SYSTEMIC RISK AND FINANCIAL LINKAGES MEASUREMENT IN THE INDONESIAN BANKING

Sri Ayomi
Bambang Hermanto[1]

Abstract

This paper measures the insolvency risk of bank in Indonesia. We apply Merton model to identify the probability of default over 30 banks during the period of 2002-2013. This paper also identify role of financial linkage a cross banks on transmitting from one bank to another; which enable us to assess if the risk is systemic or not. The results showed the larger total asset of the bank, the larger they contribute to systemic risk.

Keywords : Conditional Value at Risk; Probability of Default; systemic risk and financial linkages; Value at Risk.
JEL Classification: D81, G21, G33

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1 Sri Ayomi is bank supervisor on Financial Services Authority (OJK); (corresponding author: sriayomi@yahoo.com); Bambang Hermanto (may he rest in peace) is lecturer on Economic Department, University of Indonesia, (bhermanto78@gmail.com).

I. INTRODUCTION

Banking system has a strategic position as the intermediating and supporting payment system institution (UU No. 10/1998). As an intermediating institution, banking can give facilitations to channel the fund from those with excess fund (savers) in the position as the depositors to those who need the fund (borrowers) for various kinds of purposes. Moreover, banking also acts as an agent of development, can encourage the progression of economic improvement through credits facilities and other payment and with drawal facilities in a transaction process done by the economists.

The banking sector is exposed to some risks in doing its function. In order to be able to run its function well, it is required that the banking sector should effectively be able to manage the risks it faces so it can maintain its unremitting business process so the financial intermediating process in economy can run incessantly and efficiently. If the bank is able to reach the optimum efficiency level, it will support the management of the economy so it can function well.

Systemic risk is a determining factor in constructing a country's economic system stability due to some financial imperfections such as asymetric information, agency problem, and moral hazard which cause excessive risk taking behavior, contagion risk (domino effect) and procyclisation (prosiklisitas) of the financial intermediation.

The systemic risk can also be stated as a risk which can cause the failure of one or some financial institutions as the result of systemic events. This can be in the form of shock which can influence one of the institutions or shock which can influence the institution which then spread to another or a shock which simultaneously affect the majority of other institutions (De Bandt and Hartmann, 2000 and Zebua, 2010). Some researches on systemic risk potential in banking industry, according to Saheruddin (2009), have been done in some European countries (Nagy and Fox, 2005); The United States of America (Buehler and Gupta, 1987); Brazil (Barnhill and Souto, 2007) and in some Asian countries such as Japan (Uchida and Nakagawa, 2004) and Sri Langka (Tennekoon, 2002).

Whereas Adrian dan Brunnermeier (2009) stated that to conduct a measurement which includes systemic risk, it is better to identify the risks which exist in a system by measuring the individual systemic of an institution, in which this institutions are connected to one another and are big in size (too big to fail) so it can cause the negative spillover impact towards other institutions.

Systemic risk becomes a polemic in Indonesia when the government decided to save Century Bank by taking over (bail out) with "much too expensive" costs because the bank was considered as a failed bank and would create a systemic impact. This polemic happens because there is no scientific study or research which covers the banking systemic risks in Indonesia.

The estimation of the bank default probabilities which is carried out by estimating the systemic risk requires two variables; market values and assets' volatility. In a research conducted by Lehar (2005) and Adrian and Brunnermeier (2009), they use the stock price so they can estimate the value. Pennacchi and Redburn (2003) give a model to estimate the assets' market value and volatility by using the bank's financial report. The estimation is done not by using balance numbers but based on the profit and loss data. Tudella and Young (2003) verify Merton model to estimate the probability of default of the corporate companies in England so it can determine whether the company is failed or not. However, previously, Black and Cox (1976) did a generalization on the basic model of Merton which studied the obligation effect by including the collateral factors as the variable.

In 2013 Bank of Indonesia as the highest national banking regulator has included systemic surveillance system in the framework of SSK of which main activities include the bank evaluation and LKBB which has systemic risk potentials as well as did some researches and analyses concerning the household, corporate and by sector financial system.

Based on those experiences, the research on systemic risk for banking industry in Indonesia becomes very important to be done considering the effect and huge amount of cost which have to be guaranteed if the crisis shall happen again in the future. With this basic assumption, this paper estimates the systemic risks and the relation of banking finance in Indonesia by identifying the risks of each bank toward the banking system. Since not all of the banks are going public, the measurement of default bank probabilities and the measurement of systemic risk based on its market value and assets' volatility are estimated by using the bank's financial report. The estimation is not done by using the balance numbers but based on the profit and loss data.

Explicitly, the aim of this research are, first, to know the probability of default value of each bank based on Merton model; second, to estimate the level of the risks of each bank individually, third, to estimate the contribution of risks from each individual bank toward banking system risk as a whole, fourth, to estimate the change of risks from each individual bank toward banking system risk as a whole; and fifth, to estimate the financial linkage between one bank and the others in Indonesian banking system.

It is hoped that this paper can give positive contributions in the form of new suggestions to banking regulators and other related institutions in arranging banking industry regulations for the materialization of national financial stability and also to enrich the varieties of empirical studies on the systemic risk of banking industry in Indonesia.

The second part of this paper will cover the theory, the third part will cover the data and the applied method, while the estimation result and its analysis will be presented in chapter four. The conclusion and further suggestions will be presented in the fifth chapter as the closing.

II. THEORY

The Concept of Systemic Risk and the Bankruptcy of a Bank

The failure risk is the inability of a certain bank to pay for its debt and obligations. Before it is default, there is no other ways to clearly distinguish between the soon to be default bank and not. We only make probabilistic judgements from the failure possibilities. Thus, the bank generally pays the spread on the free-standards level of interests which is comparable with the default probabilities to compensate some loans.

Default is a rare enough phenomenon. Some specifics companies have probability of default for about 2 percent in each year, but there is no variation in the standard probability of the company (Moodys KMV, 2003).

The default in one unit of a company potentially gives influence toward the industry as a whole. According to Adrian and Brunerrmeir (2009) the systemic risk is stated as a possibility if an institution is in distress, this will trigger other institutions in the banking industry to be distressed so it can cause the bank run and the fall of the financial banking system. Whereas according to Acharya (2001), systemic risk is also a shared risk of failure which emerges from the relationship between the return of assets from the balance side of the bank.

De Bandt and Hartmann (2000) propose three interrelated basic characteristics within financial system which can give the basic principals to explain about financial fragility hypothesis, they are:

a. The banking structure or other financial institutions in which the banks generally reserve a few of their assets to fulfill the deposits withdrawal.
b. The interconnectivities of financial institutions through direct exposure and payment system.
c. The intensity of the information from the financial contract and credibility problems which mean the expected asset value in the future and the cash flow guaranteed in the contract will be fulfilled.

The Causes and Indicators of Bankruptcy

Mongid (2000) wrote that according to Hermsillo (1996) the bank failure which is often called as the bankruptcy of a bank consist of two different concepts, the first one is the economic failure or market insolvency; a situation in which the net equity of the bank becomes negative, or if the bank cannot continue its operation without creating loss which immediately result negative net equity. The second is the official failure; it is a type of failure which can be observed because an official agency announces its failure to the public. Official failure happens when the bank regulator states that the institution will not be able to operate in the long term.

Generally, we can differentiate the sources of bank failure, they are:

1. Overflowing credits expansion of the bank.
2. Asymmetrical information results in the inability of the depositors to value the assets of the bank accurately, especially when the financial condition of the bank is worsen.
3. The shock is started from outside of the banking system, detached from the bank financial condition, which causes the depositors to change their liquidity preferences or it causes the reduction on the bank's reserves.
4. The institutional limitation and the law which weakens the bank and causes the bankruptcy.

KMV Merton Model

Merton model shows that the equity can be calculated for its price and the failure probability can be estimated under some assumptions. The equity values can be determined with Black–Scholes standard in the form of:

$$E = A_t\,\Phi(d_1) - L\,e^{-r(T-t)}\,\Phi(d_2) \qquad (1)$$

$$d_1 = \frac{\ln A_t + (r + \frac{1}{2}\sigma^2)(T-t) - \ln L}{\sigma\sqrt{T-t}} \quad \text{and} \quad d_2 = d_1 - \sigma\sqrt{T-t} \qquad (2)$$

Probability of default is formulated as:

$$PD = \Phi\left(\frac{\ln(L/A_t) - (\mu - \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}}\right) \qquad (3)$$

and the length of distance to default (DD) is stated in:

$$DD = \frac{\ln A_t + (\mu - \frac{1}{2}\sigma^2)(T-t) - \ln L}{\sigma\sqrt{T-t}} \qquad (4)$$

and probability of default is summed up into PD = Φ(-DD).

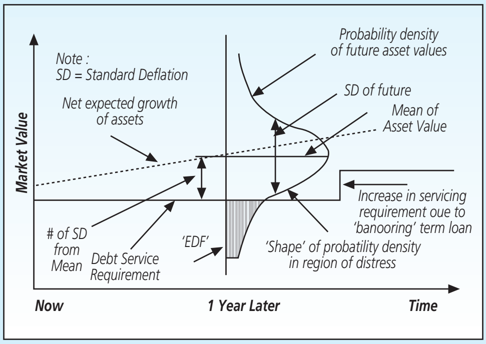

Figure 1. The probability of default or towards asset value. Default occurs when the final asset value is under the default point (shaded-in area) Crosbie dan Bohn (2003)

Cash Flow and Asset Market Value Estimation

Cooperstein, Pennachi and Redburn (1995) estimated the asset market value and its volatility using the financial report and the profit and loss data. The estimation of the auto regressive process equation of the cash flow is done using panel data analysis method.

$$C_{i,t} = \theta_t + \rho C_{i,t-1} \tag{5}$$

Market Equity Et can be calculated as the present value of the whole cash flow expected from the future which:

$$\begin{aligned} E_t &= \sum_{j=1}^{\infty} \frac{\exp^{C_{t+\Delta j}}}{(1+r)^{\Delta j}} \\ &= \frac{\theta + \rho C_t}{(1+r)^{\Delta}} + \frac{\theta(1+\rho) + \rho^2 C_t}{(1+r)^{2\Delta}} + \frac{\theta(1+\rho+\rho^2) + \rho^3 C_t}{(1+r)^{3\Delta}} + \ldots. \end{aligned} \tag{6}$$

The simpler form:

$$E_t = \frac{\rho}{(\pi - \rho)} C_t + \frac{\theta \pi}{(\pi - 1)(\pi - \rho)} \tag{7}$$

Moreover, according to Loffler and Posch (2007) the estimation of the asset market value and its volatility can be done by iteration approach. The estimation of the stochastic process of the asset of each bank is using Black-Scholes model toward market equity value and the value of account payable ledger. This technique is done by taking the initial volatility value (for example σ_o) to calculate the assets. And then, this asset value is then used to calculate the volatility to calculate the return asset which then is re used again to revise the initial volatility value σ_o (iteration process). The iteration process to k+1 is continued with the calculation of the assets market value which is shown by this equation until the convergence between the volatility of σ_o and σ can be achieved.

$$A_t = \frac{E_t + L e^{-r(T-t)}\ \Phi(d_2)}{\Phi(d_1)} \tag{8}$$

Systemic Risk Measurement

The first alternative which can be used is Value at Risk (VaR). VaR is a risk measurement method which uses statistical technique. According to Jorion (2001), VaR is generally defined as a method used to calculate the maximum loss which might happen when it is in a certain period or level of trust.

$$\text{VaR} = \mu\text{-}\alpha\ \sigma \tag{9}$$

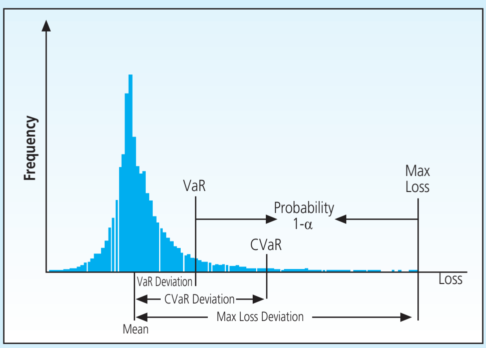

Figure 2. The Distribution of VaR.

The second alternative is by using financial linkage. The bank risk which correlates one bank to another can be seen from the financial relevance. The concept is how the Value at Risk of the individual bank can be influenced if other banks are in the distress condition. That is why other parameter is needed that is by calculating CoVaR (A|B) which means CoVaR of bank A is conditioned toward bank B which is in distress condition.

According to Roengpitya and Rungcharoenkitkul (2010) this concept is considered as an externality which cannot be gained by observing individual risk value only. It is due to the individual risk contribution which is conditioned by the other bank individual risks ΔCoVaR (A|B) portrayed an amount of excess from the Value at Risk of bank A which is separated from Value at Risk of bank A itself which caused by bank B. Whereas to calculate the additional percentage of the value at risk towards bank A when the value at risk of bank B is in distress condition, it is using % ΔCoVaR (A|B). The bigger percentage of the value at risk contribution of bank B toward the value at risk of bank A, the more systemic bank B is toward bank A.

3. METHODOLOGY

Data Collection Technique

This research is exploratory in nature in evaluating the systemic risk of individual bank towards the banking system. There are four data processing techniques used as explained below.

The *first* step is calculating the banking assets; market value, especially for the banks who have not gone public yet. Cooperstein, Pennacchi and Redburn (2003) give a model to estimate the market value and volatility of the assets by using the bank's financial report. In this paper, the estimation of market value of the bank assets is done by using the profit and loss report data.

The return assets of each bank and the return assets of the banking system is stated as:

$$X_t^i = \left(\frac{A_t^i - A_{t-1}^i}{A_{t-1}^i} \right) \text{ and } X_t^{sys} = \left(\frac{A_t^{sys} - A_{t-1}^{sys}}{A_{t-1}^{sys}} \right) \tag{10}$$

with $A_t^{sys} = \sum_i A_t^i$. X_t^{sys} shows the return of the total assets of the whole banking system; and A_{t-1}^{sys} shows the total assets of the banking system in the previous period.

To gain the time variation of the distribution between X^i and X^{sys}, this distribution is estimated as the function of a string of macro variables which can influence the amount of assets return. In this stage, the data processing technique used is Generalize Autoregressive Conditional Heteroschedasticor GARCH (1,1). The equation specification to estimate the return value of the bank assets is:

$$\begin{aligned} X_t^i &= \alpha^i + \beta^i M + \varepsilon_t^i \\ X_t^{sys} &= \alpha^{sys} + \beta^{sys} M + \varepsilon_t^{sys} \end{aligned} \tag{11}$$

The *second s*tage is calculating the probability of default of the individual bank and banking system in general. Lehar (2005), and Adrian and Brunnermeier (2009) uses the stock price to estimate this probability of default quantity. In this research, we estimate the value VaR individual dan VaR banking system using this specification:

$$\mathrm{VaR}_t^i = \hat{\alpha}^i + \hat{\beta}^i \mathrm{M} \qquad \mathrm{VaR}_t^{sys} = \hat{\alpha}^{sys} + \hat{\beta}^{sys} \mathrm{M} \tag{12}$$

with VaR_t^i as the value at risk of bank i in the period of t, and VaR_t^{sys} as the value at risk of the banking system within the period of t. M is the macro variable vector which includes SBI, JIBOR and IHSG; all of those three are calculated in their growth value.

$$\mathrm{SBI_t} = \frac{\mathrm{SBI}_t - \mathrm{SBI}_{t-1}}{\mathrm{SBI}_{t-1}} \quad \mathrm{JIBOR_t} = \frac{\mathrm{JIBOR}_t - \mathrm{JIBOR}_{t-1}}{\mathrm{JIBOR}_{t-1}} \quad \mathrm{IHSG_t} = \frac{\mathrm{IHSG}_t - \mathrm{IHSG}_{t-1}}{\mathrm{IHSG}_{t-1}} \tag{13}$$

The *third* step is calculating the parameter of Conditional Value at Risk (CoVaR) which is based on the Value at Risk of the individual bank and the whole banking system. This quantity of CoVaR actually reflects the systemic risk in the term of the influence of a bank towards the banking system as a whole. Technically, the estimation of CoVaR_t^i is done by using the coefficient of the banking system estimation result and substitute the result of the VaR_t^i estimation result towards the coefficient of $\gamma^{sys|i}$:

$$X_t^{sys} = \alpha^{sys|i} + \beta^{sys|i} M + \gamma^{sys|i} X_t^i + \varepsilon_t^{sys|i} \qquad CoVaR_t^i = \hat{\alpha}^{sys|i} + \hat{\beta}^{sys|i} M + \hat{\gamma}^{sys|i} VaR_t^i \tag{14}$$

where: CoVaR_t^i as the conditional value at risk of the banking system in the VaR of bank i; whereas as the estimated parameter. The next step is to do calculation on systemic risk contribution from the banking system of each individual bank in the form of:

$$\Delta\mathrm{CoVaR}_t^i = \mathrm{CoVaR}_t^i - \mathrm{VaR}_t^{sys} \tag{15}$$

The *fourth* step in the data processing stage is the calculation of financial linkage. In this paper, these four stages are used:

a. Analyzing the equation of CoVaR(A|B) which becomes the value at risk of bank A which is conditioned towards the value at risk of bank B:

$$X_t^A = \alpha + \beta^A M + \gamma X_t^B + \varepsilon_t^{A,B} \quad (16)$$

b. The CoVaR (A|B) estimation

$$CoVaR(A|B)_t = \hat{\alpha}^A + \hat{\beta}^A M + \hat{\gamma}\, VaR_t^B \quad (17)$$

c. The level of marginalization or the change of ΔCoVaR(A|B):

$$\Delta CoVaR(A|B)_t = CoVaR(A|B)_t - VaR(A)_t \quad (18)$$

d. The inter-bank financial linkage analysis by measuring the percentage of the risk changes of bank A conditioned by bank B:

$$\%\,\Delta CoVaR(A|B)_t = \frac{CoVaR(A\,|\,B)_t - VaR(A)_t}{VaR(A)_t} \quad (19)$$

Data Source

The data in this research includes the monthly cash flow, the capitalization equity, assets and debt values as well as macro variables data (SBI rate, JIBOR dan IHSG) also includes the monthly financial report within the period of 2002 – 2013. The data source of the research is gained from the publication result of 30 public banks which have been go public and have not yet been go public. It includes 10 banks with the total assets of more than Rp50 quintillion, 10 banks with the total assets of more than Rp10 quintillion until Rp50 quintillion and 10 banks with the assets of lower than Rp10 quintillion.

The financial report is achieved from the CFS bank reports to the Bank of Indonesia and the interest rate of SBI is achieved from Bank of Indonesia. JIBOR is achieved from Indonesian Capital Market Directory and IHSG is originated from Indonesian Stock Market (Bursa Efek Indonesia/BEI) sites.

IV. RESULT AND ANALYSIS

4.1 Probability of Default Analysis

The default condition of a bank will potentially influence other banks so there will be some systemic risks problems. Thus, the failure of a certain bank is a risk which has to be measured and responded rationally, so the attempt on the prevention of the failure of the bank must be done since the early stages.

There are many factors which influence the payment failure of a bank. The return of the assets market value and its volatility are the required main factors to calculate the probability of default in Merton model. Before it is in default condition, there is no other way that can clearly differentiate between the banks which will be in the default condition and not. We can only observe and calculate its default chance. In this term, each bank will pay insurant which is comparable with the probability of default to compensate the loaner for this indeterminacy.

The result of this research shows that for big banks, the accumulation of the average default risk probability reaches 42,36 percent during the research period. The maximum average probability of default is 93,62 percent, it was found in Bank T which has the lowest rating of

Table 1
The Banks Probability of Default and Rating

Bank Name	Assets (Rp.billion) Iteration k+1	Default Probability (DP)		Rating
		PD Average	PD with Trust Intervals of 95%	
Bank A	303.775	35,27%	34,6 - 35,9%	BBB
Bank B	219.993	38,00%	37,0 - 39,0%	BB
Bank C	171.630	42,94%	42,5 - 43,4%	BB
Bank D	216.581	16,97%	16,1 - 17,9%	A
Bank E	44.445	60,27%	60,0 - 60,5%	B
Bank F	51.004	44,98%	44,0 - 46,0%	BB
Bank G	27.385	48,03%	47,5 - 48,6%	BB
Bank H	45.600	34,47%	33,7 - 35,3%	BBB
Bank I	31.760	53,02%	52,3 - 53,7%	B
Bank J	36.074	49,63%	48,9 - 50,4%	BB
Bank K	3.453	49,25%	48,7 - 49,8%	BB
Bank L	11.598	54,59%	54,2 - 55,0%	B
Bank M	5.077	64,58%	63,5 - 65,6%	B
Bank N	14.418	42,30%	41,8 - 42,8%	BB
Bank O	4.236	69,82%	69,6 - 71,0%	CCC
Bank P	9.361	36,54%	35,1 - 38,0%	BB
Bank Q	16.831	40,92%	40,1 - 41,7%	BB
Bank R	13.757	37,32%	36,3 - 38,4%	BB
Bank S	8.838	93,60%	93,4 - 93,8%	C
Bank T	9.282	93,62%	93,6 - 93,6%	C
Bank U	1.841	51,55%	51,2 - 51,9%	B
Bank V	2.840	42,72%	41,9 - 43,6%	BB
Bank W	1.731	48,45%	48,1 - 48,8%	BB
Bank X	1.363	58,50%	54,2 - 62,8%	B
Bank Y	1.023	64,62%	64,5 - 64,8%	B
Bank Z	847	64,84%	64,3 - 65,4%	B
Bank AA	423	69,74%	69,7 - 69,8%	CCC
Bank AB	326	65,37%	65,2 - 65,5%	CCC
Bank AC	166	78,28%	78,1 - 78,5%	CC
Bank AD	703	57,85%	57,6 - 58,2%	B

Source : Data Tabulation.
Explanation : AAA= (0 - 5%); AA = (5 - 15%); A = (15 - 25%)
BBB = (25 - 35%); BB =(35 - 50%) ; B= (50 - 65%)
CCC = (65 - 75%); CC =(75 - 85%) ; C= (85 - 95%) ; D = 95% +

C. Whereas its minimum average reaches 16,9 percent which is the default risk of Bank D, which has the rating of A.

Referring to the migration matrix, it can be observed that the potential of Bank D to have the default risk in the span of one year is very small with the amount of 0,04 percent. Moreover to the bank which is in unstable condition, the probability of bankruptcy or area is also small which is only in the amount of 0,01 percent. Generally, the banks with the rating of A has the risk probability which is still under 1 percent that is 0,04 percent. However, the chance of migration to the rating of AAA (companies with the best quality, proper and stable) is also small with 0,07 percent.

There is a big enough chance of migration from the banks with the rating of A to the rating of AA in the amount of 2,25 percent. However, the number is still considered as low because it is still under 5 percent. While the migration probability of the banks with the rating of BBB to the rating of A or from the rating of BB is almost the same with the amount of 4 percent, and the chance to maintain in the same rating within one year is almost 90 percent.

Bank A and Bank H are included in the classification of BBB with the probability of default value of 35 percent. This bank can be called as a healthy bank and the financial condition is satisfactory. The ability to maintain the rating of BBB is big enough that it reaches 89,3 percent. However, the chance to elevate the rating to A, AA or AAA is also low, each with the migration probability of 4,83 percent; 0,25 percent and 0,03 percent. Although it is difficult to elevate, the default and bankruptcy probability is also very small which is 0,22 percent.

4.2. Systemic Risk Analysis

VaR of Individual Bank and VaR of the System

The result of the estimation shows the mean or average of individual bank VaR reaches -29,87 percent. This amount of average VaR is contributed by the VaR from Bank Sand Bank T which is more than 50 percent. These two banks have a low performance with the rating of C. Aggregately, the VaR of the banking system in Indonesia has a small probability of default, which is shown by the VaR of the system with the amount of -3,04 percent.

According to the result of the research, the banks with low performances such as Bank S, Bank T and Bank X, have much bigger return asset fluctuation than the other banks. This paper confirms that the average value of those banks'VaR is the biggest VaR compared to the other banks' VaR, it shows a very big individual risk in those Bank S, Bank T and Bank X.

Table 2
Individual Risk and Banking System Risk

No	Bank Name	Individual Risk		No	Bank Name	Individual Risk	
		VaR	Rank			VaR	Rank
1	Bank A	-5,01%	28	17	Bank Q	-8,63%	17
2	Bank B	-7,88%	19	18	Bank R	-7,50%	21
3	Bank C	-5,66%	27	19	Bank S	-437,7%	1
4	Bank D	-2,07%	30	20	Bank T	-112,3%	2
5	Bank E	-13,84%	11	21	Bank U	-7,28%	23
6	Bank F	-7,31%	22	22	Bank V	-7,80%	20
7	Bank G	-6,05%	25	23	Bank W	-8,97%	16
8	Bank H	-8,63%	18	24	Bank X	-37,51%	3
9	Bank I	-12,99%	12	25	Bank Y	-15,01%	10
10	Bank J	-11,16%	14	26	Bank Z	-20,09%	7
11	Bank K	-6,03%	26	27	Bank AA	-18,89%	8
12	Bank L	-11,96%	13	28	Bank AB	-15,72%	9
13	Bank M	-22,92%	6	29	Bank AC	-32,04%	4
14	Bank N	-3,95%	29	30	Bank AD	-10,76%	15
15	Bank O	-23,13%	5	31	SISTEM	-3,04%	-
16	Bank P	-7,19%	24				

Source : Data Tabulation.

The Contribution of Individual Risk towards the Banking System

The measurement of the amount of risk of a bank towards the banking system requires structural identification and the inter-bank relevance risk in the banking system, where the interconnected institutions can channel negative spillover towards the other institutions. To differentiate it with the generally understood 'systemic' terminology, this individual systemic risk is defined as the risk which is resulted by one bank towards the aggregate risk of the banking system as a whole.

The impact of individual bank CoVaR towards the system's VaR is various across the banks, it signifies that individual ΔCoVaR is significantly different between the banks. The relationship between the risk level of individual bank (measured by individual VaR) towards the banking system risk contribution (measured by ΔCoVaR) can be seen in Table 3. This table shows that the banks with the high VaR value do not always give big contribution towards the banking system risk. For example, Bank A has a risk contribution towards the biggest banking system ΔCoVaR = -3,13 percent (Rank number-1), having unconditional VaR with the amount of only -5,01 percent (rank number-28). On the contrary, Bank S, which has the biggest individual risk (rank number-1), but the risk contribution towards banking system as a whole ΔCoVaR is to the amount of -0,27% percent (rank number-20).

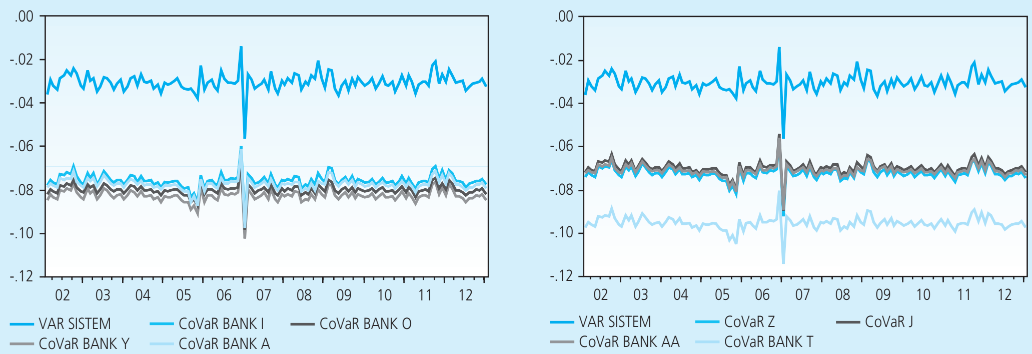

Figure 3. Banking System VaR and Bank's CoVaR

The percentage of the individual bank risk contribution toward the system, is linearly connected with the amount of the bank's contribution towards the banking system risk aggregately. The higher the risk contribution, the closer its potential systemic impact towards banking aggregately is. According to the writer, the risk contribution towards banking can be categorized as having systemic impact if the risk contribution has reached more than 10 percent.

In this term, the main point regarding the issues of systemic risk is when one bank is in a trouble, so it will create panic in the financial system, so in the end it will cause the failure of other institutions. This can lead to a financial crisis. The most alarming thing is the simultaneous failure of some banks will create a serious financial crisis due to the impact of banking crisis towards the economy is huge. Hoggarth (2002) found that the simultaneous failure causes the reduction of PDB output with the average of 15 - 20 percent during the crisis.

Referring to the threshold of 10 percent above, this research has categorized which banks which have the potential to give systemic impact towards the banking system as a whole. The result of the calculation (Tabel 3) shows that form the 30 banks observed, there are 19 banks which have the potential to give systemic impact towards the banking system, they are Bank A, Bank B, Bank C, Bank D, Bank O, Bank G, Bank F, Bank AA, Bank Y, Bank X, Bank E, Bank K, Bank Z, Bank H, Bank L, Bank I, Bank U, Bank J, Bank W.

Table 3
The Contribution of Risk towards Banking System

Bank	Individual Risk		Systemic Risk Contribution towards Banking System			Bank's Systemic Risk towards Banking System in the threshold = 10%	Rating
	VaR	Unit	%ΔCoVaR	Ordo	%ΔCoVaR		
Bank A	-5,01%	28	-3,13%	1	102,89%	Systemic	BBB
Bank B	-7,88%	19	-2,89%	2	95,30%	Systemic	BB
Bank C	-5,66%	27	-2,82%	3	92,88%	Systemic	BB
Bank D	-2,07%	30	-1,70%	4	55,98%	Systemic	A
Bank O	-23,13%	5	-1,52%	5	50,11%	Systemic	CCC
Bank G	-6,05%	25	-1,47%	6	48,27%	Systemic	BB
Bank F	-7,31%	22	-1,42%	7	46,63%	Systemic	BB
Bank AA	-18,89%	8	-1,29%	8	42,45%	Systemic	CCC
Bank Y	-15,01%	10	-1,28%	9	42,17%	Systemic	B
Bank X	-37,51%	3	-1,12%	10	36,76%	Systemic	B
Bank E	-13,84%	11	-0,86%	11	28,30%	Systemic	B
Bank K	-6,03%	26	-0,85%	12	27,88%	Systemic	BB
Bank H	-8,63%	18	-0,73%	13	24,19%	Systemic	BBB
Bank Z	-20,09%	7	-0,73%	14	24,00%	Systemic	B
Bank L	-11,96%	13	-0,69%	15	22,56%	Systemic	B
Bank I	-12,99%	12	-0,55%	16	18,23%	Systemic	B
Bank U	-7,28%	23	-0,40%	17	13,19%	Systemic	B
Bank J	-11,16%	14	-0,38%	18	12,47%	Systemic	BB
Bank W	-8,97%	16	-0,31%	19	10,24%	Systemic	BB
Bank S	-437,7%	1	-0,27%	20	8,76%	Non Systemic	C
Bank AB	-15,72%	9	-0,23%	21	7,73%	Non Systemic	CCC
Bank V	-7,80%	20	-0,20%	22	6,72%	Non Systemic	BB
Bank AC	-32,04%	4	-0,15%	23	5,10%	Non Systemic	CC
Bank N	-3,95%	29	-0,15%	24	4,97%	Non Systemic	BB
Bank T	-112,3%	2	-0,15%	25	4,86%	Non Systemic	C
Bank M	-22,92%	6	-0,13%	26	4,17%	Non Systemic	B
Bank AD	-10,76%	15	-0,12%	27	4,08%	Non Systemic	B
Bank P	-7,19%	24	0,44%	28	-14,65%	Non Systemic	BB
Bank R	-7,50%	21	0,46%	29	-15,23%	Non Systemic	BB
Bank Q	-8,63%	17	0,53%	30	-17,41%	Non Systemic	BB
Average	-	-	-	-	26,45%	-	

Source : Data Tabulation.

It is interesting to analyze that the level 19 banks which are categorized as having potential to give systemic impact towards banking, precisely to have good enough rating from B to A and only two of them having the rating of CCC that are bank AA and bank O. On the other hand, the bank which is categorized as not having potential to give systemic impact towards banking system has the rating span from CCC to BB. However, as what has been stated in the beginning that this research is an explorative research and the result of the calculation in this model at least can contribute the measurable discussion foundation for all of the economic stakeholders.

The Banking Financial Linkage

Some previous studies concluded that when smaller banks are in distress condition and declared as bankrupt it does not mean that those banks will not give huge systemic impact. It is due to the possibilities of bank run or bank panic which can emerge because the condition happens, especially, when the macroeconomic condition is having a downturn (economic recession). The study done by Simorangkir, (2006) stated that the pressure of the macroeconomic condition in Indonesia which happened in 1997-1998 significantly impacted towards the occurrence of bank runs during the period of banking crisis at that time.

In general, it can be stated that the bank, individually, has externality towards the occurring system so the assessment towards the systemic risk potential of certain individual banks should be the center of attention of the regulator. According to Roengpitya and Rungcharoenkitkul (2009) the banks which seem to operate in a prudent way and have lower individual risk, are also possible to be able to threaten the viability of the banking system stability especially in a certain condition.

According to the writer's consideration, financial linkage CoVaR (A|B) can significantly be seen as having inter-bank systemic risk impact if the level of contribution percentage %ΔCoVaR(A|B) reaches more than 10 percent. If a bank has high level of financial linkage with other banks, when it is bankrupt, the other banks will get bigger impact.

Table 4 shows that banks which have the average of %ΔCoVaR < 10% or non-systemic towards the banking system also have the average of %ΔCoVaR (A/B) < 10% or non-systemic towards the other banks. Whereas from 19 banks which have the average of %ΔCoVaR > 10% or systemic towards the banking system, 13 banks among them have the average of %ΔCoVaR (A/B) > 10% or systemic towards other banks and 6 of them have the average of %ΔCoVaR (A/B) < 10% or non-systemic towards the other banks.

However, further investigation can be done by observing Table 5. We can see that bigger banks such as bank A, B, C and D can condition the risk of other individual banks' VaR with big enough percentage. For example, Bank A has the individual VaR level of -5.01 percent; the contribution of conditional value at risk of Bank A towards Bank E or ΔCoVaR (E|A) is to the amount of -2.73 percent and the contribution percentage of %ΔCoVaR (E|A)is to the amount of 19.75 percent. On the other hand, Bank E with the individual VaR level of -13.84 persen; the contribution of conditional value at risk of bank E towards Bank A is only to the amount of -0.27 percent and the percentage of %ΔCoVaR (A|E) is to the amount of 5.43 percent. It shows that Bank A can increase the risk towards Bank E from the VaRof -13.84 percent into -16.57 percent (systemic risk potential). On the other hand, Bank E can only increase the VaR risk of Bank A from minus -5.01 percent into just -5.29 percent (non systemic risk potential). The interesting thing is when we observe the medium bank S which has not so big amount of asset and non systemic towards the banking system, can only condition 6 other banks with %ΔCoVaR (A/B) > 10% which is towards 78.48% from the VaR of bank E, 14.60% from the

VaR of bank J, 35.62% from the VaR of bank P, 29.44% from the VaR of bank Q, 27.87% from the VaR of bank R and 11.35% from the VaR of Bank Y. Bank E can condition to the amount of 14.43% towards the VaR of bank C, in which Bank C can condition the other banks with big enough percentage since it is systemic in nature. Furthermore, Bank J can condition bank E, F, G, H where bank F and G can big enough condition bank A, B, C, D and E. Bank A, B, C and D are systemic in nature. It goes furthermore, the other banks will condition each other towards other banks. Thus, when smaller banks are in distress condition and declared as bankrupt it does not mean that those banks will not give huge systemic impact

Theoretically, if there is a strong negative effect from the bank failure of one or more banks, the bank will be encouraged to invest in the same industry to be able to survive or fail altogether. This strategy is called as collective risk. The consequence of this strategy is that the bank will have asset which has higher correlation which leads to the higher possibility of collective banking failure. Acharya (2001) mentioned the occurrence of "negative externality," which in fact depends on the size of the failed banks, the uniqueness of the failed banks, and the cases in which the operating banks do not benefited and do the failed bank facilities takeover.

The spreading of the failed bank risk through the interconnection of institutions can originate from the failure of the coordination and liquidity crisis. The credence crisis does not have to originate from the failure risk of the opponent but it might originate from the deteriorating of certain spiral of asset value. However, there are other reasons in some literatures which state that the systemic risk is only the matter of coordination. Thus, the spreading of the crisis towards the liquidity to other institutions will give a systemic spreading impact towards banking. That is why, the systemic risk which caused by the lacking of liquidity in a financial system will give bigger impact to other banks at the times when the shock is spreading rapidly.

Table 4
The Systemic Risk Level and Financial Linkage (in percent)

Bank	Systemic Risk and Contribution Percentage In the Whole Banking System			Financial Linkage (FL)			Interbank Systemic Risk on the threshold FL=10%
	CoVaR	∆CoVaR	%∆CoVaR	Average CoVaR (A|B)	Average ∆CoVaR (A|B)	Average %∆CoVaR (A|B)	
Bank A	-6.16	-3.13	102.89	-31.84	-1.12	22.15	Systemic
Bank B	-5.93	-2.89	95.30	-31.51	-0.88	19.15	Systemic
Bank C	-5.86	-2.82	92.88	-33.62	-2.92	22.55	Systemic
Bank D	-4.74	-1.70	55.98	-31.75	-0.92	16.07	Systemic
Bank E	-3.90	-0.86	28.30	-38.61	-8.19	3.27	Non Systemic
Bank F	-4.45	-1.42	46.63	-31.46	-0.82	16.34	Systemic
Bank G	-4.50	-1.47	48.27	-32.17	-1.48	15.13	Systemic
Bank H	-3.77	-0.73	24.19	-29.61	0.99	7.02	Non Systemic
Bank I	-3.59	-0.55	18.23	-30.46	-0.01	4.41	Non Systemic
Bank J	-3.42	-0.38	12.47	-31.87	-1.36	1.03	Non Systemic
Bank K	-3.88	-0.85	27.88	-31.00	-0.31	7.98	Non Systemic
Bank L	-3.72	-0.69	22.56	-31.45	-0.97	10.20	Systemic
Bank M	-3.16	-0.13	4.17	-31.10	-1.00	3.87	Non Systemic
Bank N	-3.19	-0.15	4.97	-29.74	1.02	1.74	Non Systemic
Bank O	-4.56	-1.52	50.11	-32.12	-2.02	19.24	Systemic
Bank P	-2.59	0.44	-14.65	-31.14	-0.50	2.29	Non Systemic
Bank Q	-2.51	0.53	-17.41	-31.22	-0.63	3.46	Non Systemic
Bank R	-2.58	0.46	-15.23	-31.18	-0.54	2.76	Non Systemic
Bank S	-3.30	-0.27	8.76	-16.13	-0.33	3.63	Non Systemic
Bank T	-3.19	-0.15	4.86	-27.58	-0.55	6.43	Non Systemic
Bank U	-3.44	-0.40	13.19	-34.18	-3.53	10.65	Systemic
Bank V	-3.24	-0.20	6.72	-32.16	-1.53	5.64	Non Systemic
Bank W	-3.35	-0.31	10.24	-31.73	-1.15	7.74	Non Systemic
Bank X	-4.15	-1.12	36.76	-32.88	-3.28	28.36	Systemic
Bank Y	-4.32	-1.28	42.17	-33.47	-3.09	15.19	Systemic
Bank Z	-3.77	-0.73	24.00	-29.91	0.29	10.28	Systemic
Bank AA	-4.33	-1.29	42.45	-32.35	-2.10	17.35	Systemic
Bank AB	-3.27	-0.23	7.73	-29.92	0.44	4.08	Non Systemic
Bank AC	-3.19	-0.15	5.10	-31.68	-1.89	6.96	Non Systemic
Bank AD	-3.16	-0.12	4.08	-28.32	-2.20	0.69	Non Systemic

Source: Data Tabulation.
Note: FL in the table is the average bank's influence itowards other banks' VaR

Table5
The Percentage of Conditional Value at Risk %ΔCoVaR (A|B) Contribution, in percent.

BANK	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Av.
BANK A		54.3	60.6	50.7	5.4	18.7	26.4	0.1	-7.8	-1.5	28.5	10.3	13.1	-6.0	40.9	10.4
BANK B	64.2		62.5	29.0	9.2	26.4	18.5	-2.0	-1.1	-18.3	26.3	14.0	-5.4	-0.6	39.6	13.2
BANK C	71.0	62.5		41.1	14.4	23.5	46.4	1.0	-3.6	0.3	14.3	25.3	10.3	7.7	44.5	17.6
BANK D	70.0	33.8	47.3		-7.1	11.4	34.8	21.5	-5.3	2.3	26.3	-2.5	19.0	6.5	41.1	12.4
BANK E	19.8	18.6	23.5	1.6		13.9	18.6	-3.6	2.6	17.7	8.8	15.7	-19.6	8.6	19.6	10.9
BANK F	24.4	25.9	22.3	9.6	4.9		25.4	24.7	24.5	11.9	9.5	22.8	-6.6	-10.5	31.1	11.9
BANK G	34.1	18.9	47.1	30.6	9.4	26.4		18.1	18.9	11.8	-4.5	6.0	-9.1	0.4	19.4	10.6
BANK H	4.4	-1.4	0.2	17.7	-9.8	24.0	17.0		40.5	39.6	1.6	-3.6	5.1	21.2	-12.7	5.8
BANK I	-4.7	-1.6	-5.1	-4.8	-5.4	22.5	16.5	38.8		22.2	-9.6	0.2	-17.3	5.9	-3.3	3.1
BANK J	4.3	-16.7	0.8	3.7	10.1	13.9	13.2	43.6	26.6		-2.3	-4.8	16.2	8.9	-26.6	3.0
BANK K	43.3	32.3	17.3	28.0	2.1	13.0	-3.5	3.2	-9.7	-2.9		24.9	10.7	6.7	15.2	8.0
BANK L	14.0	12.7	21.7	-1.2	6.2	20.6	5.6	-3.1	1.4	-5.0	17.8		-7.2	-6.0	28.5	5.9
BANK M	13.0	-9.3	4.3	10.9	-27.7	-10.6	-12.6	0.4	-21.1	9.1	2.8	-12.7		-12.0	-5.1	-5.4
BANK N	7.9	10.2	19.5	18.2	11.2	-2.8	11.4	39.3	20.0	20.2	16.4	1.1	0.4		-6.8	9.2
BANK O	46.5	37.1	41.5	33.0	9.0	29.6	17.4	-14.0	-3.5	-27.6	10.4	30.2	-1.5	-14.0		8.9
RATA-RATA	**22.2**	**19.2**	**22.6**	**16.1**	**3.3**	**16.3**	**15.1**	**7.0**	**4.4**	**1.0**	**8.0**	**10.2**	**3.9**	**-1.7**	**19.2**	**9.7**
ΔCoVaR SISTEM	**102.9**	**95.3**	**92.9**	**56.0**	**28.3**	**46.6**	**48.3**	**24.2**	**18.2**	**12.5**	**27.9**	**22.6**	**4.2**	**5.0**	**50.1**	

Table5
The Percentage of Conditional Value at Risk %ΔCoVaR (A|B) Contribution, in percent. (Continued)

BANK	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	Av.
BANK P		143.4	127.7	35.6	35.8	18.2	31.0	35.7	38.5	33.2	29.4	40.4	38.2	33.5	27.6	39.1
BANK Q	102.6		106.1	29.4	29.6	14.9	25.6	29.5	31.8	27.4	24.2	31.6	27.6	27.6	22.8	31.6
BANK R	112.2	131.3		27.9	28.0	11.1	23.5	28.0	30.6	25.6	21.9	32.4	30.3	25.8	20.2	31.1
BANK S	2.3	2.8	2.4		-0.5	9.9	0.7	-0.9	-2.7	10.6	-7.4	2.9	-4.1	7.6	-13.5	1.8
BANK T	1.0	1.6	1.1	-2.1		32.2	28.0	4.7	17.8	-1.0	-8.1	1.7	1.1	-1.0	12.8	0.6
BANK U	-35.4	-42.5	-36.9	6.1	30.8		19.6	0.9	11.4	13.3	-0.8	2.6	5.9	-19.6	13.3	0.1
BANK V	-5.0	-6.5	-5.3	2.8	34.4	27.2		5.8	13.8	-0.0	-4.2	6.1	17.3	-9.1	-7.1	4.2
BANK W	-7.5	-0.6	-6.0	-48.8	39.3	21.5	5.0		430.9	34.1	47.8	43.7	-47.4	41.3	-132.7	17.9
BANK X	0.6	2.3	1.0	-9.3	11.8	7.5	3.6	29.3		10.6	13.8	12.9	-8.9	12.3	-29.3	4.1
BANK Y	-1.9	-2.4	-2.0	11.4	1.1	18.1	-1.5	6.5	19.4		25.3	16.6	7.9	5.5	2.3	10.7
BANK Z	-10.8	-13.2	-11.3	-8.4	-7.5	3.6	-6.4	7.9	24.5	27.1		2.6	14.0	5.5	-10.2	5.1
BANK AA	17.0	19.9	17.6	7.2	7.7	11.4	8.2	11.6	27.9	21.9	6.5		22.3	8.1	17.8	19.0
BANK AB	7.3	8.9	7.6	-4.1	2.7	9.8	14.2	-0.8	-2.3	7.3	12.5	16.0		-16.2	11.0	2.8
BANK AC	-1.9	-2.4	-2.0	8.0	0.6	-16.3	-10.7	6.8	21.3	5.1	5.1	3.9	-17.0		-14.2	2.6
BANK AD	-17.6	-20.7	-18.3	-18.2	11.7	14.4	-12.8	-12.0	-29.3	-1.9	-13.5	9.1	7.8	-18.1		-4.9
Avg.	**2.3**	**3.5**	**2.8**	**3.6**	**6.4**	**10.7**	**5.6**	**7.7**	**28.4**	**15.2**	**10.3**	**17.4**	**4.1**	**7.0**	**-0.7**	**9.7**
ΔCoVaR SISTEM	**-14.7**	**-17.4**	**-15.2**	**8.8**	**4.9**	**13.2**	**6.7**	**10.2**	**36.8**	**42.2**	**24.0**	**42.5**	**7.7**	**5.1**	**4.1**	

V. CONCLUSION

This research gives some interesting empirical conclusions which can become an opening discourse on banking systemic risk. By using 30 public banks as the research sample, the empirical conclusion which can be gained are, first, the average probability of default of the bank during the research period (2002 – 2013) is to the amount of 53,60 percent with the deviation standard of 4,81 percent. Merton model has enough special qualities because it does not need assumptions on the functional forms which used both as the early risk signal and the potential of probability of default.

The second empirical finding is that the default banking probability is highly influenced by the amount of volatility return of the bank's asset. The higher the volatility fluctuation, the bigger the risk potential of a bank to be in default condition is and or vice versa too.

On the individual bank level, the third empirical finding is that the VaR risk of individual bank is found with the average amount of -29,87 percentand VaR of banking system is only to the amount of -3,04 percent. This unconditional VaR value of each bank can be used to portray how big the risk is towards the banking system.

With the analysis of interbank financial linkage, this research gives the fourth conclusion that the individual bank risk which is conditioned towards the other individual bank risks has the average CoVaR(A|B) to the amount of -31,07 percent. Each bank gives different additional risk when the bank is in distress.

The average amount of the additional risk contribution of the bank which is conditioned by the other banks is to the amount of-1,21% and the average of contribution percentage %ΔCoVaR(A|B) is to the amount of 9,69 percent. This parameter is actually linearly related with the amount of systemic risk contribution. The higher the risk contribution, the higher the systemic risk contribution percentage is. This is the fifth empirical finding.

Those five empirical findings above show that generally, each bank has externality towards banking system as a whole, so the assessment on the potential of systemic risk in certain individual banks deserve to be noted by the regulator. Smaller banks or the banks which seem to operate in a prudent way and lower individual risk, are not possible to threaten the sustainability of the banking system stability especially in some certain conditions.The empirical finding in this research needs to be considered by both the government and the financial authority (Bank of Indonesia,Financial Service Authority or *Lembaga Penjamin Simpanan* (Saving Assurance Institution)), to be made as a suggestion in the creation of the more accurate rules and policies.

This research needs further improvement first on the term of the amount of data observed and the number of the observation needs to be increased; second, the need to consider the roles of external factors in the modeling of the financial linkage equations; the third, the need to confront and further analyze the amount of the threshold used in determining the banking systemic risk.

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