

Interbank overnight lending rate pass-through Bangkok Interbank Offered Rate (BIBOR) during the period of financial crisis: In case of Thailand's Interbank Market (2005 to 2011)

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Abstract: *A global financial crisis was happened began from the end of 2007 till nowadays which that crisis was affected to the other market around the world. Hence this paper focus on the Interbank overnight lending rate and Bangkok Interbank Offered Rate (BIBOR) behavior, a long-run relationship, and pass-through between the financial turmoil and BIBOR in case of Thailand Interbank market that cover the sample period from January 2005 to December 2011. This study findings, firstly the Interbank overnight lending and BIBOR spreads are highest in period B than period A, and period C, however we also find the Interbank overnight lending spread's variance grew due to in May 2007 to August 2009 (during the crisis period). In addition the response of Interbank overnight lending spread to BIBOR for a long-term BIBOR spread has a variance less than a short-term BIBOR and the changes in a short-term relation are stronger for Interbank overnight lending rate, BIBOR 1w, BIBOR 1m, BIBOR 2m, and BIBOR 3m more than BIBOR 6m, BIBOR 9m, and BIBOR 1y, however they have a long-run relationship to each other.*

Keywords: *Interbank Overnight Lending Rate, Bangkok Interbank Offered Rate (BIBOR), Interbank Spread Rate*

1. Introduction

In the past few years, the euro zone financial crisis had concerned to the other country about the economy system—what is happens with the economic? Also this problem seems to set up to the new question—is it can happen in Thailand with the same case as euro zone or not? However, we can learn from this case and finding the suitable solution how to manage the fiscal policy and public debt which in the normal case the suitable percentage of the public debt per GDP should not more than 60 percent, and to set up the system for helping the financial institutions to be a stronger and able to be protect the financial crisis's risk which perhaps effect to the financial institutions and monetary policy of the government as well.

The financial crisis was began from the second half of 2007, has been a recession around the world such as the demand was

decreased, increasing in unemployment rate also inflation rate as well.

Simultaneously, the government of each country trying to stimulate the economy into the recovery by increasing the government's expense, otherwise in case if the government's objective just only want to increase the supply of money in the economy system by adding the proportion of public debt, at the same time the government's income is decrease during the period of financial crisis as a result the proportion of public debt will not suitable anymore therefore the credit rating of country would be downgrade moreover in financial sector especially in banking can able to be a bankruptcy as well. Consequently, the solution and the way to promote a stability and soundness of financial and economic system ought to cooperate and making an appropriate decision to solve the problem.

The paper is structured as follows. Section 2 describes the data also a reviews of the

previous study. In Section 3, experimental methodology and hypothesis. The empirical

2. Description of data

First meaning, the liquidity risks is uncertainly of return on investment such as the spread of bid and ask, which in case if the spread rates are more widely that imply the liquidity risk is high. Secondary meaning, the liquidity for a bank means the ability to meet its financial obligations as they come due then one of the main challenges to banks is ensuring its own liquidity under all reasonable conditions. Some of previous studied had examined the liquidity risk is the traders at one bank are reluctant to expose their bank's funds during a period when these funds may be needed to cover the bank's own shortfalls (Shin-ichi Fukuda, 2012). Many pervious studied had claimed the BNP Paribas (9 August 2007) and Lehman Brothers shocks (16 September 2008). In financial market, the changes of interest rate for lending transactions used real interest rate as an indicator for changes in monetary policy (Zhangkai Huang, 2003) which the Interbank market allows liquidity to be readily transferred from banks with a surplus to banks with a deficit (Franklin Allen. al et, 2009). However, the market uncertainty and news had a significant effect on Interbank trading volume post announcement (Lee A. Smales), moreover Ben R. Craig. al et (2012) who had also found the diversification of bank liquidity risk and the private information are influence to the bidding behavior which the price in the interbank market is determine by the relationship lending that consistent with a result of Joao F. Cocco. al et (2009). Also in case of German the liquidity positions of the other banks had an impact to the price that a bank pays for liquidity. (Falko Fecht. al et, 2011).

In accordance with, Nuno and Claudio (2012) who had found the unfolding of the crisis yields had a significant to increase in persistence, volatility and a declining trend in the level and volatility of EURIBOR-OIS

results are presented in Section 4. Finally, Section 5 reported the summary.

spread during the recent financial turmoil. Nevertheless, Johann (2010) found the bank adjust the lending rate depending on the shifts in demand and the volume of loans which the changes in money market rate are only partially pass through to lending rates as a result banks have provide insurance against interest rate fluctuations and liquidity shocks which consistent with M.M.G. Fase (1995), the bank lending rates adjust to impulses in market rates. Also the demand for short-term bank credit dependent on the variety of economic factors such as private sector, household and business sector whereas the tight money reduces bank loan supplies to firms (Zhangkai Huang, 2003), if the monetary policy becomes tight enough, public companies, especially in a bank-dependent will start to suffer from losses in bank loans. Furthermore, Takashi Hatakeda (2000) who had take into account the bank lending behavior that concern the relationship between financial variables and macroeconomic activity in Japan by based on Bernanke and Gertler (1987) even though the call rate and economic activity such as real GDP does not have a significant effect and monetary policy does not affect investment via indirect finance such as bank loan.

2.1 Interest rate

An interest rate is refers to the rate is paid by a borrower (deficit) for using of money that they borrow from a lender (surplus), then the interest rate is a percentage of principal paid at some rate(www.wikipedia.org), which in case of Thailand, interest rates decisions are taken by The Bank of Thailand's Monetary Policy Committee. Anyway the interest rate time structure is the relation between the interest rate and the time to maturity of the debt that the borrower must pay a money and interest back to the lender however the interest risk can be happened when the interest rate in the market has changes or instability as a result its able to be an effect to lending rate for debt obligation, while the interest rate risk is

determines the cost of funding (R.W. Faff and P.F. Haward, 1999) it seems like any economic risk factor as well (Mark J. Flannery. al et, 1997) and the interaction between credit and interest rate risk is quantitatively significant which the interest rate sensitivity gap determines the level of pure interest rate risk (Mathias Drehmann. al et, 2010). Moreover an interest rate policy effectively shifts banks' liquidity risk (R. Todd and Henry van, 2005), and in case of the borrowers who default on their loans should be charged higher interest rate on the subsequent loans they contract (Bhagwan Chowdhry, 2000) which consistent with Dietmar and Timm (1998) to reduce credit risk of lender a bank may requirement the collateral or some form of guarantee. In sum, the interbank market is a short-term borrowing and lending when a bank want to borrowing or lending the funds both of borrower and lender (counterparty bank) must identifies itself such as asking for prices, interest rate and the maturity date which an unexpected decrease in available funds that can be make banks used the lending facility (Vitor Gaspar. al et, 2008). Additionally, the average interest rate paid to the inside bank is higher than the average rate paid to the outside banks because the inside banks extracts rents form good firms and the outside bank bids too low for bad firms (Lamont K. Black, 2011)

The previous literature that is related to our study includes Nicola Carcano and Silverio Foresi (1997) that the long-term interest rate display a lower volatility than short-term interest rate that imply a volatility-adjusted and correlation-adjusted immunization also outperforms strategies based on factor analysis of interest rate changes. Anyway the bank interest margin is positively related to the bank's market power, operating costs, the degree of credit risk, and interest rate risk, also an increases in the bank's equity capital has a negative impact on the spread however the impact of rising interbank market rate on the spread is obscure and depends on the net position of the bank in interbank market (Kit Pong Wong, 1997). As Manthos. al et, (2011), the relationship between bank risk-taking and

interest rate is strong negative which the short-term rate is the annual average of the 3-month interbank rate, the long-term rate is the annual average of the 10-year government bond yield, and the central-bank rate is the European Central Bank policy rate for the euro area countries. Moreover, an unexpected employment announcement had a positive impact on the 3-month Treasury bill interest rate and the Fed's probable response influence the response of interest rates to economic announcements (Adrienne A. Kearney, 2002).

2.2 **Spread rate**

In generally, the central banks normally use the average overnight interbank market rate as an indicator for the liquidity situation on the interbank market (Jens Tapking, 2006) which an increase in the trading volumes would require a decrease (increase) in the interest rate to guarantee the expected liquidity position remain unchanged then trading volumes can adjust while interest rates may remain unchanged. Forthermore, the borrower and lender relationship is characterized by the borrower is better informed with respect to their ability and willingness to repay which at the same time the lender is at a disadvantage (Robert A. Jarrow , 2011). Some of the important previous literature that is relevant to our study in part of spread rate include, Noh-San Kwark (2002) who had found the information on future fluctuations had a significant impact to interest rate spread when investment decisions are inflexible to adjust to a new shock while the leading behavior of the interest rate spread is not generated by the full adjustment model of investment decision. Anyway the liquidity and solvency variables describe all most of the spread variations, following Hong-Ghi Min. al et (2003) found the U.S. interest rate and macroeconomic fundamentals had a significant effect to role for the determination of bond spread that relevant to Mingshu Hua (2009) who had studied the bid-ask spread quote behavior on foreign exchange market which had found the dealers of small banks and the local branches of global banks quoted wider spreads respond to possible losses resulting from unexpected

news or the fluctuation of exchange rate to cover costs, and the foreign bank dealer widen the spreads mainly following a counterparty's move as well. As Jianxin Wang (1999), the bid-ask spread on the computer-based overnight trading system is the determinants of a market volatility thus the trader are concerned with adverse information in a screen-based trading environment and the screen-based traders are more sensitive to market volatility than floor-based traders in setting the bid-ask spread. Moreover the real financial markets are noisy and uncertain on the shortest trading time scales therefore trading translate into noise and bid/ask spreads is very small relative to price (Joseph L. McCauley, 2008). As Hakan. al et (2004), the inflation uncertainty is an indicator of interest rate spread moreover the Blue Chip forecasts of the LIBOR, FFR and LIBOR-FFR are directionally accurate (Hamid Baghestani, 2010). While the finding of Charlotte Christiansen (2002) the impact of macroeconomic announcements on the correlation between credits spreads and the term structure of interest rates are negatively

correlated. However Kiyotaka and Makoto (2009) found the firm-level financial factors and issue-specific factors had an impact to the credit spread influence credit spread moreover the longer term (12 month) LIBOR-OIS was more significant with both of credit and liquidity risk (Deborah Gefang, al et, 2011), and the difference between the 3-month, T-bill rate and the federal funds rate are the predictive power of a money market spread better than the another spread (Mathias Moersch, 1996). Additionally, the relationship between the spread and monetary policy is only a weak association which that spread as an indicator of policy as relative to Srinivas and Stanley D. (2010) which the lower spread is consistent with greater default risk for US Treasury securities. Nevertheless, the macroeconomic condition accounts for about 6 percentage of the overall variation of credit spreads and the average credit spreads decrease in GDP growth rate (Dragon and Hong, 2010) as Eric C. et al (1995), found the expected spread responds positively to an increase in the volatility of the funding cost.

3. Experimental methodology and hypotheses

Interbank overnight lending rate and Bangkok Interbank Offered Rate (BIBOR)

We begin by comparing Interbank overnight lending rate and Bangkok Interbank Offered Rate (BIBOR), additionally we also analyze the commercial bank loan and deposit rates by using the data from the Bank of Thailand (BOT) during the sample period that cover from January 2005 through December 2011. Firstly, we analyze the changes of Interbank overnight lending rate and BIBOR also the changes of commercial banks loan and deposit rates as well. Secondly, to explained the relationship between Interbank overnight lending rate and BIBOR we study the spread rate and report the basic statistic, Augmented Dickey-Fuller test, cointegration test, and error correction model (ECM), respectively. To finding the result of our study the hypothesis in this part as follows:

Hypothesis1. To conclude that the Interbank overnight lending rate and Bangkok Interbank Overnight Lending Rate (BIBOR) would need to be statistically significantly lower during pre-crisis

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
1. Interbank Overnight									
-Lending Rate	2.79	3.14	4.95	0.96	1.26	0.04	1.89	4.30	0.12
2. Bangkok Interbank Offered Rate: BIBOR									
-BIBOR 1 Week	2.99	3.26	5.14	1.26	1.24	0.11	1.95	4.04	0.13
-BIBOR 1 Month	3.08	3.26	5.30	1.27	1.27	0.10	1.97	3.86	0.15
-BIBOR 2 Months	3.13	3.28	5.35	1.30	1.27	0.09	1.97	3.80	0.15
-BIBOR 3 Months	3.18	3.29	5.41	1.35	1.27	0.08	1.98	3.75	0.15
-BIBOR 6 Months	3.29	3.35	5.51	1.50	1.25	0.10	1.97	3.86	0.14
-BIBOR 9 Months	3.36	3.39	5.60	1.57	1.25	0.11	1.97	3.91	0.14
-BIBOR 1 Year	3.44	3.46	5.65	1.63	1.25	0.13	1.97	3.93	0.14
3. Commercial Banks Loan Rates									
-MOR*	7.10	7.25	8.13	5.88	0.67	-0.10	1.85	4.79	0.09
-MLR**	6.75	6.91	7.75	5.63	0.66	-0.07	1.72	5.82	0.05
-MRR***	7.28	7.47	8.25	6.00	0.70	-0.15	1.77	5.62	0.06
4. Commercial Banks Deposit Rates									
-Deposit 3 Months	1.96	2.05	4.00	0.70	1.06	0.54	2.23	6.21	0.04
-Deposit 6 Months	2.04	2.13	4.13	0.70	1.08	0.51	2.27	5.56	0.06
-Deposit 12 Months	2.24	2.32	4.63	0.70	1.18	0.47	2.27	4.93	0.08
-Deposit 2 Years	2.68	2.50	4.63	1.25	1.07	0.41	2.09	5.23	0.07
-Deposit more than 2 Years	2.82	2.54	4.63	1.50	1.00	0.44	2.04	5.92	0.05

* MOR: Minimum Overdraft Rate, ** MLR: Minimum Lending Rate, *** MRR: Minimum Retail Rate. The table summarizes basic statistics of the financial variables for our study, and we used to measure as liquidity risk of Thailand's Interbank market.

and higher in the period of crisis. Thus, a null hypothesis for this analysis is that these Interbank overnight lending rate and BIBOR during the crisis period should have higher statistically significantly than the other period.

Hypothesis2. To conclude that the spread rates of Interbank overnight lending rate and Bangkok Interbank Offered Rate (BIBOR) should have a relative to each other. Then, the null hypothesis is the spread rate of Interbank overnight lending rate should have a relation on BIBOR.

4. Empirical results

4.1 Basic statistics test

Since the financial turmoil was began that was to happened a financial crisis around the world, therefore before we analyze the spread rate of Interbank overnight lending rate and Bangkok interbank offered rate (BIBOR), firstly we would like to report the basis statistic that the table below shows the result of basic statistics of Interbank Overnight Lending Rate, Bangkok Interbank Offered Rate (BIBOR), Commercial bank loan and deposit rates.

Thailand's Interbank market used the Interbank overnight lending rate and BIBOR for reference in lending and borrowing transactions. In table1 reports summarizes basic statistic of Interbank overnight lending rate, BIBOR, and commercial banks loan and lending rate from January 2005 to December 2011, according to the statistic result such as the mean which Interbank overnight lending rate was lower than BIBOR and the short-term BIBOR also was lower than the long-term BIBOR that following the interest rate theory which the long-term maturity has a higher risk more than short-term maturity as a result the long-term interest rate have to higher more than a short-term because it is about the future risk in case of a borrower may fail in payback

for the principle when the contract maturity thus the lender must protect the default risk with charging the borrower with a higher interest rate. The maximum value of each interest rate was happened in 2006 (see more in figure1) at that time it was during pre-crisis, conversely after the crisis was happened from the second half of 2007 the trend was dropped dramatically particularly in the end of 2008 until 2010 from 3.6% to 1.3% that may imply during the crisis period the bank's liquidity was happened a lack or lower in liquidity with ensue on the crisis, concurrently it was happened the bankruptcy and downgrade of credit rating as a result each bank have to cut down their interest rate which after the interest rate was decreased the lending or borrowing transactions between the banks will be excess as well, however in practice during the crisis period the banks who want to borrowing they must give a collateral or some form of guarantee to the banks who lending as well. The standard deviation is indicates the stable, the BIBOR 1month, 2months, and 3months was higher more than Interbank Overnight Lending Rate, BIBOR 6month, BIBOR 9month and BIBOR 1year, respectively. And the skewness suggests the Interbank overnight lending rate and BIBOR was almost nearly zero (normal distribution) especially in Interbank overnight lending rate.

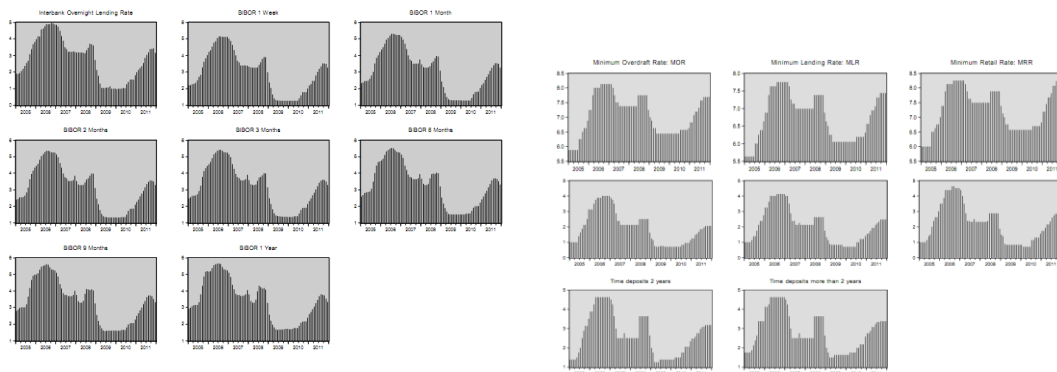


Fig.1. Interbank overnight lending rate and Bangkok Interbank Offered Rate

Additionally, we also analyze the commercial banks loan and deposit rates, we finding the commercial banks loan rate which composed of minimum overdraft rate (MOR), minimum lending rate (MLR) and minimum retail rate (MRR) were began increasing from the end of 2005 which those rates were constant about 7.3% and increased to 7.8% in an early of 2008 (see in figure2) whereas afterward it was drop downed dramatically which seems like the Interbank overnight lending rate and BIBOR changes that suggesting those are imply to each other. Moreover the commercial banks deposit rates are also have a same changes with commercial banks loan rate that may suggest during the period of financial crisis the Thai's economy also was slowdown therefore the Bank of Thailand (BOT) who indirectly control of the retail loan and deposit rate in Thailand want to stimulate the economy as a result the commercial banks loan and deposit rates would be decreased. Following the economic theory, when the consumers have more revenue they will increasing their consumption as well hence for helping the economic sector the loan and deposit rates should be decreased as a result the consumer who has more revenue they will bring their money into the financial sector which they would get a higher of return from investing than deposit in the banks that ensue on the economy able to be recovery as well. The skewness is indicate the distribution which the commercial banks loan has the skewness lower than the commercial banks deposit rate and skewed left but close to normal distribution whereas the skewness of commercial banks deposit is more skewed right.

Fig.2. Commercial banks loan and deposit rates

4.2 Econometric test and result

Vector Autoregressive Model (VAR) is used for analyzing the interrelation of time series and the dynamics impacts of random disturbances or innovations on the system of a variable, the term vector is a vector of two or more variables (Christopher A. Sims, 1980). The VAR model is especially useful for describing the dynamic behavior of economic and financial time series and for forecasting what would be happen in the future. In this subsection we are taking into account to uses the vector autoregressive (VAR) models to determine the interdependence of the Thailand's Interbank overnight lending rate and BIBOR spreads, also examines the relationships therefore the statistic results are as follows:

*Period A: January 2005-April 2007, *Period B: May 2007-August 2009, Period C: September 2009-December 2011. *Overnight: Interbank Overnight Lending Rate. The significance of the coefficients at 1% level.

Table 2 presents the spread rate of Interbank Overnight Lending Rate and Bangkok Interbank Offered Rate (BIBOR) with their 99% confidence intervals for the sample period. In this part we have separate the data for three periods which includes January 2005 to April 2007 (Period A), May 2007 to August 2009 (Period B), and September 2009 to December 2011 (Period C). The average and maximum of Interbank overnight lending and BIBOR spread are highest in period B more than period A, and period C, respectively also the standard deviation is much higher in period B than period A and period C which implies the period B has more volatile than the other period which suggests we have accept the null hypothesis1 that the statistically significantly of Interbank overnight lending rate and BIBOR during the period of crisis are higher than the pre-crisis and after-crisis periods.

Table 2
Summary statistics of Interbank Overnight Lending Rate and BIBOR spreads

Period A*	Overnight	BIBOR 1 week	BIBOR 1 month	BIBOR 2 months	BIBOR 3 months	BIBOR 6 months	BIBOR 9 months	BIBOR 1 year
Mean	-0.08	-0.08	-0.08	-0.07	-0.07	-0.04	-0.04	-0.04
Median	-0.12	-0.08	-0.09	-0.08	-0.07	-0.04	-0.04	-0.03
Maximum	0.23	0.21	0.23	0.22	0.43	0.47	0.46	0.48
Minimum	-0.43	-0.43	-0.51	-0.51	-0.52	-0.53	-0.53	-0.53
Std. Dev.	0.17	0.17	0.17	0.18	0.19	0.21	0.22	0.23
VAR estimation								
R-squared	0.84	0.90	0.91	0.91	0.90	0.89	0.90	0.90
Adj. R-squared	0.53	0.70	0.73	0.72	0.71	0.67	0.70	0.69
F.E. equation	0.12	0.09	0.09	0.10	0.11	0.12	0.12	0.12
F-max	7.23	4.54	4.92	4.90	4.63	4.33	4.44	4.52
Period B*								
Overnight	BIBOR 1 week	BIBOR 1 month	BIBOR 2 months	BIBOR 3 months	BIBOR 6 months	BIBOR 9 months	BIBOR 1 year	
Mean	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09
Median	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.07
Maximum	0.88	0.91	0.84	0.84	0.84	0.80	0.79	0.80
Minimum	-0.22	-0.21	-0.23	-0.27	-0.27	-0.23	-0.42	-0.23
Std. Dev.	0.24	0.24	0.22	0.22	0.22	0.22	0.28	0.27
VAR estimation								
R-squared	0.92	0.94	0.90	0.90	0.91	0.92	0.91	0.91
Adj. R-squared	0.79	0.83	0.73	0.72	0.74	0.79	0.75	0.74
F.E. equation	0.11	0.10	0.10	0.10	0.10	0.12	0.13	0.14
F-max	6.73	8.84	5.29	5.02	5.49	6.78	5.79	5.53
Period C*								
Overnight	BIBOR 1 week	BIBOR 1 month	BIBOR 2 months	BIBOR 3 months	BIBOR 6 months	BIBOR 9 months	BIBOR 1 year	
Mean	-0.07	-0.07	-0.07	-0.07	-0.07	-0.08	-0.08	-0.08
Median	-0.05	0.00	-0.01	-0.03	-0.03	-0.01	-0.02	-0.03
Maximum	0.27	0.22	0.22	0.21	0.21	0.20	0.20	0.20
Minimum	-0.31	-0.32	-0.23	-0.23	-0.23	-0.23	-0.24	-0.23
Std. Dev.	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.12
VAR estimation								
R-squared	0.89	0.76	0.73	0.77	0.78	0.83	0.84	0.85
Adj. R-squared	0.84	0.61	0.25	0.37	0.40	0.53	0.52	0.58
F.E. equation	0.11	0.10	0.09	0.09	0.09	0.08	0.08	0.08
F-max	1.22	1.74	1.52	1.92	2.03	2.70	2.81	2.29

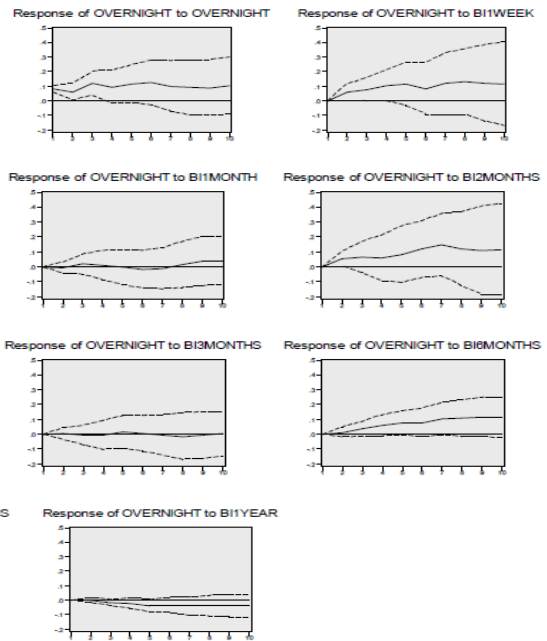
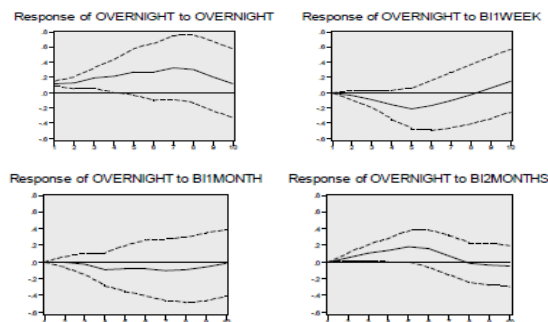


Fig.3. Impulse response estimates (Period A). See more detail in Appendix 1. Confidence intervals are calculated using the bias-corrected wild bootstrap.



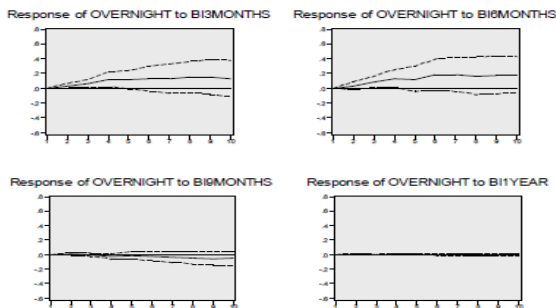


Fig.4. Impulse response estimates (Period B). See more detail in Appendix 2. Confidence intervals are calculated using the bias-corrected wild bootstrap.

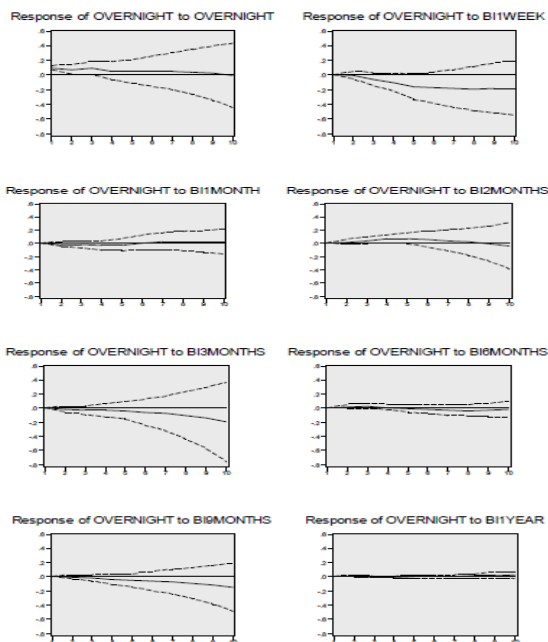


Fig.5. Impulse response estimates (Period C). See more detail in Appendix 3. Confidence intervals are calculated using the bias-corrected wild bootstrap.

Fig. 3 shows impulse response function for the period A. There are four panels in figure3 that each exhibiting the dynamic responses of Interbank overnight lending rate to BIBOR. Period B panels are shown in figure4 and figure5 for period C. If a confidence interval contains zero the true response is zero cannot be rejected the null hypothesis at the specified level of significance. From the Fig. 3, 4, and 5 the impact of Interbank overnight lending spread shocks seems like produces large non-zero responses during period B than period A and C, that implied the Interbank overnight lending spread's variance grew due to in May 2007 to August 2009 (during the crisis period). Contrastingly, the response of Interbank overnight lending spread to BIBOR in each term are different for instance, a long-term BIBOR spread will nearly zero more than a short-term that implies the long-term BIBOR spread's variance do not increase much more as same as a short-term. In sum, following the above finding of this part which suggests we cannot reject the null hypothesis² that the Interbank overnight lending rate and BIBOR spreads both have a relation to each other.

4.2.1 Augmented Dickey-Fuller Test

Table2: Augmented Dickey-Fuller test

		Period A			Period B			Period C		
		Lag	t-statistic	Critical value	Lag	t-statistic	Critical value	Lag	t-statistic	Critical value
- Interbank Overnight										
At level	Drift	1	-0.1018923	-3.724070	1	-2.240115	-3.711457	1	-1.729267	-3.711457
	Trend with drift	1	-1.863223	-4.374307	1	-2.339519	-4.356068	1	-0.646210	-4.356068
1st difference	Drift	1	-4.919402**	-3.737853	1	-3.36668**	-2.986225	1	-3.657533**	-2.986225
	Trend with drift	1	-6.052217*	-4.394309	1	-3.281069***	-3.238054	1	-4.120134**	-3.603202
-BIBOR 1week										
At level	Drift	1	-0.116965	-3.724070	1	-2.516487	-3.711457	1	-1.588876	-3.711457
	Trend with drift	1	-1.514523	-4.374307	1	-2.598833	-4.356068	1	-0.835026	-4.356068
1st difference	Drift	1	-4.485597*	-3.737853	1	-3.950263*	-3.724070	1	-3.939539**	-3.724070
	Trend with drift	1	-5.989504*	-4.394309	1	-3.850752**	-3.603202	1	-4.280586**	-3.603202
-BIBOR 1month										
At level	Drift	1	-0.372952	-3.724070	1	-2.580996	-3.711457	1	-1.439139	-3.711457
	Trend with drift	1	-1.557099	-4.374307	1	-2.662579	-4.356068	1	-0.630546	-4.356068
1st difference	Drift	1	-3.747226*	-3.737853	1	-4.243112*	-3.724070	1	-3.806301*	-3.724070
	Trend with drift	1	-4.620353*	-4.394309	1	-4.135851**	-3.603202	1	-4.556922**	-3.603202
-BIBOR 3months										
At level	Drift	1	-1.007295	-3.724070	1	-2.692156	-3.711457	1	-1.406887	-3.711457
	Trend with drift	1	-2.015182	-4.374307	1	-2.790317	-4.356068	1	-0.683468	-4.356068
1st difference	Drift	1	-3.254628**	-2.991878	1	-4.503968*	-3.724070	1	-3.844954*	-3.724070
	Trend with drift	1	-3.715669**	-3.612199	1	-4.39331*	-4.374307	1	-4.457118*	-4.374307

		Period A			Period B			Period C		
		Lag	t-statistic	Critical value	Lag	t-statistic	Critical value	Lag	t-statistic	Critical value
-BIBOR 6months										
At level	Drift	1	-1.456107	-3.724070	1	-2.718438	-3.711457	1	-1.412635	-3.711457
	Trend with drift	1	-2.468701	-4.374307	1	-2.824264	-4.356068	1	-0.721209	-4.356068
1st difference	Drift	1	-3.357549**	-2.991878	1	-4.605656*	-3.724070	1	-3.784152*	-3.724070
	Trend with drift	1	-3.652424**	-3.612199	1	-4.48584*	-4.374307	1	-4.364714**	-3.603202
-BIBOR 6months										
At level	Drift	1	-2.093320	-3.724070	1	-2.793314	-3.711457	1	-1.538257	-3.711457
	Trend with drift	1	-3.084328	-4.374307	1	-2.879024	-4.356068	1	-0.996298	-4.356068
1st difference	Drift	1	-3.475445**	-2.991878	1	-4.879767*	-3.724070	1	-3.848414*	-3.724070
	Trend with drift	1	-3.574511***	-3.249079	1	-4.767905*	-4.374307	1	-4.574088**	-3.603202
-BIBOR 9months										
At level	Drift	1	-2.483038	-3.724070	1	-2.978160	-3.711457	1	-1.534993	-3.711457
	Trend with drift	1	-3.587653	-4.374307	1	-3.066537	-4.356068	1	-0.994398	-4.356068
1st difference	Drift	1	-4.085849*	-3.737853	1	-5.013827*	-3.724070	1	-3.91303*	-3.724070
	Trend with drift	1	-4.041109**	-3.612199	1	-4.900526*	-4.374307	1	-4.339176**	-3.603202
-BIBOR 1year										
At level	Drift	1	-2.348684	-3.724070	1	-3.131633	-3.711457	1	-1.635387	-3.711457
	Trend with drift	1	-3.388863	-4.374307	1	-3.221764	-4.356068	1	-1.185990	-4.356068
1st difference	Drift	1	-3.558478**	-2.991878	1	-5.218405*	-3.724070	1	-3.970186*	-3.724070
	Trend with drift	1	-3.513667***	-3.249079	1	-5.100431*	-4.374307	1	-4.308424**	-3.603202

Table : Cointegration test

Dependent Variable	Independent Variable	Coefficient	p-value	t-statistic	R-squared	Adjust R-squared	F-statistic	p-value
Interbank Overnight	Constant	-0.002286	0.739100	-0.334292	0.911724	0.903485	110.6578	0.000000
	BIBOR 1w	0.849538	0.000000	5.422476				
	BIBOR 1m	0.702089	0.245500	1.170421				
	BIBOR 2m	-0.614808	0.582200	-0.552571				
	BIBOR 3m	-0.106946	0.911800	-0.111109				
	BIBOR 6m	0.321227	0.440400	0.775559				
	BIBOR 9m	-0.177645	0.800900	-0.233139				
	BIBOR 1y	0.003500	0.993500	0.008141				

- *Statistic significant at the 1% level.
- ** Statistic significant at the 5% level.
- *** Statistic significant at the 10% level.

Table 3 present an ADF-test of Interbank overnight lending rate and BIBOR. Even though the Interbank overnight lending rate and BIBOR are do not stationary at level that because the t-statistic value is more than MacKinnon Critical value however we have change into 1st difference that the result is t-statistic is lower than MacKinnon thus the Interbank overnight lending rate and BIBOR are stationary (no unit root) at 1st difference anymore the t-statistic value of all term in period B seems almost more than the period A and C which may consistent with the result of previous section as well.

4.2.2 Cointegration Test

The cointegration test is a long-run relationship test by Engle and Granger that we have to use the residual from the ordinary least square (OLS) to test the stationary at integration of order 0 or unit root at level with Augmented Dickey-Fuller (ADF). The cointegration results are as below:

* The significant of the coefficients at 1%

Variable	Lag	ADF-statistic	Critical value	Result
ERES	0	-8.864368*	-2.593824	Stationary

* Statistic significant at the 1% level.

Regression equation:

$$\text{OVERNIGHT} = C (1) + C (2)*\text{BI1WEEK} + C (3)*\text{BI1MONTH} + C (4)*\text{BI2MONTHS} + C (5)*\text{BI3MONTHS} + C (6)*\text{BI6MONTHS} + C (7)*\text{BI9MONTHS} + C (8)*\text{BI1YEAR}$$

Error Correction	△OVERNIGHT	△BI1WEEK	△BI1MONTH	△BI2MONTHS	△BI3MONTHS	△BI6MONTHS	△BI9MONTHS	△BI1YEAR
ConstEq1	-0.46	-0.33	-0.39	-0.32	-0.22	-0.08	-0.07	0.01
△OVERNIGHT(-1)	-0.41	0.55	0.46	0.43	0.32	0.17	0.07	0.00
△OVERNIGHT(-2)	0.01	0.55	0.40	0.32	0.24	0.15	0.08	0.08
△BI1WEEK(-1)	-0.08	-1.08	-0.11	0.02	0.15	0.33	0.36	0.47
△BI1WEEK(-2)	-0.32	-0.86	-0.17	-0.02	0.11	0.30	0.38	0.40
△BI1MONTH(-1)	-1.02	-0.91	-2.49	-1.98	-1.89	-1.31	-1.18	-0.79
△BI1MONTH(-2)	0.88	0.56	-0.79	-0.44	-0.43	-0.45	-0.55	-0.25
△BI2MONTHS(-1)	3.57	3.65	4.36	3.57	3.54	1.74	1.96	0.75
△BI2MONTHS(-2)	-0.78	-0.14	0.08	-0.62	-0.62	-1.10	-0.66	-1.27
△BI3MONTHS(-1)	-1.47	-1.64	-2.04	-1.87	-2.14	-0.65	-1.13	-0.35
△BI3MONTHS(-2)	0.16	-0.47	0.36	0.70	0.49	1.00	0.42	0.47
△BI6MONTHS(-1)	-2.81	-2.31	-2.49	-2.51	-1.97	-2.02	-1.19	-0.97
△BI6MONTHS(-2)	-1.98	-0.95	-0.88	-0.72	-0.36	-0.14	0.76	1.41
△BI9MONTHS(-1)	3.65	2.37	4.33	3.99	3.18	2.37	1.21	0.98
△BI9MONTHS(-2)	4.30	3.34	3.53	3.23	2.77	1.87	0.61	-0.01
△BI1YEAR(-1)	-1.57	-0.68	-1.96	-1.54	-1.05	-0.42	0.15	0.23
△BI1YEAR(-2)	-2.43	-2.15	-2.79	-2.70	-2.44	-1.88	-1.34	-1.13

From Table4 calculation we will get a residual, afterward we continually to test a residual with ADF test (see in Table5), then we have a result is the ADF test statistic (-8.864368) is lower than MacKinnon Critical (-2.593824) at a significant level 0.01 that suggesting the Interbank overnight lending rate has a long-run relationship on BIBOR that consistent with a result of impulse response estimates in fig. 3, 4 and5.

4.2.3 Error correction test

Until the previous test, we were testing the long-run relation of Interbank overnight lending rate and BIBOR and we had found they are have a long-run relationship. Next, error correction model (ECM) is estimated to study the short-run relationship in Table 6.

Even though many speed-of-adjustment coefficients are statistically different from zero in each variables, the adjustment coefficient on ECM (first row for each variable) in Interbank overnight lending rate and BIBOR, that explained the changes of the ECM terms (short-term relationship), in this part we finding the Interbank overnight lending rate (-0.46), BIBOR 1w (-0.33), BIBOR 1m (-0.39), BIBOR 2m (-0.32), and BIBOR 3m (-0.22) are strong in short-term relationship much more than BIBOR 6m (-0.08), BIBOR 9m (-0.07), and BIBOR 1y (0.01).

5. Summary

This study analyze the changes of

Interbank overnight lending rate and BIBOR which cover the period from 2005 to 2011, to explained the relationship between Interbank overnight lending rate and BIBOR moreover we study the spread rate of both interest rates and report the basic statistic, Augmented Dickey-Fuller test, cointegration test, and error correction model (ECM).

The main findings are, firstly the basic statistic of Interbank overnight lending and BIBOR spreads are highest in period of crisis when we comparing with the period of pre-crisis (A) and after-crisis (C), and we also finding the impact of Interbank overnight lending spread shocks produces large non-zero responses during period B than period A and C that are implied the Interbank overnight lending spread's variance grew due to in May 2007 to August 2009 (during the crisis period), therefore we cannot reject the hypothesis1. In addition the response of Interbank overnight lending spread to BIBOR in a long-term BIBOR spread is nearly zero more than a short-term. And the next finding is the Interbank overnight lending rate has a long-run relationship on the BIBOR as a result of the ADF test which the t-statistic (-8.864368) is lower than MacKinnon Critical (-2.593824) as well as the ECM test had showing us a results that the changes in a short-term relationship is stronger in Interbank overnight lending rate, BIBOR 1w, BIBOR 1m, BIBOR 2m, and BIBOR 3m than BIBOR 6m, BIBOR 9m, and BIBOR 1y.

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