

The Dynamic Relationship of Stock Indexes on Interbank Money Market Rates: Evidence from Thailand

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ABSTRACT: Many researches shed light on investigation the several variables that might be able to influence economic system, this research play an important to identify the relationship of stock indexes on interbank money market rates, we make used of a secondary data by based upon the top ten largest stock exchanges in the world and BIBOR from 2006 to 2011 and applied the simple linear regression model as our model. Over the whole sample period, the result that we have found from the variance decomposition analysis and impulse response analysis there are three important stock indexes which lead up to the BIBOR changes that consists of DJIA, FTSE100, and ASX. Another interesting feature found in this study is that from the Granger causality analysis, the DJIA, NASDAQ, NIKKEI225, FTSE100, TSX, SSE, BOVESPA, ASX, and DAX were found to directly causality on the BIBOR, except the HSI over the sample period.

Keywords: Interbank money market; Bangkok Interbank Offered Rate; Stock indexes

JEL Classifications: G01; G21; G32

1. Introduction

Given the globalization of financial market or several new markets in recent years, it can move money or financial product freely between markets. Thus, the effect of a growth very rapidly in financial market, it is able to increase the volatility of market. As a result, every sector of economy have pay more attention and focus on the recent globalization era to set up some mechanism or seeking the suitable way to solve that problem, to make the economic and financial sectors stability, and soundness of economic system. As, the past few years, financial crisis continued to occur from 2007 till present which cause the recession and also can be lead to a domino effect of economic systems that be transfer between countries. Hence, several part of economic sector have been analyzed the impact of financial turmoil in economic system, for instance, the relative response of financial market, stock market, business cycle to financial turmoil when the global markets have changed.

An important point for interest rate risk is it can affect the other economic variables and changes in the interest rate will lead to an increase in the cost of money which relative to the expected inflation rate, the profitability of investment opportunities and so on. Indeed, the interest rate is a one tool for moving the economic system in the era of the global financial integration, in which interfere with the efficiency of financial intermediaries and market to move funds to people and companies. Therefore,

to ensure the soundness and stability of the financial system the interest rate should be reflect to all factors and conditions that perhaps have a significant sensitivity when the market situation has changes which in accordance with the efficient market hypothesis that the prices in market should be fully reflected all economic variables and the uncertainties of macroeconomic fundamentals (Azad et al, 2012).

The interest rate is a one significant part of Thailand's economy owing to the Bank of Thailand (BOT) used the interest rate to control the inflation rate and economic growth rate in Thailand. Indeed, the BOT's actions affect interest rate, the money supply, and all of which have direct and indirect impacts on financial market. As, Giorgio and Zeno (2011) mentioned that "the central bank is care about monetary policy and financial stability that it might able to be suggestion to assign to central banks a preferred target in term of price stability". The one of the committees which working with the BOT is the Monetary Policy Committee (MPC), they are work and play an important point to the government's policies, the country's economics, and financial environment. Generally, the MPC meets approximately 6 weeks to makes policy decision and to evaluate the determinant of economic and monetary condition by based upon the risk variables, such as the world oil prices, monetary policy in other countries and the world commodity prices which affect an inflation and economic growth. Both of internal and external economic conditions are affect the country's policy and it able to be an indicator for forecast or predict what will happen to the factors that affect the economic system in the next period. Accordingly, the economist should make assessments and the policy decision by base on all conditions that able to be an affect to economic system as well.

An important feature of our analysis here is to understand the stock indexes that determine the changes of interbank money market rates, this research we capture particularly on the interrelationship between two parts of an economic sector that consist of the interbank money market and the stock market, we will analyze the interbank money market rate and the stock index then conclude the dynamic relationship on it. We would like to take an action to more understanding and improve our knowledge on the sensitivity of interbank money market to changes in the stock market. Similarly, we will specify which stock index has more significant affect and be able to forecast the interbank money market rate in Thailand.

The knowledge of the response of BIBOR to stock indexes is crucial not only for the financial institution or financial companies, but also for everyone who takes an interest in interbank money market rate and stock indexes for purposes risk management, portfolio management, asset pricing, and so on. The remainder of the paper is structured as follows. Section 2 provides the theoretical background and literature review. Section 3 details the data and methodology in this study. Descriptions of econometric results are present in section 4. Finally, section 5 conclusions.

2. Theoretical Background and Literature Review

2.1 Definition of Interbank money market

A financial market is a market in which to channel funds from savers (lenders) who have an excess of funds to spenders (borrowers) who have a shortage of funds (Mishkin, 2004), a market that provide financing for business. A well-functional of financial market is a key factor in economic growth which has direct and indirect effects on personal wealth, the business behavior, the consumer behavior, and the cyclical of the economy as well. In recent years, financial market is complex and comprising many different types of market, for instance, bond market, stock market, foreign exchange market, money market. Therefore, all of financial markets should relevant to each other in which when one market

face fluctuates the other market should be face that affect too which in accordance with the efficient market hypothesis (EMH). As the theory of the efficient market (Fama, 1970) that mentioned “anytime the information can be effect to the prices and fully reflect available information in the market”. As, Mishkin (2004) noted more detail definition that is “all prices are always correct and reflect market fundamental”. In addition to, the efficient market hypothesis, it can classify into three types which consist of, 1) weak-form, 2) semi strong-form, and 3) strong-form (Shleifer, 2000; Stephen et al., 2005). Consequently, interbank rates adjustment must reflect instantaneously to news, information, and economic variables in the market following the efficient market hypothesis. Therefore, researchers must take into account the efficient market hypothesis in their analysis of financial market by investigating all conditions that might affect to the prices in market and market fluctuation to increase high understanding for reducing their risk and to plan for the future.

The interbank money market refers to a market which transfers funds from one to the other or a moving of funds from lenders to borrowers by financial market, the markets for trading in the money market such a short-term debt or securities which the debt or securities are issues with maturities of at less than 1 year. Nevertheless, the commercial bank lending had an impact from the monetary policy and relation on the economic activities (June and Pronkamol, 2007). As, Anoop et al. (2007) noted that “when monetary policy had changes many countries also change their discount rates especially the short-term rates than long-term rates”. In practice, the most lenders and borrowers in interbank money market are the financial institutions such a bank. For transactions, the bank borrowers must pay for borrowing the money to the bank lender with the interbank rate.

A financial institution is important sources of financing that provide a financial service such raise money from investors and provides financing for other investors who want to borrow the money. Simultaneously, the financial institution’ aim is to lend to good borrowers and reject bad borrowers (Xiaofen, 2007) because they are concerning about the default risk however Tor and Kasper (2003) have found the size of small consumer loan does not influence default risk of a bank lending policy. Besides, Leonardo et al (2004) suggested that “the response of bank lending to a monetary policy shock has an expected negative sign”. For corporations, financial institution is an intermediary that service to both of the companies and depositors. Usually, to cover the bank’s cost of service the financial institution will charge the borrowers with a higher interest rate than they pay for depositors. And basically, the financial institutions become more concern about reducing the risk that their institutions faced and they also want to be sure that the counterparty be honest and not default on the loan or obligations.

Indeed, there are many variables that might cause of fluctuations both of direct and indirect in interest rate, such as common macroeconomic risk factors (Mathias et al, 2010). And, we also can call those variables that able to fluctuate in interest rate as risk in which the degree of risk or uncertainty can affect the demand and supply of funds as well. Theoretically, there are two types of risk; systematic risk and unsystematic risk (Stephen et al, 2005). In systematic risk, it is the part of an asset’s risk which refers to any risks that affect a large number of assets, each to a greater or lesser degree. In unsystematic risk, refers to a risk that specifically affects a single asset or a small group of asset thereby it able to be eliminated in a diversified portfolio (Mishkin, 2004). According to the definition of risk or uncertainty above, we can write the total risk of an asset as being made up of systematic risk and unsystematic risk:

$$\text{Total Asset Risk} = \text{Systematic Risk} + \text{Unsystematic Risk} \quad (1)$$

2.2 Definition of Interbank offered rates

The financial institution and financial companies face the important effect from the interest risk and default risk (Sanjay, 1996; Mathias et al, 2010) especially during the financial crisis which fiscal policies in many countries had led to increased fears of sovereign default (Andreas, 2011). As a cause of the sovereign debt of Spain, Portugal, Ireland, Greece and other developing countries that had been downgraded in credit rating (Huixin, 2012). However, the improving of country's international credit has an effect from the monetary policy (Paschakis and Smithin, 1998) and decrease in default risk able to reduce the interest rate spread (Noh-Sun, 2002). In addition, high volatility in interest rate with the significant level of financial leverage has contributed to the growing relevance of interest rate exposure (Laura et al, 2011).

An interest rate is a cost of borrowing that borrows must pay for lending the money from lender in which the interest rate usually expressed as a percentage of the principle. Besides, changes in the interest rates have a significant impact on financial institutions, business, and the overall economy as well.

In the past decade till recently, many financial economists engage in research on the effect of financial turmoil that can have a devastation effect on economic system, monetary policy, financial fluctuation, stock volatility and among other topics. Likewise, they have increase their focus and explain the volatility in interest rates because of the interest rates are a significant part of economy and have an effect on the overall health of the economy such a willingness to spend or save and investment decisions. In actually, there are many interest rates in the economic system in which we can separate the interest rates into two types, 1) short-term interest rate is the interest rate on a loan with a maturity not excess one year, and 2) long-term interest rate is the interest rate on loan that maturity over one year. Generally, the short-term interest rates are also called money market rates in which the interbank money market rate is the one of short-term interest rate. In monetary policy, the short-term interest rate is more significant effect on it. Following some evidence from previous study, short-term interest rate in financial market such a short term securities repurchase agreements (repos) does a one of indicator in monetary policy (Kay and Dieter, 2001), and also an important input for business cycle analysis (Chew et al, 2013). However, the volatility in financial markets (Faff and Haward, 1999), and the macroeconomic variables have an influence on short-term interest rate (Thomas and Michele, 2007) which consistent result with Ming et al. (2008), they noted that "the monetary policy rate had influence and faster adjustment speed on short-term interest rate". Similarly, monetary policy also had a significant impact on long-term interest rate (Hakan and Richard, 2009).

Thailand's interbank money market rate is called the Bangkok Interbank Offered Rate (BIBOR), which quoted by the Bank of Thailand (BOT) in every working day at 11:15 AM (Bangkok time). The BIBOR is the interest rate in which banks can borrow THB funds from other banks in the Bangkok interbank market. Formally, in Thailand's money market, the BIBOR was effective from 2005 and the BOT try to promote the BIBOR to financial institutions for using the BIBOR to be a reference rate or underlying in financial transactions. The tenors of BIBOR are composed of, 1 week, 1 month, 2 months, 3 months, 6 months, 9 months, and 12 months. In economics, short-term interest rate such interbank money market rate is the better indicator to specify the monetary policy and it can reflect the real situation in financial market.

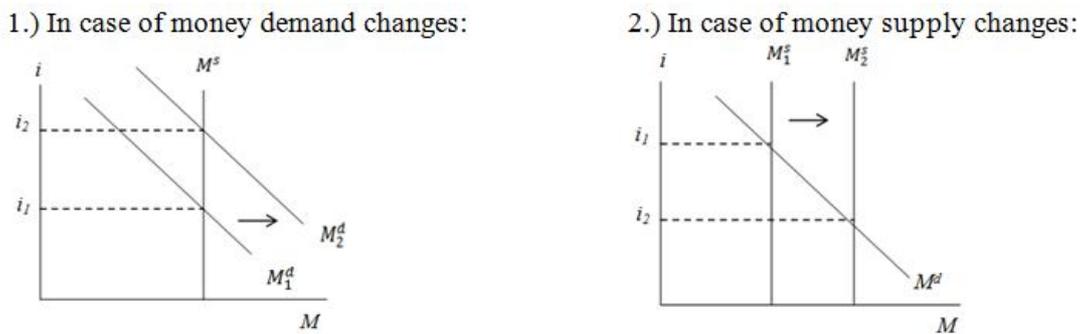
In order to calculate the interest rate following the economic theory we have to consider the vital variables that might affect the supply and demand of funds. Basically, in the case of a simple loan the formula for calculation a simple interest rate is follows equation:

$$I = P x r x t \quad (2)$$

where I is the interest rate, P is the principle, r is the percentage of interest rate, and t is the timing of loan.

Theoretically, change in variables that might influence the interest rate changes such income, and money supply that able to shift the interest rate as follows:

Figure 1. Interest rate shift when money demand and money supply changes (adopt from Mishkin, 2004)



Notes: i = Interest Rate, M = Quantity of Money, M^d = Money Demand, M^s = Money Supply

As we can see in figure 1, the changes of money demand and money supply on interest rate. In economic system, the amount of money demand and money supply both have a significant effect to the interest rate. When the money demand increase owing to during a business cycle expansion or when recovery begin in which other economic variables are constant as a result the interest rate will increase. Conversely, in a recession the money supply rises when everything else remaining equal thereby an interest rate will decrease.

In practice, all of financial transactions in Thailand's money market are only use a reference rate such BIBOR, THBFIX to be an underlying asset. And, the method to calculate the BIBOR is the BOT will calculated from the average of rate which derived by eliminating the first two highest and lowest of the quotes and arithmetic-averaging the remaining rates for the day. Meanwhile, the method to calculate the THBFIX or Thai Baht Implied Interest Rate, which refers to an interest rate for lending in Thai Baht, it is defined by the following formula:

$$THBFIX = \left[\left(\frac{FWD}{SPOT} \right) \times \left(1 + SIBOR \times \frac{DAYS}{360} \right) \right] \times \frac{365}{DAYS} \quad (3)$$

where $THBFIX$ is the Thai Baht Interest Rate Fixing, FWD is the average USD/THB forward exchange rate, $SPOT$ is the average USD/THB spot exchange rate, $SIBOR$ is the US Interest rate for the respective tenor, $DAYS$ is the number of day.

Usually, the data for the BIBOR is published by the BOT at 11:15 AM (Bangkok time) every working day, the THBFIX is published by the Reuters at 11:00 AM (Bangkok time) every business day.

As mentioned before, the issue of interest rate risk is more interest to everyone and there are many variables that might impact on interest rate. As, Elyas and Iqbal (1998) noted that "a sensitively of the bank stock returns distribution has a significant impact from the interest rate and interest rate volatility", Oldrich (2005) described the interest rate should be set by supply and demand of borrowing and lending, production opportunities in the economy, time preference for consumption, attitude toward risk, return of the participants in the economy, and the distribution of wealth across the participants". Accordingly, in this study we have assume the sensitivity of an interest rate such

BIBOR might has a significant impact from the economic variable such the stock indexes thereby we will explore the correlation between Thailand's money market rate such BIBOR and stock indexes to understand the response of the BIBOR to the changes of stock indexes during the sample period.

2.3 Definition of stock market

The stock markets are also called equity market which refers to a market where securities such a share of stock are issued and traded. Moreover, the stock market is probably the one important financial market in which when the company decides to go public for helping the firm's investment the one choice is by issuing shares on a stock market (primary market) that called an initial public offering (IPO) and the buyers become part-owners of the firm. However, if the investors do not want to hold their securities anymore the secondary market allows investors to trade securities among themselves.

Not surprisingly, the financial system is complex in structure and function as a result the financial market becomes a dramatic increase in risk or uncertainty. Obviously, many stock markets are moving toward trading the stock, simultaneously the investors are trying to explore the new investment channel to add more their investment opportunity as well as to decrease risk that may effect to their profitability. As a result, in the past few years until recently, we will find not only an investor who wants to avoid risk but also the financial institutions, they are decided to eliminate the risk that could happen in the future.

In the past, stock prices have been extremely volatile particularly during the financial crisis that started from the end of 2007, this is a major disruption in financial market because of the crisis is caused by instability of the market and lead to a contraction in economic activity. Similarly, fluctuation of the stock prices in stock market is very excited and affects the size of investor's wealth and their willingness to spend. As, Thomas et al (2006) suggested that "the stock market situation such a bluish market can motivate and be very attractive for investor behavior.

As well-know, many previous studies claimed that the stock market risk is about the volatility of the stock prices with many variables in economic system. However, some evidence found the variable in which might affect the prices stability is the monetary policy (Viv and Devid, 1998), moreover and an affect of global, country and industry factors had a significant sensitivity when the stock market fluctuation (Mohan and Shawkat, 2007). Likewise, Hui (2004) noted that "the federal funds rate target and the monetary shocks had a significant impact to stock prices especially when the business conditions is bad", the politics, economy, and financial sector both of inside and outside of countries have an effect to stock prices, the investor's markets sentiment and the instability of market (Kasimir and Lasse, 2008), and consistent with some evidence of Chun-Li (2011) and Timo (2011) they have found the stock returns are reached to unanticipated increase in the federal funds rate.

Besides, for this study we take into account to analysis the correlation between interbank money market rates and stock indexes in case of Thailand's money market in which some evidence of previous study that related to our study is Praphan and Subhash (2002), they have suggested that an interest rate had a negative long run relationship on stock prices in Philippines, Singapore and Thailand whereas a positive relation in Indonesia and Malaysia. And, the money growth in Malaysia, Singapore, and Thailand has a positive impact to stock market.

Consequently, there are several reasons to take an interest in stock market risk and interest rate risk, Noh-Sun (2002) mentioned that "the financial variables such stock prices and interest rate are adjusted to new information much faster than real variables therefore it have been used as lending indicators to predict future condition of the real economy", Federico (2002) suggested that "it as a key economic

variable linking and monetary phenomena which it had implications for the pricing of fixed-income securities and derivatives, and it was a benchmark to evaluate asset pricing". Therefore, in this study we would like to explain the movements in the stock indexes affect BIBOR and the overall correlation between variables by making a clearly understand and help us answer questions how changes in the stock indexes will affect the Thailand's money market rate such BIBOR.

3. Data and Methodology

3.1 Data

To examine the sensitivity of the interbank money market rates to changes in the stock indexes, in this study we have collected the secondary data from the Bank of Thailand (BOT) that cover the sample period from January 2006 to December 2011. The time series data of interbank money market rate is the BIBOR for tenor running from 1 week, 1 month, 2 months, 3 months, 6 months, 9 months, and 12 months. Consider ten stock indexes to be our independent variable, we base the data on the ten largest stock exchanges in the world by market capitalization in 2011 (www.world-stock-exchanges.net/top10.html), are composed of Dow Jones Industrial Average (DJIA), NASDAQ Composite (NASDAQ), Nikkei heikin kabuka (NIKKEI225), FTSE (FTSE100), SSE Composite (SSE), Hang Seng (HSI), TSX Composite (TSX), BM&F Bovespa (BOVESPA), S&P/ASX (ASX), and Deutscher Aktien (DAX).

For reason why we examine the relationship between BIBOR and stock indexes is that because of the interest rate is a one part of monetary policy in which the central bank such BOT used it for control the economic growth. Moreover, as well-know, the top ten of stock markets in the world have a significant impact on the other stock market which has a market capitalization smaller than them. Besides, we are in the global market era that several risks in one market able to be affected other market which in accordance with the efficient market hypothesis. Thus, in this study we have assumed the interbank money market should response to the stock index because they are in the financial markets. For this study we based the stock indexes on the top ten largest stock markets in the world by market capitalization and we intently to assess which stock index has important significant effect on BIBOR.

3.2 The econometric model

In order to explore the correlation between variables, there are many tools to study and explain on it however in this study we have focus only on the relationship between BIBOR and stock indexes thereby we have applied a simple model of regression model in econometric test to be our model to help us understand a movement in stock index that have occur the changes of BIBOR by using the BIBOR to be a dependent variable and the stock indexes to be an independent variable. Following Engle and Granger, we have applied the multiple linear regression models as follows:

$$BIBOR_t = \alpha_0 + \alpha_1 Stock\ Indexes_t + \varepsilon_t \quad (4)$$

where α_0 and α_1 are a parameters, $BIBOR_t$ is the Bangkok Interbank Offered Rate, $Stock\ Indexes_t$ is the top ten largest stock market in the world by market capitalization which consist of DJIA, NASDAQ, NIKKEI225, FTSE100, SSE, HSI, TSX, BOVESPA, ASX, and DAX, and ε_t is an Error term.

This equation tries to telling us about the correlation between dependent variable and independent variable in which our hypothesis in this study we have assumed the BIBOR and stock index should be relevant to each other. Consequently, as mentioned above we will start to explore the relationship between variables with the econometric test start from unit root test, Granger causality analysis,

variance decomposition analysis, and impulse response function analysis, respectively. The result from this study will describe the stock indexes process on BIBOR changes to help us understand the complexity of Thailand's money market rates.

4. Econometric Results

As mentioned in previous part, this study we have used the econometric test to explain the interrelationship between our variables by modify the multiple regression model. We specific investigated the dynamic relationship of the top ten stock indexes in year 2011 by based on the market capitalization on BIBOR during the sample period running from January 2006 to December 2011. Then, we have presented the econometric result as follows, the first subsection was the unit root test, the second subsection was the Granger causality analysis, the third subsection was the variance decomposition analysis, and the last subsection was the impulse response function analysis.

4.1 Unit Root Test

Before going on to analyze the correlation between the BIBOR and stock indexes, firstly we must taking into account the stationary of data. Regarding our study using the time series data of BIBOR and stock index in which the data might non-stationary thus it be able to effect to the result of econometric test as a spurious regression or a spurious relationship between variables thereby we must test a stationary before investigate the interrelationship by econometric test. For this study, our tool to test a stationary we will use a unit root test with Augmented Dickey-Fuller (ADF).

Table 1. Unit root-ADF test (Trend and intercept)

Variable	Level	Lag ¹	Equation test	t-statistic	MacKinnon Critical
BIBOR 1 week	1 st difference	0	With trend and intercept	-3.40968	-3.16505***
BIBOR 1 month				-3.41096	-3.16505***
BIBOR 2 months				-3.50547	-3.47531**
BIBOR 3 months				-3.49480	-3.47531**
BIBOR 6 months				-3.43216	-3.16505***
BIBOR 9 months				-3.44452	-3.16505***
BIBOR 12 months				-3.49548	-3.47531**
DJIA				-6.61169	-4.09455*
NASDAQ				-7.03415	-4.09455*
NIKKEI225				-7.30297	-4.09455*
FTSE100				-7.66589	-4.09455*
SSE				-8.42820	-4.09455*
HSI				-7.39586	-4.09455*
TSX				-6.53811	-4.09455*
BOVESPA				-6.88139	-4.09455*
ASX				-6.28011	-4.09455*
DAX	-7.09778	-4.09455*			

Note: Lag¹ = Length (Automatic based on SIC); * = Significant at 0.01; ** = Significant at 0.05; *** = Significant at 0.10.

Following the role of stationary in which the t-statistic value must less than the MacKinnon critical value. From the unit root test with ADF in table 1 shows us, all of our variables had the t-statistic

value less than the Mackinnon critical value. The BIBOR 1 week, 1 month, 2 months, 3 months, 6 months, 9 months, and 12 months were rejected the null hypothesis at the 1st difference. Also, the stock index which consists of the DJIA, NASDAQ, NIKKEI 225, FTSE 100, SSE, HIS, TSX, BOVESPA, ASX, and DAX were rejected the null hypothesis at the 1st difference. To sum up, our variables were stationary at 1st difference with the significant level at 1%, 5%, and 10%.

4.2 Granger Causality analysis

Obviously, the performance of an economic in every countries are depending on the monetary policy, such as money supply, exchange rate, and interest rate, and the fiscal policy such government's revenue and expenses in which both of monetary and fiscal policies must influence each other. Therefore, that suggest the interbank money market rates and stock indexes should have a significant effect to the performance of an economic as well. Thus, this subsection intends to analyze the causality of the variables to explain the causes and effects following Granger (1969). We have used the above concept to explain the relationship between interbank money market rates and stock indexes.

Table 2. Granger Causality Test

Null Hypothesis:	p - values						
	1 week	1 month	2 months	3 months	6 months	9 months	12 months
DJIA does not Granger Cause BIBOR	0.1060*	0.1443*	0.1303*	0.1307*	0.1415*	0.1383*	0.1354*
BIBOR does not Granger Cause DJIA	0.7260	0.8606	0.8476	0.8051	0.7639	0.7571	0.7581
NASDAQ does not Granger Cause BIBOR	0.0432*	0.0563*	0.0486*	0.0498*	0.0607*	0.0650*	0.0723*
BIBOR does not Granger Cause NASDAQ	0.7483	0.7355	0.7117	0.6999	0.6639	0.6228	0.5862
NIKKEI 225 does not Granger Cause BIBOR	0.0593*	0.0540*	0.0646*	0.0749*	0.0823*	0.0823*	0.0819*
BIBOR does not Granger Cause NIKKEI225	0.7584	0.6020	0.6289	0.6904	0.8013	0.8520	0.8972
FTSE 100 does not Granger Cause BIBOR	0.0375*	0.0295*	0.0298*	0.0296*	0.0314*	0.0327*	0.0334*
BIBOR does not Granger Cause FTSE100	0.8672	0.9847	0.9913	0.9854	0.9688	0.9567	0.9410
SSE does not Granger Cause BIBOR	0.6385	0.1213*	0.1313*	0.1865	0.3532	0.4309	0.5341
BIBOR does not Granger Cause SSE	0.0964*	0.0763*	0.0879*	0.1083*	0.1825	0.2580	0.3265
HSI does not Granger Cause BIBOR	0.2373	0.2383	0.2326	0.2320	0.2516	0.2545	0.2633
BIBOR does not Granger Cause HSI	0.5601	0.4149	0.4228	0.4776	0.5507	0.5489	0.5237
TSX does not Granger Cause BIBOR	0.0291*	0.0267*	0.0243*	0.0237*	0.0273*	0.0260*	0.0276*
BIBOR does not Granger Cause TSX	0.8934	0.8038	0.7915	0.8226	0.8602	0.8675	0.8440
BOVESPA does not Granger Cause BIBOR	0.2601	0.2681	0.2334	0.1969	0.1469*	0.1177*	0.0918*
BIBOR does not Granger Cause BOVESPA	0.0350*	0.0202*	0.0189*	0.0196*	0.0218*	0.0191*	0.0157*
ASX does not Granger Cause BIBOR	0.2177	0.2194	0.1879	0.1572	0.1480*	0.1078*	0.0930*
BIBOR does not Granger Cause ASX	0.7629	0.5459	0.5071	0.5615	0.6473	0.7027	0.7307
DAX does not Granger Cause BIBOR	0.1270*	0.1767	0.1757	0.1581	0.1363*	0.1276*	0.1100*
BIBOR does not Granger Cause DAX	0.9449	0.9475	0.9149	0.9275	0.9349	0.9324	0.9289

Note: * = reject null hypothesis at significant level 10%

To clearly understand in the causality which stock index does a cause the BIBOR and how much causality on it, from table 2 we have found the results of causality test between BIBOR and stock index are as follows:

- 1.) The causality of the BIBOR and DJIA: the DJIA does a cause BIBOR in every tenor.
- 2.) The causality of the BIBOR and NASDAQ: the NASDAQ does a cause BIBOR in every tenor.
- 3.) The causality of the BIBOR and NIKKEI225: the NIKKEI225 does a cause BIBOR in every tenor.
- 4.) The causality of the BIBOR and FTSE100: the FTSE100 does a cause BIBOR in every tenor.
- 5.) The causality of the BIBOR and SSE: The SSE does a cause BIBOR only tenor 1 month and 2 months.
- 6.) The causality of the BIBOR and HSI: the HIS does not a cause BIBOR in every tenor.
- 7.) The causality of the BIBOR and TSX: the TSX does a cause BIBOR in every tenor.
- 8.) The causality of the BIBOR and BOVESPA: the BOVESPA does a cause BIBOR only in tenor 6 months, 9 months, and 12 months.
- 9.) The causality of the BIBOR and ASX: the ASX does a cause BIBOR only in tenor 6 months, 9 months, and 12 months.
- 10.) The causality of the BIBOR and DAX: the DAX does a cause BIBOR in tenor 1 week, 6 months, 9 months, and 12 months.

To summarize, the causality of stock index on BIBOR follow the Granger causality analysis that suggest the DJIA, NASDAQ, NIKKEI225, FTSE100, and TSX were causality on BIBOR in every tenor. Besides, the SSE, BOVESPA, ASX, and DAX were causality on BIBOR in some tenor. Conversely, the HSI was the only one stock index does not cause BIBOR in every tenor.

4.3 Variance Decomposition analysis

According to our assumption, the uncertainty about the stock market might have a significant impact to the interbank money market therefore the financial institutions which trading on interbank money market should pay more attention on the stock market because of the information or news in both internal and external of market always implied to each other as well. Hence, all activities that happen on the market will be a positive or negative impact to financial institutions so we called the bank's risk.

In previous subsection, we have investigated the causality of stock indexes on BIBOR to answer our assumption which stock index does a cause the BIBOR. Here, our analysis in this subsection we need to examine the sensitivity of the BIBOR to changes in the stock indexes by using the variance decomposition analysis for explore the short-run and long-run relationships of our variables.

As we have seen from variance decomposition analysis in table 3, the DJIA, FTSE100, and ASX seem like they had more significant relation on BIBOR in every tenor than other stock indexes. Additionally, we also found the stock indexes were varying directly with the tenor of BIBOR.

Table 3. Variance Decomposition Test

Period	S.E.	BIBOR 1w	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.121	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.198	97.198	0.102	0.263	0.026	0.001	0.329	0.444	0.004	1.196	0.437	0.000
3	0.276	87.451	0.843	0.173	1.327	0.126	0.220	2.918	0.243	3.249	3.450	0.000
4	0.371	74.341	3.034	0.158	3.670	0.915	0.123	3.793	1.713	5.064	7.166	0.023
5	0.479	63.061	5.858	0.320	5.373	2.608	0.137	3.120	3.149	5.785	10.549	0.040
6	0.591	54.906	8.529	0.488	6.336	4.749	0.269	2.276	3.833	5.914	12.674	0.026
7	0.695	49.328	10.809	0.598	6.723	7.006	0.455	1.672	3.747	5.815	13.815	0.033
8	0.787	45.558	12.609	0.659	6.740	9.248	0.655	1.305	3.275	5.687	14.191	0.073

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9	0.864	42.932	13.965	0.695	6.517	11.352	0.855	1.096	2.762	5.601	14.064	0.161
10	0.928	40.959	14.960	0.720	6.198	13.191	1.048	0.980	2.403	5.563	13.670	0.307
Period	S.E.	BIBOR 1m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.111	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.191	94.920	0.643	0.659	0.000	0.403	1.529	1.767	0.013	0.026	0.026	0.014
3	0.267	85.993	0.773	0.400	2.260	1.622	1.086	5.101	0.585	0.227	1.905	0.048
4	0.363	73.436	2.818	0.217	5.705	2.817	0.637	5.824	2.362	0.591	5.566	0.027
5	0.474	62.588	5.613	0.202	7.936	5.024	0.402	4.558	4.047	0.653	8.958	0.017
6	0.586	54.954	8.288	0.281	8.920	7.497	0.408	3.227	4.796	0.554	11.051	0.025
7	0.690	49.758	10.678	0.351	9.222	9.874	0.537	2.346	4.594	0.443	12.124	0.074
8	0.781	46.278	12.648	0.387	9.087	12.118	0.709	1.838	3.968	0.365	12.434	0.168
9	0.856	43.875	14.178	0.407	8.669	14.181	0.897	1.559	3.340	0.314	12.253	0.328
10	0.918	42.063	15.330	0.422	8.143	15.939	1.092	1.411	2.922	0.283	11.822	0.571
Period	S.E.	BIBOR 2m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.112	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.195	93.816	0.637	0.473	0.011	0.912	1.728	1.908	0.020	0.255	0.030	0.211
3	0.269	84.648	0.816	0.298	1.858	3.169	1.261	5.367	0.726	0.153	1.585	0.120
4	0.362	71.931	3.340	0.171	4.944	4.815	0.733	6.100	2.583	0.229	5.083	0.071
5	0.471	60.932	6.651	0.126	6.977	7.298	0.487	4.668	4.304	0.192	8.322	0.042
6	0.582	53.201	9.668	0.157	7.780	9.922	0.514	3.231	5.065	0.128	10.272	0.061
7	0.684	47.863	12.331	0.187	7.967	12.325	0.668	2.340	4.826	0.098	11.249	0.146
8	0.772	44.218	14.530	0.196	7.758	14.535	0.862	1.863	4.154	0.088	11.504	0.291
9	0.846	41.650	16.233	0.197	7.289	16.552	1.071	1.631	3.495	0.083	11.286	0.515
10	0.907	39.673	17.511	0.199	6.735	18.251	1.285	1.533	3.068	0.077	10.829	0.838
Period	S.E.	BIBOR 3m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.113	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.202	94.254	0.604	0.201	0.000	0.821	1.530	1.414	0.074	0.408	0.042	0.652
3	0.279	85.917	0.736	0.123	1.836	3.236	1.135	4.212	0.948	0.215	1.262	0.382
4	0.372	73.622	3.269	0.091	4.778	5.128	0.670	4.848	2.883	0.195	4.289	0.228
5	0.481	62.834	6.661	0.055	6.570	7.728	0.450	3.642	4.674	0.150	7.093	0.144
6	0.590	55.231	9.748	0.048	7.148	10.432	0.477	2.478	5.487	0.099	8.739	0.113
7	0.690	49.880	12.490	0.048	7.198	12.868	0.624	1.825	5.259	0.083	9.547	0.179
8	0.777	46.122	14.783	0.044	6.930	15.067	0.810	1.541	4.562	0.079	9.740	0.322
9	0.848	43.402	16.573	0.039	6.450	17.056	1.010	1.465	3.865	0.077	9.514	0.548
10	0.908	41.258	17.925	0.038	5.914	18.730	1.216	1.496	3.396	0.071	9.078	0.877
Period	S.E.	BIBOR 6m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.113	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.210	93.955	0.529	0.076	0.001	0.960	0.926	1.069	0.130	0.963	0.003	1.389
3	0.291	86.368	0.574	0.061	1.370	3.678	0.782	3.167	1.118	0.667	1.274	0.941

4	0.384	75.117	2.967	0.165	3.733	5.863	0.492	3.482	2.972	0.384	4.216	0.609
5	0.490	64.737	6.271	0.210	5.081	8.636	0.327	2.496	4.771	0.238	6.846	0.387
6	0.597	57.149	9.289	0.209	5.346	11.496	0.355	1.685	5.672	0.163	8.341	0.296
7	0.693	51.609	11.991	0.215	5.219	14.016	0.496	1.375	5.510	0.133	9.047	0.389
8	0.776	47.527	14.298	0.232	4.902	16.216	0.683	1.392	4.830	0.118	9.201	0.601
9	0.844	44.431	16.136	0.241	4.471	18.148	0.890	1.580	4.125	0.106	8.967	0.905
10	0.901	41.913	17.551	0.232	4.038	19.740	1.103	1.845	3.645	0.095	8.530	1.309
Period	S.E.	BIBOR 9m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.117	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.221	94.075	0.386	0.033	0.036	1.110	0.863	0.635	0.157	1.342	0.012	1.351
3	0.307	86.945	0.588	0.083	1.683	3.803	0.791	2.312	1.015	1.036	0.856	0.889
4	0.401	75.788	3.240	0.427	4.298	5.983	0.532	2.715	2.533	0.609	3.310	0.564
5	0.508	65.218	6.812	0.648	5.741	8.767	0.341	1.949	4.143	0.384	5.644	0.354
6	0.613	57.350	10.054	0.727	5.980	11.627	0.327	1.346	5.028	0.263	6.974	0.324
7	0.708	51.469	12.949	0.788	5.793	14.106	0.429	1.226	4.929	0.201	7.588	0.523
8	0.789	47.030	15.431	0.850	5.419	16.221	0.584	1.404	4.328	0.164	7.716	0.853
9	0.855	43.612	17.417	0.877	4.943	18.046	0.765	1.728	3.705	0.139	7.503	1.263
10	0.910	40.843	18.937	0.854	4.475	19.526	0.956	2.106	3.309	0.123	7.110	1.760
Period	S.E.	BIBOR 12m	DJIA	NASDAQ	NIKKEI 225	FTSE 100	SSE	HSI	TSX	BOVESPA	ASX	DAX
1	0.124	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.237	94.018	0.225	0.044	0.096	1.239	0.667	0.459	0.157	1.624	0.000	1.471
3	0.327	86.590	0.628	0.201	1.812	4.041	0.695	1.886	1.012	1.327	0.835	0.973
4	0.423	75.144	3.478	0.859	4.318	6.456	0.500	2.253	2.407	0.805	3.164	0.615
5	0.530	64.303	7.169	1.339	5.622	9.428	0.323	1.615	3.916	0.517	5.374	0.394
6	0.634	56.163	10.490	1.565	5.760	12.366	0.297	1.157	4.763	0.362	6.638	0.438
7	0.728	50.035	13.424	1.727	5.506	14.830	0.380	1.161	4.671	0.275	7.225	0.767
8	0.806	45.379	15.921	1.864	5.092	16.870	0.518	1.440	4.100	0.225	7.356	1.236
9	0.871	41.790	17.904	1.923	4.608	18.580	0.685	1.848	3.526	0.197	7.161	1.778
10	0.924	38.913	19.404	1.883	4.156	19.920	0.866	2.301	3.191	0.183	6.794	2.389
Cholesky Ordering: BIBOR, DJIA, NASDAQ, NIKKEI 225, FTSE 100, SSE, HIS, TSX, BOVESPA, ASX DAX												

4.4 Impulse Response Function analysis

To clarify the relationship between BIBOR and stock index we will continue to test the impulse responses in which this analysis able to make others know of relation between variables because of the impulse responses analysis can show us a direction of relationship as negative or positive, more than this we also know a short-run relationship and long-run relationship as well.

The impulse response' graphs shown us the impact of stock indexes shocks on BIBOR as follows:

- 1.) The DJIA: the DJIA shock on BIBOR was positive relation in every tenor and increased from the short-run throughout long-run however it was little fell in the long-run.
- 2.) The NASDAQ: the NASDAQ shock on BIBOR was positive relation in tenor 1 week, 1 month, 2 months and 3 months afterward in 6 months, 9 months, and 12 months was negative relation.

- 3.) The NIKKEI225: the NIKKEI225 shock on BIBOR was seems like the DJIA that it was positive relation but the degree of change was less than DJIA.
- 4.) The FTSE100: the FTSE100 shock on BIBOR was positive relation in every tenor moreover it was increased from short-run throughout long-run.
- 5.) The SSE: the SSE shock on BIBOR was seems like the NASDAQ but the degree of positive relation on SSE shock is more than NASDAQ.
- 6.) The HSI: the HSI shock on BIBOR was positive relation in short-run but in long-run it was negative relation especially from tenor 2 months till tenor 12 months.
- 7.) The TSX: the TSX shock on BIBOR was positive relation and it was increased in short-run whereas in long-run it was decreased.
- 8.) The BOVESPA: the BOVESPA shock on BIBOR was negative relation especially in tenor 1 week however after tenor 1 week the degree of negative relation was decreased.
- 9.) The ASX: the ASX shock on BIBOR was negative relation in every tenor of BIBOR and began from short-run until long-run.
- 10.) The DAX: the DAX shock on BIBOR was negative relation in every tenor particularly in tenor 12 months which the degree of negative relation in short-run was less than long-run.

In sum up, from the impulse response analysis in which presented the response of the BIBOR to changes in the stock indexes, this subsection found the stock indexes especially the DJIA, FTSE, and ASX had more significant effect to BIBOR than other stock indexes due to the degree of relationship on BIBOR of DJIA, FTSE, and ASX shocks were higher.

Figure 2. Impulse responses of BIBOR 1 week to stock index.

Response to Cholesky One S.D. Innovations ± 2 S.E.

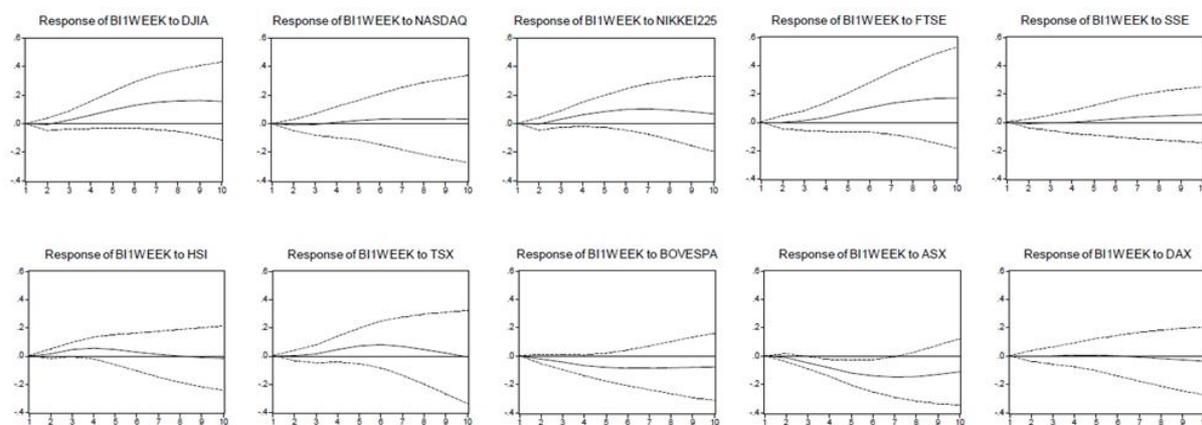


Figure 3. Impulse responses of BIBOR 1 month to stock index.

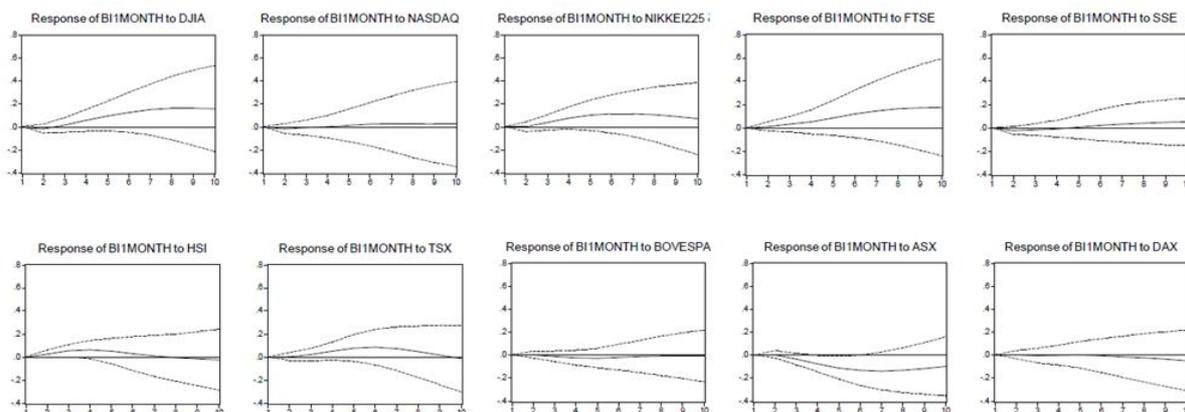


Figure 4. Impulse responses of BIBOR 2 months to stock index.

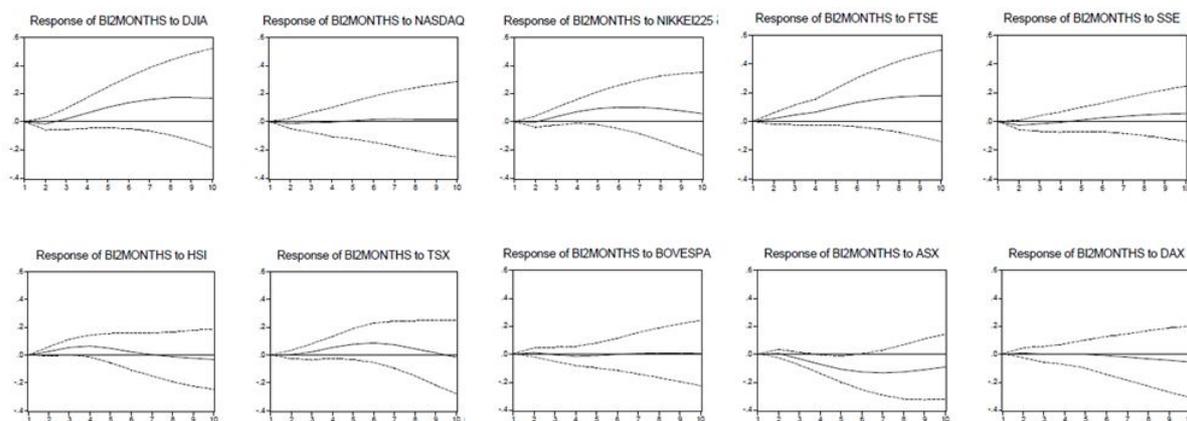


Figure 5. Impulse responses of BIBOR 3 months to stock index.

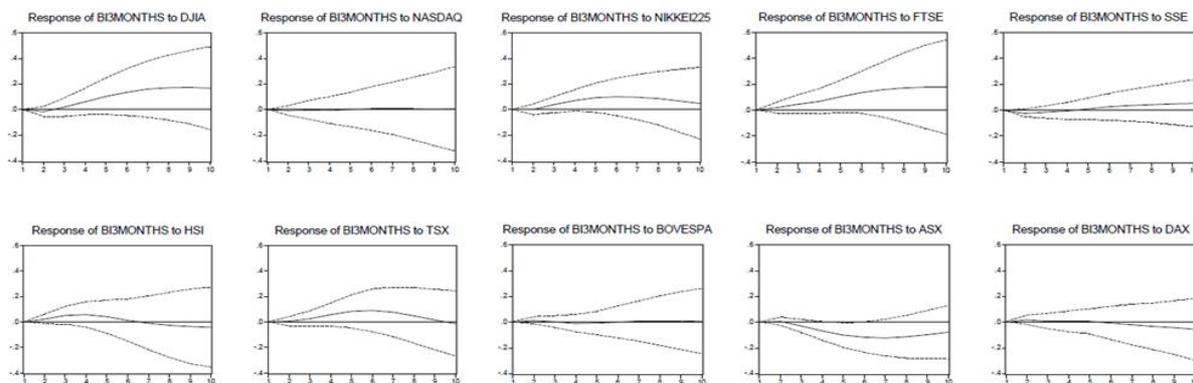


Figure 6. Impulse responses of BIBOR 6 months to stock index.

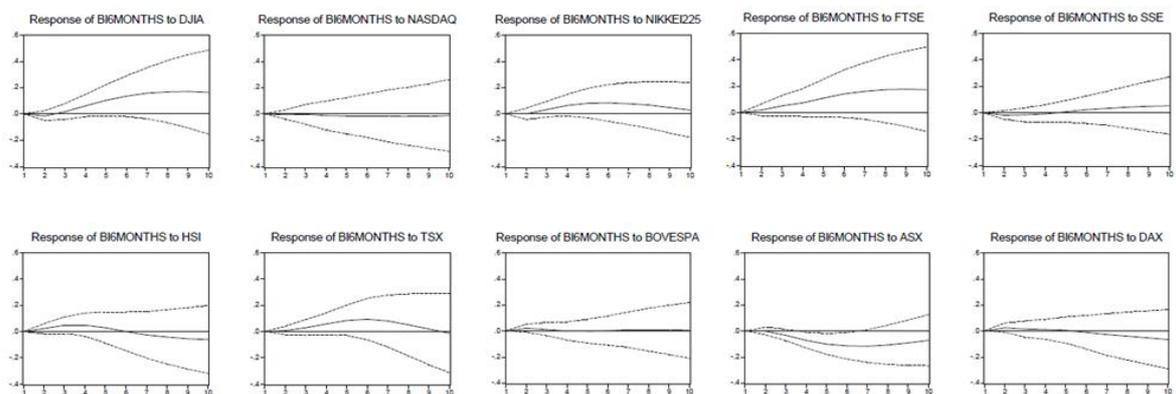


Figure 7. Impulse responses of BIBOR 9 months to stock index.

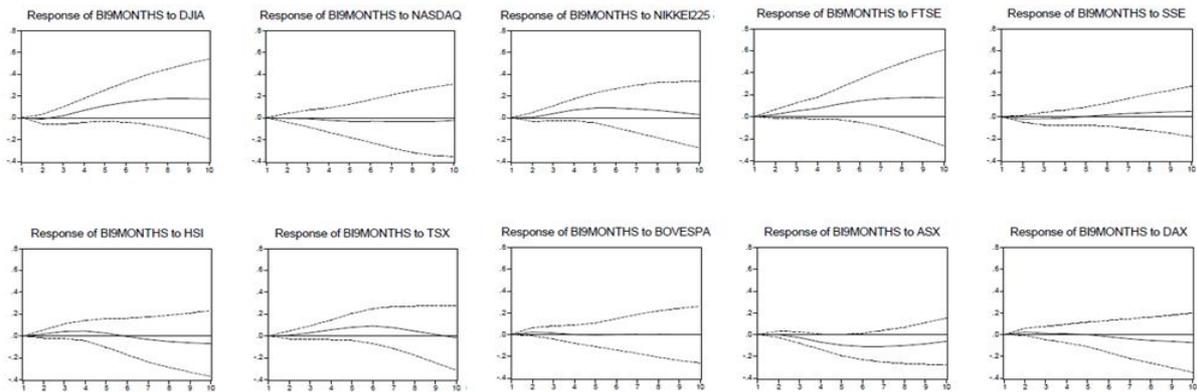
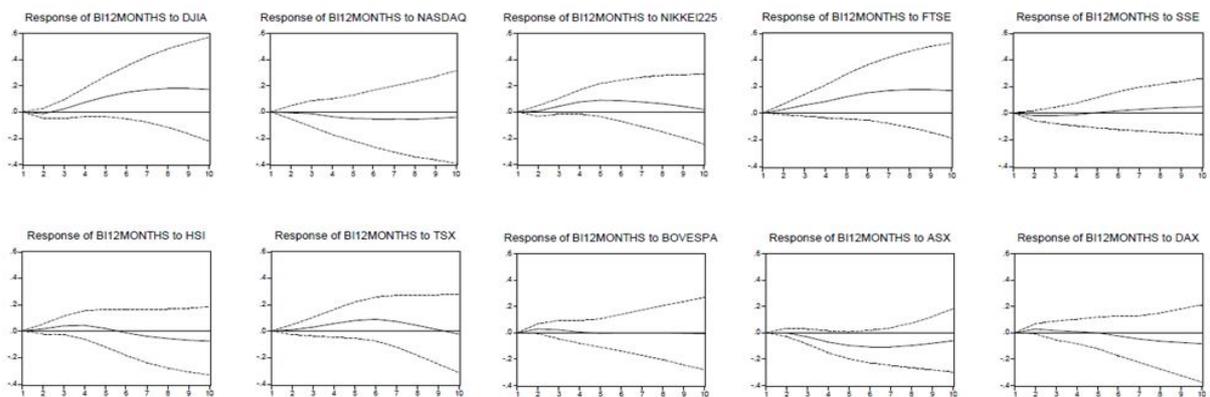


Figure 8. Impulse responses of BIBOR 12 months to stock index.



5. Conclusions

There are several reason to suspect that the correlation between interbank money market rates and stock indexes. In this study we attempt to investigate the dynamic relationship between the interbank money market and the stock market by description the correlation of the BIBOR and stock indexes during the sample period that begin from January 2006 to December 2011. Therefore, to explain how the performance of the stock indexes affect BIBOR changes and how much the degree of movement in stock indexes impact on BIBOR we have used the econometric test, such as the granger causality test, variance decomposition test, and impulse response test, to be our tools then analyzed that relationship between variables.

Accordingly, in recent research we have found the empirical result from the econometric test such the unit root test with ADF has reported the BIBOR in every tenor and the stock indexes was stationary at 1st difference in which following the rule and regulation of stationary that is the t-statistic value must less than the MacKinnon critical value. From the Granger causality analysis, this test found the changes in the DJIA, NASDAQ, NIKKEI225, FTSE100, TSX, SSE, BOVESPA, ASX, and DAX were causality on BIBOR, except the HSI. Next, to explain the dynamic relationship of stock indexes on BIBOR we have used the variance decomposition analysis and the impulse response analysis. The result from variance decomposition analysis found the DJIA, FTSE100, and ASX had more significant relative to BIBOR than other stock indexes. The impulse response analysis found the degree of relationship of DJIA, FTSE100, and ASX were higher started from the short-run throughout long-run. Likewise, all of the stock indexes were vary directly with the tenor of BIBOR. All in all,

there are three stock indexes which seem to have a major interrelation and important determinants in the BIBOR changes better than other stock indexes that consist of DJIA, FTSE100, and ASX over the sample period.

For the future study, should be studied in another stock index and use another variable that may influence the BIBOR, for explore the dynamic relationship on it.

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