



The Balance Sheet Network Analysis for Measuring Systemic Risk of Islamic Commercial Banks in Indonesia

D. Agus Harjito,^{a*} M.A.B. Hananta Wiratama^b

^{a,b}*Universitas Islam Indonesia*

**Corresponding author: agus_h@uii.ac.id*

Abstract

Systemic risk in a simple definition is potential loss suffered by the financial system which is commonly caused by the individual institution in the system. The default of Bear Stearns and Lehman Brothers in 2008 which were two of the five largest investment banks in the U.S at the time has changed the perspective that Too-Big To Fail was not solely an issue in the vulnerable financial system. Nevertheless, recent studies indicate that Too-Connected To Fail (TCTF) problem is actually the main issue of the vulnerable financial system. This study provides early warning system regarding the systemic event by measuring the systemic risk in Indonesian Islamic commercial banks (ICBs). This study employs a balance sheet network analysis to measure the systemic risk in Indonesia ICBs which relies only on the interconnection among banks in the system. The purposive sampling method is applied in this study involving 10 banks in 2012 and 11 banks in 2013 and 2014. This study investigates the capital loss suffered by an individual institution in case of bank default in the system, the Too-Connected to Fail (TCTF) risk which measures how risky the individual bank towards others and system, and the TCTF vulnerability which measures how vulnerable an individual bank in case of a bank default in the system. It is forecast that this study can be one of the references for the macro prudential and micro prudential supervisions in Indonesia.

Keywords: balance sheet network, systemic risk, Islamic commercial banks

© 2017 International Islamic University Malaysia

1. Introduction

The evolution of financial world is getting faster. The evolution leads the system to be more complex and highly interconnected, which in turn increases vulnerability of the system. In the last several years, regulators have been mainly concerned about “too-big-too-fail” (TBTF) problems that in turn lead to macro and micro financial regulations being more concern to huge financial institutions with large amount of assets.

The presence of 2008 financial crisis, however, showed the evidence that the TBTF was not solely an issue in the increase of global financial system convergence. It has been evidenced that the trigger of the crisis was not the institutions with large assets, but their balance sheet structure were highly interconnected in the system. Mortgage lenders were run out of cash at the time and triggered the giant financial institution into bankruptcy. Bear Stearns and Lehman Brothers, the top 5 largest U.S investment bank at the time, were default.

The conventional view regarding the TBTF is not in the spotlight anymore. Moreover, many studies proposed that an institution considered to be TBTF was not necessarily considered to be interconnected in the system. Meanwhile, recent studies also confirmed that the main determinant of the crisis was too-connected-to fail (TCTF) problem.

Aldasoro and Angeloni (2013) stated that banks with considerable market share or assets had less systemic importance rather than banks, which became big players in the interbank market. An institution considered to be TBTF is not necessarily TCTF (Lau, 2013). Measuring systemic risk based on the linkage of banks balance sheet is necessary. The balance sheet network analysis is the model that can satisfy the TCTF problem which becomes the main issue of systemic event.

The balance sheet network analysis can be applied on the conventional banks and the Islamic banks. The balance sheet network analysis mainly focuses on the linkage between institutions. There would be no different in term of application of this model between the conventional and Islamic banks. In this regard, balance sheet network analysis relies only on the assessment of direct exposures, or network exposures, gathered from balance-sheet information (Lau, 2013). The outputs of this model are capital losses of each bank in case of bank default, the TCTF risk of each bank and the TCTF vulnerability of each bank.

Financial crisis always requires expensive price to recover. Financial crisis in the 1997/1998 showed the huge impact of banking crisis. Restructuring of the system spent 45 percent of the Indonesia GDP (Simorangkir, 2012). Financial crisis is likely to recur in the future, especially with the vulnerability of the banking system recently. Contagion default risk causes systemic risk, which is a crucial reason for the financial crisis (Ascarya *et al.* 2012). Prevention is therefore immensely important. Assessing systemic risk is one of the prevention steps in the systemic event.

In the last 6 years, Islamic banks in Indonesia have shown incredible development. The Indonesia Financial Service Authority (OJK) has released a statistical data of Islamic banks in Indonesia in December 2014. As at December 2014, the total assets of Islamic banks were IDR 278 trillion. It grew around 4 times compared to 2009, which was only IDR 68 trillion. Despite growing quite incredibly, Islamic banks in Indonesia are still new where the total assets of Indonesia Islamic banks as at December 2014 was only about 4% compared to the conventional banks. Albeit relatively small in term of total assets, early warning is necessary to do in order to prevent systemic event. Following this, this study intends to analyse and ultimately offer early warning of capital losses suffered by ICBs system if there is a bank default in the system, determine which bank has large TCTF risk among ICBs in Indonesia and to determine which bank is the most vulnerable if there is shock triggered by other banks.

The rest of paper is organized as follows. Section 2 explains the literature review, section 3 presents the research method, section 4 presents the simulation and results. Finally, section 5 concludes the study.

2. Literature Review

Systemic risk threatens the financial system, which has the influence to destabilize the economy of a country or even wider. Global financial meltdown in 2008 was an evidence of a systemic event which was triggered by subprime mortgages and destroyed financial system of the United States and the global financial system. The U.S economy fell down and forced the Federal Reserve to implement uncommon monetary policy and the quantitative easing (QE) in order to re-stimulate the U.S economy.

In a simpler explanation, systemic risk is a potential loss in the system, which is triggered by an individual default of an institution in the system and may damage other institutions. Systemic risk is a risk that not only impacts an individual financial institution but others too. It has impact on the other financial institutions, on the real domestic economy, on the other countries or even globally (Aldasoro and Angeloni, 2013). Other researchers define systemic risk as the risk that comes up from the financial institution because of insufficient solvency and liquidity squeeze in the financial institution especially for financial intermediation or banks with probability to spread out the impact to the other financial institutions or to the real sector Blancer *et al.* (2013).

Systemic risk has two main elements: initial default trigger and distribution of loss. Initial default trigger is an individual default institution, which leads to systemic event. The default of a bank has two main sources, which are, credit shock and funding shock. Distribution of loss of an institution to other institutions in the system is commonly known as contagion risk.

Loss distribution will not occur in the absence of balance sheet interconnection among institutions in the system. Interconnectedness among the institutions in the financial system brings greater fragility to the system. Loss distribution caused by a default institution which has great interconnection to the participants in the system will be easily spread out to the other institutions. Huser (2015) stated that, banking sector is considered to be a network where banks are highly interconnected through both sides of their balance sheet, assets and liabilities. Interbank transactions are like “wireless connection” among banks, creating the interconnectedness of the bank’s balance sheet.

Interbank transactions have an important role in the systemic event. Interbank transactions create the interconnection between banks balance sheet in the system and facilitate the contagion loss. The ignition chain of the systemic risk is the interbank transactions. Systemic risk and interbank transactions have a positive relationship (Krause and Giansante, 2012). Greater interbank transactions will lead to greater

probability of systemic risk and fragility of the financial system as a whole. Aldasoro and Angeloni (2013) stated that, midsize bank with the largest interbank transactions in the system has more systemic importance than large size bank with small amount of interbank. Turkish banking crisis in 2000, the major player of interbank which known as Demirbank is the trigger of the crisis as argued by Kuzubas *et al.* (2014).

Based on the discussion above, it can be clearly argued that interbank transactions are the key players of the systemic event, which leads to contagion loss. More attention to the big size player is not necessary anymore and the regulators must give more attention to the major player in the interbank loan. The TBTF problem is not the main transmission of systemic event, but the TCTF problem is.

Islamic banks are the financial intermediary that follows the Shariah principles. The financial transaction in Islamic banks must avoid the unlawful (Haram) transaction. The unlawful transactions are the interest based transaction (*Riba*), absolute risk outcome (*Gharar*), winning of a party is linked with the loss of another (*Myser*) or usually called zero sum game, and financing for unlawful business for example casino, club and so forth (Hanif, 2014). *Riba* in the general meaning is an extra charge of money for lending and borrowing, or conventionally known as interest. Al-Baqarah 2:275 states that:

“Those who take interest will not stand but as stands whom the demon has driven crazy by his touch. That is because they have said: Trading is but like *riba*. And Allah has permitted trading and prohibited *riba*. So, whoever receives an advice from his Lord and stops, he is allowed what has passed, and his matter is up to Allah. And the ones who revert back, those are the people of Fire. There they remain forever”.

The prohibition of *riba* is clearly stated in the Qur’an. In order to replace the interest in the Islamic banks business operation, Islamic banks have several contracts that are grouped into two, which are, the profit-loss sharing (PLS) contract and the leased based contract.

In the past three years, the development of ICBs in Indonesia showed admirable growth. The number of offices and total assets of the system represent the growth of this industry. Between 2012 until 2014, the number of ICBs in Indonesia has increased to 12 banks from 11 banks previously. The increase number of banks leads to an increase number of offices. Figure 1 presents the number offices of the Islamic commercial banks in Indonesia.

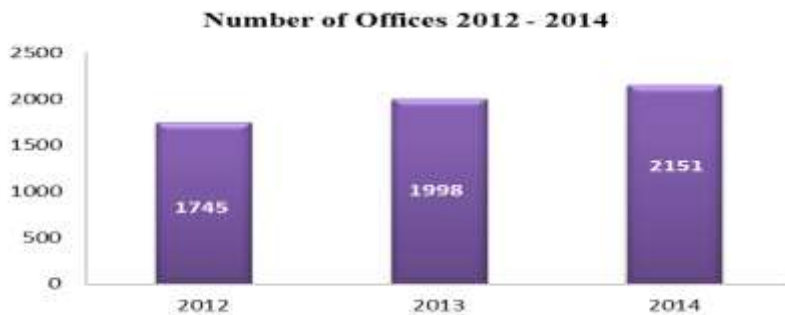


Figure 1. Number of Offices 2012 – 2014

Number of offices has increased over the years. In the last three years, number of offices grew around 23 percent, from 1,745 offices to 2,151 offices. The total assets of ICBs have also significantly increased in the last 3 years.

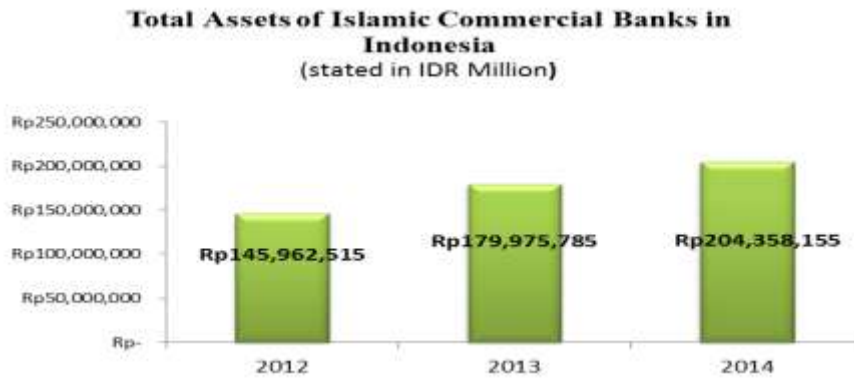


Figure 2. Total assets of Islamic commercial banks in Indonesia 2012-2014

Figure 2 showed the growth of the ICBs assets in the past three years. Since 2012 until 2014, the total assets grew about 40% from Rp 145 trillion to Rp 204 trillion.

3. Research Method

This study is a quantitative exploratory type of study. This study uses secondary data which is taken from an audited financial report of each sample bank. Purposive sampling has been employed in this study. The sample banks must satisfy several criteria below:

- a. Acknowledged by the Indonesian Financial Service Authority (OJK).
- b. The object is absolutely an entity. It is not become a part of other entities and incorporated as *perseroan terbatas* (PT).
- c. The banks publish audited annual report and complete with notes to the financial statements in the period of the research, which is from 2012 until 2014.

In 2012, there are 10 banks that have satisfied those criteria. Meanwhile in 2013 and 2014, there are 11 banks that have satisfied the criteria.

Table 1: List of banks sample in 2012

No	Name of Islamic Commercial Banks
1.	PT. Bank Muamalat Indonesia Tbk.
2.	PT. Bank Victoria Syariah
3.	PT. Bank BRI Syariah
4.	PT. Bank BNI Syariah
5.	PT. Bank Syariah Mandiri
6.	PT. Bank Syariah Mega Indonesia
7.	PT. Bank Panin Syariah Tbk.
8.	PT. Bank Syariah Bukopin
9.	PT. BCA Syariah
10.	PT. May bank Syariah Indonesia

Source: Otoritas Jasa Keuangan 2012

Table 2: List of banks sample in 2013 and 2014

No	Name of Islamic Commercial Banks
1.	PT. Bank Muamalat Indonesia Tbk.
2.	PT. Bank Victoria Syariah
3.	PT. Bank BRI Syariah
4.	PT. Bank BNI Syariah
5.	PT. Bank Syariah Mandiri
6.	PT. Bank Syariah Mega Indonesia
7.	PT. Bank Panin Syariah Tbk.
8.	PT. Bank Syariah Bukopin
9.	PT. BCA Syariah
10.	PT. May Bank Syariah Indonesia
11.	PT. Bank Tabungan Pensiunan Nasional Syariah

Source: Otoritas Jasa Keuangan 2014

3.1 The Model

This study employs the balance sheet network analysis to measure systemic risk on ICBs in Indonesia. This model relies only on the direct network impact. It focuses mainly on the balance sheet interconnection between banks in the system, which causes a contagion loss in the system. The final outputs of this analysis are two measurements of systemic risk, which are, the TCTF risk and the TCTF vulnerability. The TCTF risk represents the systemic importance of a bank. The TCTF vulnerability measures the fragility of a bank towards the contagion loss which is caused by bank default in the system.

This study requires a simulation of bank default in the system in order to measure systemic risk. This model can accommodate credit and funding shock as the default trigger. This study employs credit shock as the default trigger. Besides that, this model requires the assumption of Loss Given Default (LGD). This study employs 70% as the LGD assumption. Next part will explain briefly how to measure systemic risk using this model and the credit shock simulation.

In the example of the simulation below, we analyse the impact of Bank J as the trigger default to the Bank I balance sheet. Figure 3 shows a simplified Bank I balance sheet before Bank J collapses. Bank I has interbank assets at Bank J.

$$\sum_{j \neq i} x_{ij} + a_i = k_i + d_i \tag{1}$$

Where,

- $\sum_{j \neq i} x_{ij}$: Total lending Bank i to Bank j
- a_i : Total other asset of Bank i
- k_i : Total equity of Bank i
- d_i : Total other liabilities of Bank i

$\sum_{j \neq i} x_{ij}$	k_i
a_i	d_i

Figure 3: Simplified of Bank I balance sheet before shock

In case of credit shock which causes initial default of a bank J:

$$\sum_{j \neq i, m} x_{ij} - x_{im} \times LGD_m + a_i = (k_i - x_{im} \times LGD_m) + d_i \quad (2)$$

: Loss Given Default of Bank j

This is simplified of Bank I balance sheet after shock.

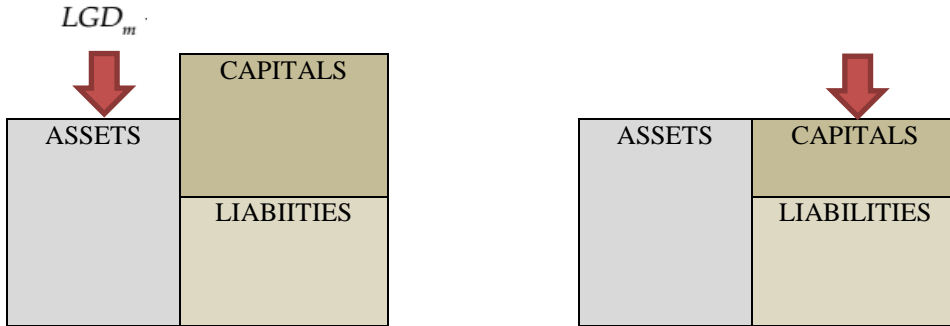


Figure 4. Simulation of Bank I balance sheet after shock

Figure 4 demonstrates Bank I balance sheet after Bank J collapses. The assets of Bank I decreased amounted to 70 percent as LGD times the total loan to Bank J. In the right side of Bank I balance sheet, capital of Bank I will cover the losses, which caused reduction within the same amount of the losses suffered by Bank I.

The final step of this model is measuring the systemic risk using two useful measurements, the TCTF risk, and the TCTF vulnerability. The TCTF risk and the TCTF vulnerability are the tools for measuring systemic risk (Lau, 2013). Both the TCTF risk and the TCTF vulnerability measure loss of individual bank caused by systemic event. The TCTF risk measures how big the impact of a default bank is to the other banks in the system. A default bank will affect the loss in capital to other banks. Meanwhile, the TCTF vulnerability is the measurement of the fragility of a bank if there is bank default in the system (Lau, 2013). The TCTF vulnerability is the opposite of the TCTF risk. While the TCTF risk measures the loss in the capital of other banks, the TCTF vulnerability measures the loss in the capital of a bank triggered by another banks in the system. The formula of the TCTF risk and the TCTF vulnerability is shown below:

$$\text{TCTF Risk } (i) = \frac{\sum_{j \neq i} \left[\frac{\text{Capital loss of bank } j \text{ induced by bank (cluster) } i}{\text{Capital of bank } j \text{ prior to the fundamental shock}} \right]}{\text{Number of banks in system excluding bank (cluster) } i}$$

$$\text{TCTF Vulnerability } (i) = \frac{\sum_{j \neq i} \left[\frac{\text{Capital loss of bank } i \text{ induced by bank (cluster) } j}{\text{Capital of bank } i \text{ prior to the fundamental shock}} \right]}{\text{Number of triggering banks (or clusters) other than bank } i}$$

4. Results and Discussions

This section explains how default bank causes loss in the capital to the other banks and the entire system, identifies which bank that has the highest impact on other banks and which bank is the most vulnerable in the system between 2012 until 2014, based on the default simulation.

Table 3: Interbank Assets and Interbank Liabilities in 2012 - 2014

Bank	Interbank Assets*			Average Interbank Assets in 3 years*
	2012	2013	2014	
PT. Bank Muamalat Indonesia Tbk.	20.001	20.054	259	13.438
PT. Bank Victoria Syariah				
PT. Bank BRI Syariah			35.000	35.000
PT. Bank BNI Syariah	250.632	34.033		142.333
PT. Bank Syariah Mandiri	100.924	31.070	234.145	122.046
PT. Bank Syariah Mega Indonesia	58.254	5.909	165.391	76.518
PT. Bank Panin Syariah Tbk.			5.616	5.616
PT. Bank Syariah Bukopin	21	30.020		15.021
PT. BCA Syariah	50.000	150.000	30.021	76.674
PT. Maybank Syariah Indonesia			20.000	20.000
P.T. Bank Tabungan Pensiunan Nasional Syariah		19.50	19.50	

Bank	Interbank Liabilities*			Average Interbank Liabilities in 3 years*
	2012	2013	2014	
PT. Bank Muamalat Indonesia Tbk.	438.886	219.942	339.761	332.863
PT. Bank Victoria Syariah	34.000	11.500	34.000	26.500
PT. Bank BRI Syariah	120.000		100.000	110.000
PT. Bank BNI Syariah	5.924	31.070	85.396	40.797
PT. Bank Syariah Mandiri	73.537	20.074	280	31.297
PT. Bank Syariah Mega Indonesia	30.009	5.000	100.000	45.003
PT. Bank Panin Syariah Tbk.	83.000			83.000
PT. Bank Syariah Bukopin	60.000		50.000	55.000
PT. BCA Syariah				
PT. Maybank Syariah Indonesia	67.462		35.000	51.231
PT. Bank Tabungan Pensiunan Nasional Syariah				

*Stated in million Rupiah

Table 3 shows the interbank transactions of each Indonesia ICBs in 2012 – 2014 among banks in the system. All of the banks in Indonesia ICBs have interbank transaction among banks in the system. Table 4 shows the capital condition of Indonesia ICBs in the research period.

Table 4: Banks capital in 2012-2014

Bank	Bank Capital*			Average Capital*
	2012	2013	2014	
PT. Bank Muamalat Indonesia Tbk.	1.809.131	3.321.207	4.023.952	3.051.430
PT. Bank Victoria Syariah	152.534	156.582	185.315	164.810
PT. Bank BRI Syariah	1.068.564	1.698.128	1.707.843	1.491.512
PT. Bank BNI Syariah	1.187.218	1.304.680	1.950.000	1.480.633
PT. Bank Syariah Mandiri	4.180.690	5.361.999	5.436.979	4.993.223
PT Bank Syariah Mega Indonesia	258.935	770.053	787.450	605.479
PT. Bank Panin Syariah Tbk.	487.666	525.366	1.072.795	695.276
PT. Bank Syariah Bukopin	273.072	292.620	501.282	355.658
PT. BCA Syariah	304.376	313.516	626.035	414.642
PT. Maybank Syariah Indonesia	950.849	992.216	1.048.169	997.078
PT. Bank Tabungan Pensiunan Nasional Syariah	-	169.833	905.429	358.421

*Stated in million Rupiah

4.2.1. Capital Losses

The sample banks are considered as a system. The balance sheet network analysis requires an LGD assumption. In this simulation, the LGD assumption is about 70%. Table 5, 6, and 7 show the default simulation in 2012, 2013, and 2014. Based on the simulation, in the case of BMI, the default will cause the greatest contagion loss in term of Rupiah and more than half banks in the system will be impacted by the BMI. Capital loss in the system has amounted to IDR 307 billion. In case of default, BMI will cause capital loss in BNIS about IDR 175 billion which is the greatest potential loss in this simulation. The second greatest impact is BRIS. If BRIS is default, it will trigger IDR 84 billion capital loss in the system. Surprisingly, the MBSI is the third greatest. The MBSI is considered as small size assets bank, however, in this simulation, the MBSI will trigger IDR 47 billion-capital loss in system.

Table 5: Default simulation in 2012

Stated in Million Rupiah	Capital losses in bank:										Capital loss in system	
	BMI	BVS	BRIS	BNIS	BSM	BSM G	PNBS	BKPS	BCAS	MBSI		
BMI	-	-	-	175.442	21.000	40.778	-	0,245	35.000	35.000	0	307.220
BVS	12.600	-	-	35.000	10.500	-	-	-	-	-	-	58.100
BRIS	49.000	-	-	-	35.000	-	-	-	-	-	-	84.000
BNIS	-	-	-	-	4.147	-	-	-	-	-	-	4.147
BSM	14.001	-	-	37.459	-	-	1	15	-	-	-	51.476
BSMG	21.006	-	-	-	-	-	-	-	-	-	-	21.006
PNBS	24.500	-	-	21.000	-	-	-	-	-	-	12.600	58.100
BKPS	-	-	-	42.000	-	-	-	-	-	-	-	42.000
BCAS	-	-	-	-	-	-	-	-	-	-	-	-
MBSI	47.223	-	-	-	-	-	-	-	-	-	-	47.223

Credit shock triggered initially in:

Table 8: Capital loss suffered by the system in case of bank default in the system

Initial Shock Triggered by		Capital Loss in System (Stated in Million Rupiah)		
		2012	2013	2014
BMI	PT. Bank Muamalat Indonesia	307.220	153.960	237.833
BVS	PT. Bank Victoria Syariah	58.100	8.050	23.800
BRIS	Bank BRI Syariah	84.000	56.000	70.000
BNIS	Bank BNI Syariah	4.147	21.749	59.777
BSM	Bank Syariah Mandiri	51.476	14.447	484
BSMG	Bank Syariah Mega Indonesia	21.006	24.504	70.000
PNBS	Bank Panin Syariah	58.100	2.100	-
BKPS	PT. Bank Syariah Bukopin	42.000	-	35.000
BCAS	PT. BCA Syariah	-	-	-
MBSI	PT. Maybank Syariah Indonesia	47.223	-	24.500
BTPNS	PT. Bank Tabungan Pensiunan Nasional Syariah	-	-	-

In 2014, formation of top three most substantial impact banks in the system is not changing. BMI is still in the first position. In case of default, BMI will cause IDR 237 billion capital loss and will cost to BNIS about IDR 162 billion. In the second place, there are two banks, which are BRIS and BSMG. The BRIS and BSMG potentially incur IDR 70 billion of capital loss. The third place is the BNIS. The BNIS will cause capital loss in the system amounting to IDR 59 billion (refer table 7).

Table 8 summarizes the simulation result (see Table 6 and Table 7). The probability of capital loss in the system would vary every year. Only the BRIS and the BCAS showed the increasing probability of capital loss in the last three years. After determining the losses that caused by fundamental credit shock of each bank we then divided them into two measurements of systemic risk which are the TCTF risk and the TCTF vulnerability.

TCTF Risk of Each Bank

The final output of this study is the TCTF risk and the CTF vulnerability. The TCTF risk refers to the impact of default bank to the other banks relative with affected bank capital. On the other hand, the TCTF vulnerability can be referred as the measurement of the fragility of bank towards bank fundamental shock in the system. In contrast of the TCTF risk, which is associated with interbank liabilities, the TCTF vulnerability is strongly associated with interbank assets relative with its capital.

Table 9: TCTF risk of each bank 2012-2014

Bank	TCTF Risk			
	2012	2013	2014	Average
PT. Bank Muamalat Indonesia Tbk.	4,620805	4,303084	1,919560	3,614483
PT. Bank Syariah Bukopin			0,386557	0,386557
PT. Bank Victoria Syariah	0,389569	0,473995	0,262859	0,375474
PT. Bank Syariah Mega Indonesia	0,116111	0,367057	0,457451	0,313539
PT. Bank BRI Syariah	0,354567	0,429224	0,141787	0,308526
PT. Bank Panin Syariah Tbk.	0,444821	0,123651		0,284236
PT. Bank BNI Syariah	0,009919	0,040561	0,563041	0,204507
PT. Maybank Syariah Indonesia	0,261028		0,143456	0,202242
PT. Bank Syariah Mandiri	0,393465	0,067784	0,000741	0,153997
PT. BCA Syariah	-			-
PT. Bank Tabungan Pensiunan Nasional Syariah		-	-	-

Based on the three years simulation in 2012, 2013, and 2014, the TCTF risk index is shown in Table 10. Table 10 shows the riskiest bank to the least risky bank in the system based on the last three years average. The greatest score of the TCTF means the riskiest bank in the system.

The BMI recorded the greatest TCTF risk in three consecutive three years. This is not surprising because the BMI was the largest player on interbank liabilities in 2012, 2013, and 2014 (see table 4). The average of the TCTF risk in the last three years shows that the BMI is the riskiest bank in the system even though the BMI was not the largest bank in the system.

TCTF Vulnerability of Each Bank

Table 10: TCTF vulnerability of each bank in 2012-2014

Bank	TCTF Vulnerability			
	2012	2013	2014	Average
PT. BCA Syariah	0,1149894	0,3349111	0,0223630	0,157421
PT. Bank BNI Syariah	0,0566243	0,0772780	0,0840521	0,072651
PT. Bank Syariah Mega Indonesia	0,1574828	0,0053714	0,0049923	0,055949
PT. Bank Tabungan Pensiunan Nasional Syariah		0,0160746	0,0392750	0,027675
PT. Bank Syariah Bukopin	0,0000538	0,0359070	0,0209610	0,018974
PT. Maybank Syariah Indonesia	0,0250303	-	-	0,008343
PT. Bank Muamalat Indonesia Tbk.	0,0155075	0,0042279	0,0000451	0,006593
PT. Bank Syariah Mandiri	0,0042246	0,0013520	0,0078168	0,004464
PT. Bank BRI Syariah	-	-	0,0071728	0,002391
PT. Bank Victoria Syariah	-	0,0024945	-	0,000832
PT. Bank Panin Syariah Tbk.	0,0000016	0,0000094		0,000004

Table 10 shows the TCTF vulnerability index between 2012 and 2014 of each bank and ranks based on the last three years average. The two largest assets size bank, the BMI and the BSM were not included in the vulnerable bank list. The BCAS, which is a small size bank, was the most fragile bank in the system (see Table 4). The BCAS was the third largest interbank assets player in the system.

As interbank transactions, banks capital has a big role in the systemic events. The capital of a bank could reduce significantly on the fragility of bank. It has been proven that the BSM was the largest player in the interbank assets (see Table 4), but the BSM was not included in the top 5 fragile bank (see Table 10). This is because the BSM has huge capital or even the largest capital compared to other bank in the system which is amounted to almost IDR 5 trillion (see Table 5).

5. Conclusions

Based on the default simulation, three results have been recorded which are potential capital losses, TCTF risk and TCTF vulnerability. The greatest potential losses that will be suffered by the system arose when the BMI collapses (see Table 9). The BMI is the riskiest bank in the system which is within 3.61 score of the TCTF risk of three years average (see Table 10). Meanwhile, the most fragile bank in the system is the BCAS on three years average of the TCTF vulnerability score (see Table 11). Based on the results of this study, we derive at least two findings which are linearity systemic risk with interbank transaction and the capital adequacy to reduce systemic risk.

The linearity between systemic risk and interbank transaction has been confirmed by the current research and supported previous finding by Aldasoro et al. (2013) and Lau (2013). In contrast, another study found that a less informative balance sheet approach compared to the market approach because of accounting rules being less informative (Borri et al., 2012). Market approach will not answer the main problem of systemic risk. Meanwhile, the balance sheet network approach will provide more complex and closer to the reality. Kuzubas et al. (2014) in their study had demonstrated the balance sheet network

approach through centrality model to analyse the role of interbank transaction on the Turkish financial crisis in 2000 and the result is that, the interbank has a big role towards the systemic event. Gai et al. (2011) also confirmed that a more complex and concentrated financial system will lead to a greater fragility of the system.

In relation to capital adequacy, this study found that stronger capital proportion on banks balance sheet will significantly reduce the fragility of the bank itself. This is supported by this study. Large size banks will not have big contribution if the banks' capital is large and adequate to cover fundamental shock (Laeven, Ratnovski and Tong, 2014). Anand, et al. (2013) also reported the same finding about capital adequacy in which they stated that the capital strengthen the stability of an interconnected institution.

This study still have many shortcomings. Wider coverage of study is needed, because in reality the ICBs not only have transaction among them but also with conventional banks too. Increase banks sample would be better for future research.

References

- Aldasoro, I., & Angeloni, I. (2013). Input - Output - Based Measure of Systemic Importance. *SAFE Working Paper No. 29*. Retrieved from: <https://ssrn.com/abstract=2317299>.
- Anand, K., Gai, P., Kapadia, S., Brennan, S., & Willison, M. (2013). A Network Model of Financial System Resilience. *Journal of Economic Behavior & Organization*, 85(C), 219-235.
- Ascarya, C.W., & Syarifuddin, F. (2012). The Anatomy of Financial Crisis and How to Prevent It: The Case of Dual Financial System in Indonesia. *Bank Indonesia Working Paper*.
- Bank for International Settlement. (1994). *Annual Report 1993-1994*. Basle, Switzerland.
- Bank Indonesia. (2009). *Peraturan bank Indonesia NOMOR 11/ 3 /PBI/2009*. Jakarta.
- Bank Indonesia. (2009). *PERATURAN BANK INDONESIA NOMOR 11/10/PBI/2009*. Jakarta.
- Beck, T., Kunt, A. D., & Merrouche, O. (2010). Islamic vs. Conventional Banking Business Model, Efficiency, and Stability. *Policy Research Working Paper*.
- Blancher, N., Mitra, S., Morsy, H., Otani, A., Severo, T., & Valderrama, L. (2013). Systemic Risk Monitoring ("SysMo") Toolkit - A User Guide. *IMF Working Paper*.
- Bluhm, M., & Krahen, J. P. (2014). Systemic risk in an interconnected banking system with endogenous asset markets. *Journal of Financial Stability*, 13, 75-94.
- Borri, N., Giorgio, G. D., Caccauaio, M., & Sorrentino, A. M. (2012). *Systemic Risk in European Banking Sector*. Department of Economics and Finance, LUISS University, Viale Romania .
- Chan Lau, E. V. (2009). Assessing The Systemic Implications of Financial Linkages. *IMF Working Paper of Global Financial Stability Report*. IMF.
- Choiruzzad, S. A. (2012). The Central Bank in the Development of Islamic Economy Project in Indonesia: Role, Motivations and Moderating Effect. *The Ritsumeikan Journal of International Studies*, 25(2), 437-460.
- Gai, P., Haldane, A., & Kapadia, S. (2011). Complexity, Concentration and Contagion. *Journal of Monetary Economics*, 58(5), 453-470.
- Hanif, M. (2014). *Differences and Similarities in Islamic and Conventional Banking*. National University of Computer & Emerging Sciences, Islamabad .
- Huser, A. C. (2015). Too Interconnected to Fail: A Survey of the Interbank Networks Literature. *SAFE Working Paper No. 91*. Retrieved from: <https://d-nb.info/1069159921/34>.
- Kaufmann, G. G. (1996). Bank Failures, Systemic Risk, and Bank Regulation. Retrieved from: <http://www.cato.org/sites/cato.org/files/serials/files/cato-journal/1996/5/cj16n1-2.pdf>.
- Krause, A., & Giansante, S. (2012). Interbank Lending and The Spread of bank Failures: A Network Model of Systemic Risk. *Journal of Economic and Behavior*, 83, 583-608.
- Kuzubas, T. U., Omercikoglu, I., & Saltoglu, B. (2014). Network centrality Measures and Systemic Risk: an Application to the Turkish Financial Crisis. *Physica A: Statistical Mechanics and its Applications*, 405, 203-215.
- Laeven, L., Ratnovski, L., & Tong, H. (2014). *Bank Size and Systemic Risk*. International Monetary Fund Research Division .
- Lau, J. A. (2013). *Systemic Risk Assessment and Oversight*. London: Incisive Media.
- Lenzu, S., & Tedeschi, G. (2012). Systemic Risk on Different Interbank Network Topologies. *Physica A: Statistical Mechanics and its Applications* 391 (18), 4331-4341.
- Ministry of Religion. (2010). *Al-Qur'an*. Yogyakarta: UII Press.
- Otoritas Jasa Keuangan. (2013). *Statistik Perbankan Syariah Desember 2013*. Jakarta: Departemen Perizinan dan Informasi Perbankan Deputi Direktur Publikasi dan Administrasi (IDAP) Otoritas Jasa Keuangan.
- Otoritas Jasa Keuangan. (2014). *Statistik Perbankan Syariah Desember 2014*. Jakarta: Departemen Perizinan dan Informasi Perbankan Deputi Direktur Publikasi dan Administrasi (IDAP) Otoritas Jasa Keuangan.
- Penerbit, T. (2010). *Undang-Undang Perbankan Syariah dan Surat Berharga Syariah Negara*. Bandung: Fokus Media.
- Roulet, C., & Wignall, A. B. (2013). Macro-prudential Policy, Bank Systemic Risk and Capital Controls. *OECD Journal. Financial Market Trends*, 2013(2).

Simorangkir, I. (2012). Kajian Indikator Peringatan Dini Bank Runs di Indonesia: Pendekatan Markov-Switching. *Bank Indonesia Working Paper*. Jakarta, Bank Indonesia.