at time *t* and $p_{i,t}$ are the value of bank *i* at time *t* and time*t-1*, respectively.

This paper constructs the bank stock portfolio as equal-weighted average of bank stock return of individual country that calculated by equation (2)

$$R_{i,t} = \sum_{i=1}^{q} w_i r_{i,t} \quad (2)$$

Where $R_{i,t}$namely "Return" denotes the portfolio of bank stocks in ASEAN- during closing days of the month *t*, then$w_i$is the weight of country *i*, $r_{i,t}$which presents the listed commercial banks for each country at time *t*, and *q* is the number of banks in the country.

Moreover, this issue was examined one very popular model from family GARCH, produced by Bollerslev (1986) this model showed that well when the time variation in the volatility of bank stock returns. In addition, the result utilized to inspect the part of interest rate and exchange rate in disclosing bank stock comes back to take into record the time-varying properties of the data generating process. Adopting this method, the assumption of homoscedasticity is relaxed to allow me to describe how the variance of the errors evolves. Bollerslev (1987) produced the GARCH (1,1) that explains the time-varying process.

$$\begin{gathered} R_{i,t} = \gamma_0 + \gamma_1 MKT_{i,t} + \gamma_2 INT_{i,t} + \gamma_3 FX_{i,t} + \varepsilon_t \\ \varepsilon_t = \nu_t \sqrt{h_t} \\ h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \end{gathered} \quad (3)$$

Where $R_{it}$is the return of bank stock for country *i* at time *t*, $MKT_{it}$is the change of market index country *i* at time *t*, INT_{it} is the change in interest rate for country *i* at time *t* and $FX_{it}$is the return of exchange rate for country *i* at time *t*. Other parameters are presented as before, ε_t is disturbance term that has a conditional distribution$\left(\varepsilon_{j,t}\middle|\Omega_{t-1}\sim(0,h_t)\right)$and $\nu_t$is and$iid\ (0,1)$process independent of h_t , while $\Omega_{t-1}$is the information set available at time *t*-1. In the conditional variance equation, the ARCH term of the previous period, i.e.ε_{t-1}^2, and one-period lag of GARCH effect, i.e.h_{t-1}, were incorporated into the model.

2. Data

Data includes the stock prices of 44 commercial banks listed[****] in five countries in ASEAN, namely Indonesia (IND), Malaysia (MYS), the Philippines (PHL), Singapore (SGP) and Thailand (THA). The monthly closing prices from January 1997 to December 2015 totaled to 228 observations were collected from the DataStream. The samples started since the period of Asian financial crisis and therefore represent long-term memory.

The three risk factors include market rate, interest rate, and exchange rate. Stock market prices of ASEAN-5 collected from Morgan Stanley Capital International (MSCI) ASEAN indexes are used as the proxy for the market rate variable represented by “MKT”. The one-year government bond yield denotes the interest rate factor, namely “INT” collected from the central bank of each country. For the foreign exchange risk variables “FX”, the real effective exchange rate movement is represented by the percentage rates of change of real effective exchange rate index collected from Bank for Internationals Settlements (BIS).

Results and Discussion

1. Descriptive statistics and Unit Root Test results

Firstly, Table1 provides the return of sample period, rate of market risk, interest rate, and rate of exchange rate. Three of the five countries have positive bank stock returns, except Indonesia and Thailand. The highest mean of the rate of returns is Singapore while the lowest mean is Thailand. Regarding volatility measured by standard deviation, Thailand has the highest volatility of return, followed with Indonesia, Malaysia, the Philippines, and Singapore,

[****] The 44 commercial banks showed in Notes 1.

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respectively. Some of the samples show positive skewness (or skewed to the right). The kurtosis of all countries excesses value of three or has a leptokurtic distribution. It can be observed from the result that the return distributions of all the variables show significant departure from the normal distribution. The p-value of Jarque-Bera statistics exhibits that the null hypothesis of normality of the return distribution can be strongly rejected for all the variables.

For the rate of market index, this statistic showed that all countries are the same because their countries used price index from MSCI ASEAN indexes. However, mean of interest rate is negative in all cases. The Philippines has the highest volatility of interest rate but the lowest shows in Malaysia. For the change in foreign exchange, top of the mean exhibits in Indonesia but the lowest is in Malaysia. The Jarque-Bera point out in the Table 1, which showed three risk factors are not normal distribution explained by the Jarque-Bera test. And the last column tested unit root by Augmented Dickey-Fuller (ADF), the results showed that the variables are stationary.

Table 1 Summary statistics for variables

		Std.			Jarque-Bera Test		
Variable	Mean	Dev.	Skewness	Kurtosis	JB statistics		ADF Test
IND							
Return	-0.00222	0.11392	-0.12374	6.73939	133.42040	0.00000	-12.563***
MKT	-0.00206	0.07955	-0.67493	7.09617	176.7073	0.00000	-11.712***
INT	-0.00351	0.08798	-0.04858	8.63678	301.93580	0.00000	-19.243***
FX	-0.00086	0.06545	-3.36812	34.51610	9867.09800	0.00000	-11.106***
MYS							
Return	0.00161	0.09775	0.39263	11.5100	693.8507	0.00000	-11.524***
MKT	-0.00206	0.07955	-0.67493	7.09617	176.7073	0.00000	-11.712***
INT	-0.00418	0.06340	-1.83513	14.31695	1344.67000	0.00000	-11.524***
FX	-0.00156	0.01957	-0.23522	16.96096	1853.73100	0.00000	-13.028***
PHL							
Return	0.00301	0.08131	0.57214	7.24601	183.7105	0.00000	-12.563***
MKT	-0.00206	0.07955	-0.67493	7.09617	176.7073	0.00000	-11.712***
INT	-0.00807	0.21800	-0.61920	23.45697	3990.20400	0.00000	-15.659***

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera Test JB statistics		ADF Test
FX	0.00010	0.01914	-0.48426	7.29318	184.00970	0.00000	-11.000***
SGP							
Return	0.00425	0.08051	-0.13935	7.14395	163.8753	0.00000	-13.322***
MKT	-0.00206	0.07955	-0.67493	7.09617	176.7073	0.00000	-11.712***
INT	-0.00300	0.18508	-0.43433	6.78410	143.20320	0.00000	-15.404***
FX	0.00011	0.00847	0.01327	4.10142	11.53147	0.00313	-14.105***
THA							
Return	-0.00492	0.12844	0.19026	7.82028	222.1091	0.00000	-12.853***
MKT	-0.00206	0.07955	-0.67493	7.09617	176.7073	0.00000	-11.712***
INT	-0.00794	0.08615	-0.75931	8.29694	288.45590	0.00000	-10.721***
FX	-0.00055	0.02445	-1.88964	22.76527	3847.01400	0.00000	-11.713***

Note: The rate of bank stock returns, market, interest rate, and foreign exchange rate represents Return, MKT, INT, and FX for each country, respectively. ADF: Augmented Dickey-Fuller (ADF) which showed the numbers in parentheses indicate the probability of failing to reject null hypothesis. ***, **, * indicate the significance level at 1%, 5% and 10%, respectively.

2. Heteroscedasticity Results

The checking GARCH model is an appropriate model to estimate the heteroscedasticity test. The result showed in Table 2. From the table, it showed the ARCH effect that all of data could estimate by GARCH methodology.

Table 2HeteroscedasticityTest

Country	ARCH (1) effect	F-Statistic
IND	0.00000***	21.76082
MYS	0.08740*	2.94672
PHL	0.02820**	1.16277
SGP	0.04250**	4.163282
THA	0.09820*	2.75698

Numbers in parentheses indicate the probability of failing to reject the null hypothesis. ***, **, * indicate the significance level at 1%, 5% and 10%, respectively.

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3. The GARCH (1, 1) Empirical Results

The GARCH (1,1) was estimated by maximum likelihood, presented in Table 3 for five countries. The results indicate that market risk variables, i.e.γ_1 are positive and statistically significant at a 1% level for all countries. The highest market risk is Thailand; in contrast, Malaysia is the lowest fluctuation on bank stock return through market risk factor. Additionally, the responsibility of interest rate changing is weak in various countries. There is only one country, namely, Singapore, which shows coefficient γ_2 that is positively significant, whereas the other countries show the insignificance. There are three listed commercial banks in Singapore; hence, an interest rate change is a key indicator to take benefit and competition for profitability, indicating a positive significant factor seems to be related to paper of Elyasiani and Mansur (1998). However, the countries (Indonesia, Malaysia, the Philippines, and Thailand) which have no significance may hedge their interest risk exposure through the use of interest rate derivatives (Ekinci, 2016; Flannery, 1981;Purnanandam, 2007).

Table 3 Maximum likelihood estimate of GARCH (1,1) model of mean and conditional volatility of returns for bank stocks

Variable	IND	MYS	PHL	SGP	THA
γ_0	0.00352	0.00145	0.00526	-0.00159	0.00192***
	(0.25970)	(0.55870)	(0.18150)	(0.58270)	(0.00000)
γ_1	0.84378***	0.61568***	0.68443***	0.81677***	0.91976***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
γ_2	-0.05758	0.01453	-0.00848	0.04022**	0.04260
	(0.16380)	(0.80660)	(0.69280)	(0.02990)	(0.44880)
γ_3	0.26864***	-0.03217	0.19563	0.40129	1.04781***
	(0.00110)	(0.79880)	(0.46840)	(0.18430)	(0.00010)
α_0	0.00002	0.00005	0.00007*	0.00004**	0.00001
	(0.37000)	(0.17500)	(0.06160)	(0.03600)	(0.40070)
α_1	0.06074**	0.22584***	0.04383**	0.03234***	0.01199***
	(0.01620)	(0.00000)	(0.07110)	(0.00000)	(0.00680)
β_1	0.92500***	0.77740***	0.91820***	0.93764***	0.99609***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Adjust R^2	0.48390	0.46981	0.46111	0.45489	0.49624

Note:$R_{i,t} = \gamma_0 + \gamma_1 MKT_{i,t} + \gamma_2 INT_{i,t} + \gamma_3 FX_{i,t} + \varepsilon_t; \varepsilon_t = \nu_t\sqrt{h_t}$;
$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$; where $R_{i,t}$is the return of stock i at time t.$MKT_{i,t}, INT_{i,t}\ and FX_{i,t}$represent respective market index, interest rate change, and exchange rate return at time t. ε_t is disturbance term that has a conditional distribution $\left(\varepsilon_{j,t}\middle|\Omega_{t-1}\sim(0,h_t)\right)$ and $\nu_t$is independent of $h_t$and follow$iid\ (0,1)$process. The conditional variance equation was specified as GARCH (1,1). Numbers in parenthesis indicate the standard errors. *indicates the significance level at 10%, **indicates the significance level at 5%, ***indicates the significance level at 1%, respectively.

It is shown from the results that the coefficient estimates for foreign rate return i.e.γ_3 are positively statistically significant in Indonesia and Thailand. The unexpected movement of FX may produce gains or losses on bank balance sheet. The bank stock returns have been affected by the increase of the FX rate positive. However, Malaysia has only the negative impact on bank stock return through FX factor but insignificant. This result of Malaysia is similarly related to US stock data (Choi & Elyasiani, 1997; Wetmore & Brick, 1994). Thailand has the highest fluctuation in FX because after switching from fixed to floating exchange rate, the regime starts. It may have sensitive effect on the stock market, especially Thai banking sector. This finding is consistent with previous studies (Hooy et al., 2004). Moreover, the fluctuation of FX from a change (positive or negative) explained the movement in the depreciation causes decrease in bank stock returns conversely when appreciation can increase returns by inverse operations.

Considering the estimated parameters of the conditional variance and determined by the time-invariant component of riskα_0, ARCH parameter α_1 and GARCH parameter β_1, their parameters have time varying component in the conditional return general process. The results show that the intercept in term of the conditional variance equation of all countries is positive effect. The row of ARCH $(\alpha_1)$and GARCH effect $(\beta_{1)}$ confirms the suitableness of using GARCH model. It can be observed that the sum of coefficients of the lagged squared error and lagged conditional variance is very close to one, implied that shocks to the conditional variance will be highly persistent. Moreover, ARCH effect is smaller than GARCH effect explaining the conditional variance of bank stocks that previous shock is less sensitive than own lagged volatility.

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Conclusion and Recommendation

This study investigates the sensitivity of ASEAN-5 commercial bank stocks generated from the three risk factors, represented by market, interest rate, and foreign exchange risk from January 1997 to December 2015 using monthly data. The methodology investigates a GARCH (1,1) methodology that allows the volatility to time-varying. This result exhibits that shocks to the conditional variance have a high persistence. Moreover, ARCH effect is smaller than GARCH effect explaining that shock is less sensitive than own lagged volatility. Hence, a new shock in the market is less sensitive to bank stocks than a long memory in the past period.

As a result, the estimated coefficient of market beta is statistically significant and positive for all countries, which are consistent with the market condition, plays a greater role in explaining bank stock returns under the sample period. Similarly, the fluctuation of foreign exchange from a change shows both positive and negative statistically significant in these cases, suggesting that the sensitivity in the exchange rate is an indeed important factor in determining bank stock returns and that depreciation causes decrease in bank stock returns in contrast when appreciation can increase returns by opposite operation.

Although the interest rate risk has insignificance in most countries on bank stock returns, there is only one country, namely, Singapore, shows positive significance; hence, an interest rate change is a key indicator to take benefit and competition for profitability, indicating a positive significant factor seems to be related to the paper of Elyasiani and Mansur (1998).

Recommendation for investors and bankers should closely monitor the foreign exchange rate and market condition since both risks can be explained the bank stock returns in ASEAN-5. Additionally, the bank manager may have adequately hedged their foreign exchange exposure to manage the fluctuation in the exchange rate that can be impacted to bank profitability.

Notes

1. There are 44 commercial banks in five countries.

- 13 banks from Indonesia (Bank Mandiri, Bank Rakyat, Bank Central Asia, Bank Negara, Bank CIMB Niagatbk, Bank Danamon, Bank Permatatbk, Bank Pan Indonesia, Bank International Indonesia, Bank OCBC, Pt Bank Bukopintbk, Bank Tabungan, and Pt Bank Mega Terbuka)
- 10 banks from Malaysia (Malayan Banking, CIMB group, Public Bank, RHB Capital, Hong Leong Finance, Hong Leong Bank, AMMB Holding, AFFIN Holdings, BIMB Holdings, and Alliance financial)
- 8 banks from the Philippines (BDO Unibank, Metropolitan Bank, Bank of the Philippines, Philippine National Bank, China Banking, Rizal Commercial, Security bank, and Union Bank)
- 3 banks from Singapore (Oversea-Chinese Bank, United Overseas Bank, and DBS Bank)
- 10 banks from Thailand (Bangkok Bank, Krung Thai Bank, Siam Commercial Bank, Kasikornbank, Bank of Ayudhya, Thanachart Bank, TMB Bank, Tisco Bank, CIMB Bank, and Kiatnakin Bank)

2. The selection of the GARCH process was estimated by autocorrelation and partial autocorrelation functions of squared errors. The result showed the use of GARCH (1,1) model.

3. The LM-statistic test is not presented here because I conserve space. The results from two tests are consistent.

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