THE EFFECT OF INTERNAL BANKING AND MACROECONOMIC VARIABLES ON SYSTEMIC RISK

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Abstract. The 2008 Global Financial Crisis makes systemic risk one of the focuses of research that continues to grow and makes the financial sector the center of analysis. The banking crisis is one of the sources of the financial crisis. This study attempts to analyze how the influence of bank internal variables and macroeconomics on systemic risk. Measurement of risk contribution uses the conditional value-at-risk (CoVaR) model with using a sample of five banks with the largest assets in Indonesia. The results of the study show that there are influences between internal banking and macroeconomic variables on systemic risk in Indonesia. Liquidity, leverage, and ROA have an effect on and are positively related to systemic risk, but in this case the ROA variable does not significantly influence while the deposit and size variables significantly influence and are negatively related. The results of this study refute the doctrine of "Too Big to Fail" which has been valid. In macroeconomic variables, namely the exchange rate and interbank money market interest rates (PUAB) have a positive relationship with the economic situation of a country that will affect the performance of the financial system in the country.

Key words: Systemic Risk; Delta-CoVaR; Banking; Risk Management.

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Introduction

The financial crisis is an event that has a broad impact. The financial crisis causes losses that spread across financial institutions, and threatens the overall financial system which creates systemic risks that affect the economy as a whole. The financial crisis which gave a very significant impact, one of which was the global crisis in 2008. The financial crisis that year began with the fall of one financial institution in the United States and spread to the financial system to cause a global systemic crisis and a decline in the world economy. With the measurement of systemic risk hoped that this will be a useful thing to monitor the performance of the financial system so that if there is interference there will be a signal that we get through the measurement.

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Banking is an important component of the financial system. In 2017 banks in Indonesia controlled an asset share of 69.75% of the entire financial institution system (Bank Indonesia, 2018). In carrying out these functions the banking sector has exposure to various kinds of risks. The crisis that occurred in the banking sector is one part of the financial crisis when viewed from the source of the financial crisis. If banks experience a shake-up then it can make the financial system a total loss due to the large percentage of bank assets in financial institutions. Therefore, the banking sector is demanded to be able to manage risk well so that the financial intermediation process in the economy can run efficiently. The high proportion of banking assets in financial institutions is one reason why disruptions in the banking sector can cause disruptions in the financial system.

The occurrence of a crisis in the banking sector is directly or indirectly related to various activities carried out by the banking industry itself. The amount of funds and the composition of public deposits in the banking system have a large influence on the stability of the banking industry. The structure of banking capital resilience is one of the important components in facing systemic risk. This is because when banks experience a lack of capital, the bank cannot fulfill its obligations in returning customer funds when withdrawn on a large scale (bank runs) and raises credit problems and will disrupt the financial system as a whole so that the economy will suffer (Brownlees and Engle, 2017).

Hopefully this research can provide direction in making policies to mitigate the risk of banking individually (microprudential) and as a whole (macroprudential). This study the author will try to analyze how far the effect of the influence of bank internal variables and macroeconomic shock on systemic risk. Measurement of systemic risk contribution itself will be focused on the latest approach, which is undercapitalization which is experienced by every banking institution that has spillover impact on other institutions in the banking system. This research uses the calculation of conditional value at risk (CoVaR) from Adrian and Brunnermeier.

Review Literature

The bank runs explain the conditions in which investors or capital owner's panic and ultimately sell assets or withdraw their funds for fear that economic conditions will worsen and endanger their funds (Diamond et.al, 1983). According to Kindleberger (1978) that bank runs occur due to fundamental factors, both macroeconomic fundamentals and bank fundamentals. Furthemore, bank runs are random events due to the self-fulfilling prophecy of customers due to asymmetric information regarding bank performance problems (Diamond et al., 1983; Balcerzak, et al., 2017). According to Gorton (1988) where the causes of bank runs can also come from bank

fundamentals. In modern fast changing world, bank as an intermediary between capital providers and capital seekers are exposed to a big variety of risks (Tsvetkova et al., 2019; Chovancová et al., 2019). Banks will have difficulty providing liquidity to meet their customer withdrawals when the bank has poor financial performance. So that these conditions resulted in the lack of liquidity available at the bank, so banks were always vulnerable to bank runs. Bank runs that occur in a bank institution can result in a banking crisis if bank runs on a bank spread to other banks (contagious effect) (Hussain et al., 2020).

Contagion is a phenomenon that affects financial markets. If a crisis occurs in a country it will have an infectious effect on other countries so that the country will experience financial instability and disruption to its banking system which can affect its economic condition (Cappiello, Gerard, and Manganelli, 2004). This is because the crisis greatly affects the economic cycle which can hamper the production process and industrial development. (Fruet-Cardozo et al., 2019; Povolná et al., 2019). In another view, contagion is the idea that an event can cause a chain reaction or domino effect between banks. Shocks to one or several banks can have an impact on other banks. For example, Flannery (1996) developed a model in which banks became wary of lending to other banks because basically interbank money market loans created interdependencies that could spread shocks through the banking system.

There are two main channels for transmission in the banking market, namely through real channels or exposure and information channels. In principle, these two fundamental channels can work simultaneously and also independently (Bandt De and Hartmann, 2014). Real Channel is the first channel related to the potential for domino effects through real exposure on the interbank market and or in the payment system. Transmission occurs through physical exposure between banks on the interbank money market through withdrawal of depositors or changes in valuation of different assets between banks. The interbank money market here banks benefit from borrowing from each other rather than each bank holding more liquid assets. The benefits of risk sharing between banks come at the cost of risk of transmission (Hartmann et.al, 2009). Assymetric second channel information namely interbank transmission arises through information problems, especially asymmetric information which leads to adverse selection phenomena (Hartmann et al., 2009). Interest rates will increase further because only negative choices from risky banks will borrow. This in turn can make banks with surplus liquidity to stop lending to borrowers and instead accumulate liquidity, which causes the market to not run optimally (Hartmann et al., 2009).

According to the Group of Ten (2001) systemic risk is defined as a risk that can cause loss of public trust due to shock and increased uncertainty in the financial system which can have a negative impact on the overall macro economy. Systemic risk can

occur unexpectedly and cause a significant negative impact on the economy. When a financial crisis occurs, losses spread throughout financial institutions and will threaten the financial system as a whole. The spread raises systemic risks, namely risks that can cause the entire financial system to be disrupted, with consequences that have the potential to harm a company or institution and the economy in real terms (Adrian and Brunnermeier, 2016). In addition, this can be seen from the increase in the number of disruptions to payment systems, credit flows, and asset value declines.

Data and Methodology

This study of time series data in 2008q1-2018q2 and the difference in place (cross section) is by using five commercial banks in Indonesia with the highest assets included in BUKU 4 with the largest assets included in BUKU 4. This is due to banks with large assets having more complex banking activities. This study uses internal banking variables such as liquidity, leverage, deposit, profitability, and bank size while for macroeconomic shock variables will use interest rates and exchange rates. The research method used in this study is the General Method of Moment (GMM) method to explain the factors that influence systemic risk.

$$\Delta CoVaR_{it} = \Delta CoVaR_{it-1} + \alpha_1 Liquidity_{i,t} + \alpha_2 Leverage_{i,t} + \alpha_3 Deposit_{i,t} + \alpha_4 Profitabilitas_{i,t} + \alpha_5 Size_{i,t} + +\alpha_6 Interest_{i,t} + \alpha_7 \Delta EX_{i,t} + \varepsilon_{it}$$

Systemic Risk (using the ΔCoVaR calculation from Adrian Brunemeier 2016).
Leverage (calculated using Debt to Equity Ratio).
Liquidity (calculated using Loan to Deposit Rtaio).
Deposits (calculated using the total deposit ratio to total assets)
Profitability (using Return on Asset)
Size (using the size of the total assets of a bank)
Interest Rate (using interbank money market interest rates)
Exchange Rate (using the rupiah exchange rate against the US dollar)

$\Delta CoVaR$ is the difference between CoVaR at institutional pressure in the median condition and the condition of the institution's distress. $\Delta CoVaR$ can measure systemic risk components that are integrated with certain institutional pressures. $\Delta CoVaR$ is a measure of statistical dependencies, and is therefore best seen as a useful form of time (Adrian and Brunnermeier, 2016). The formation of systemic risk measurement in this study uses $\Delta CoVaR$ with a quantile regression approach because it is simpler. Quantile regression is an analytical tool used in estimating both conditions when they are normal or median conditions and when distress. This calculation refers to research by Adrian and Brunnermeeier (2016), which measures systemic risk by calculating ($\Delta CoVaR$) using banking stock return data in 2008q1-2018q2 and using IHSG return data and IHSG (state variable) volatility. The first step in this study will calculate

systemic risk with ($\Delta CoVaR$) as a proxy for systemic risk and the next stage will use panel data regression with GMM methods to explain the factors that influence systemic risk.

The first stage in the calculation ($\Delta CoVaR$) which becomes a proxy of systemic risk is to calculate the return losses of each individual bank and the total return of individual banks. The next stage is to estimate VaR and $\Delta CoVaR$ as functions of state variables. CoVaR can be estimated after obtaining VaR value because CoVaR corresponds to VaR which is the return on asset market value (asset return) obtained conditionally from a bank while ($\Delta CoVaR$) is obtained from calculating the marginal CoVaR in a state of distress with CoVaR under normal conditions. In the CoVaR model state variables are used which are macro variables that function as time-varying VaR and CoVaR. A state variable is needed to convert VaR and CoVaR with constant time to time variance.

The data used in the study is panel data, which is a combination of time series data and in several samples (cross section). The combination of cross section and time series data is used to overcome weaknesses and answer questions that cannot be answered by the cross section and time series models. The dynamic panel data model allows researchers to better understand the dynamics of adjustment in a study. The dynamic relationship is indicated by the lag in the variable. Lag himself explained that the variable was not only influenced by the current period but was also influenced by the previous period of the independent variable or the so-called distributed lag.

If there is a lag in a model it will produce an endogenity problem which when estimated using Pooled Least Square (PLS), Fixed Effect (FE), and Random Effect (RE) will produce a biased and inconsistent estimator, (Baltagi et.al, 2005). Therefore, to overcome this endogenity problem using the Generalized Method of Moments (GMM) approach. Endogenity problems, if estimated using fixed effects or random effects, will produce biased and inconsistent estimates (Verbeek, 2004).

There are at least two reasons underlying many studies that use GMM, first is that GMM is a common estimator and provides a more useful framework for comparison and assessment. The second reason is that GMM provides a simple alternative to other estimators, especially towards maximum likelihood. However, GMM also has several weaknesses, namely: (i) GMM estimator is asymptotically efficient in large sample sizes but less efficient in finite sample sizes, and (ii) this estimator sometimes requires a number of programming implementations so that a software is needed (software) which supports the application of the GMM approach.

Result

The proxy used to describe systemic risk that occurs in Indonesia in this study uses the Delta CoVaR calculation developed by Adrian and Brunenermeier (2016). The calculation can give an idea of what percentage of loss or loss will be received by the whole system due to the shock and the spillover effect caused by an institution to its normal state at a certain level of trust (Adrian and Brunemeier, 2016). This study aims to look at the influence between bank characteristics and macroeconomic variables on systemic risk in Indonesia in 2008-2018q2. The samples used in this study were Bank Mandiri, BNI Bank, BRI Bank, BCA and CIMB Bank. The analysis used in this study uses dynamic panel data regression with the GMM method. The following estimation results use Generalized Method of Moments (GMM):

Table 1: Results of GMM System Estimator for Internal Banking Variables and Macroeconomics of Systemic Risks

Variabel	*Coef.*	*P-value*
Dcovar.L1	0,207	0,005*
Liquidity	0,007	0,019**
Deposit	-4,480	0,000*
Leverage	0,092	0,026**
ROA	0,008	0,867
Size	-0,541	0,000*
Exchange Rate	1,314	0,000*
Interest Rate	0.086	0,082**
AR (1)	0,000	
AR (2)	0,446	
Sargan Test	0,291	
Sargan Test (GMM)	0,164	
Sargan Test (Difference GMM)	0,718	
Sargan (IV)	0,184	
Sargan (Difference IV)	0,997	

Source: STATA 14, 2019 Output Results
Description: * significance at the level of 1%, ** significance at the 5% level, and *** significance at the level of 10%

Discussion

Liquidity in this study uses Loan to Deposit Ratio to describe the liquidity of a bank. The results of this study are consistent with the theory in Saunders and Cornett's (2007) book and in line with the results of previous studies conducted by Episona-Lopez et al

(2012), de Mendonça and Silva (2018) explain the importance of liquid banking conditions, because if the bank in conditions that are not liquid, it is feared that if there is a large withdrawal of funds at a certain time, the bank will experience high losses and will potentially cause bank runs. The loss is due to the bank being unable to fulfill the demand for funds requested or withdrawn by the customer because the assets owned by the bank are illiquid or not just can be disbursed in the form of money when the withdrawal occurs. The funds deposited by the community at the bank are certainly not left alone by the bank but are transferred in other assets either through the money market or channeled in the form of loans to the community in accordance with the function of the bank as a fund collector and fund channeler. The results of this study are also supported by previous research conducted by (Iachini and Nobili, 2016) which shows that systemic liquidity risk accurately identifies high systemic risk events. So the results of this study are consistent with those obtained by de Mendonça and Silva (2018), Episona-Lopez et al (2012), Aldasoro and Faia (2016), Iachini and Nobili (2016), Ramos-Tallada (2015), Jobst (2014), Brunnermeier and Pedersen (2009) and Freixas and Parigi (2000) liquidity of a bank will be directly proportional to the reduction of systemic risk.

The leverage variable used in this study uses the debt to equity ratio to ratio (DER) to describe the leverage of a bank. The higher DER value illustrates that the composition of debt is greater than the total capital of the bank. The results of this study are in line with other studies conducted by Adrian and Brunnermeier (2011) showing that companies with higher leverage contribute significantly to systemic risk, both at the level of 1% and 5%. Brunnermeier et al (2012) and Beltratti and Stulz (2012) reveal that banks with high leverage contribute more to systemic risk. When a bank has high leverage, it means that the bank has a higher burden or obligation because it must return the debt from the funds held. This has resulted in a decrease in income from the bank because it must continually pay the debt burden. When payments occur periodically and regularly and there is a shock in the banking system, if the leverage is high, the bank will be more vulnerable and fragile. The results of this study also support previous studies conducted by De Mendonça and Silva (2018), Mayordomo et al. (2014), Jobst (2014), Beltratti and Stulz (2012), Adrian and Shin (2010), Shleifer and Vishny (2010) and Brunnermeier and Pedersen (2009) whose results state that leverage is positively related to systemic risk.

The third variable is the deposit can be seen in Table 4.1 that the results have a significant effect and negatively related. Deposits are third party funds deposited by the community in the bank and can only be withdrawn for a certain period of time. This means that when deposit deposits in a bank increase in number, it will further reduce the systemic risk of a given bank. The nature of deposits that can only be withdrawn at

a certain time that has been determined makes deposits cannot be withdrawn at any time. In line with these results Brunnermeier et al. (2012) state that banks with more deposits will contribute less to systemic risk because funding from the bank will not be withdrawn at any time by the customer so that the funding is guaranteed. The results of this study are in line with de Mendonça and Silva (2018), Ramos-tallada (2015), Mayordomo et al. (2014), Jobst (2014) and Brunnermeier et.al. (2012) which shows that systemic risk reduction will occur when total deposit deposits in banks increase.

Return on Assets (ROA) is used as a proxy for the profitability of a bank. Can be known through Table 4 does not significantly have a positive effect on systemic risk. Banks with returns that are too high make a bank have more risk even though the yield will also be higher. This is in line with several studies showing that banks with more traditional business models, captured by higher lending, contribute less to systemic risk. Where this is a bank with a traditional model that still only gives credit distribution without recognizing financial products. It was also stated in several other studies that banks that are more involved in non-traditional activities have higher systemic risk exposure (Brunnermeier et al., 2012; De Jonghe et al., 2015; DeYoung and Torna, 2013). Briefly there is a trade-off between risk and return that results in an increase in risk appetite (de Mendonça and Barcelos, 2015) or better known as high risk high return. The results of this study support previous studies conducted by de Mendonça and Silva (2018), de Mendonça and Barcelos (2015), and Adrian and Shin (2010) which state that there is a positive relationship between ROA and systemic risk.

The last variable which includes the internal banking is size. The results of this study contradict some of the studies conducted (Bostandzic and Weiß (2018); Beck and Laeven (2006) which argue that banks with large assets will contribute to greater systemic risk and vice versa. In addition, it also breaks the assumption that the bigger the size of a bank, the more systemic risk will be, or more commonly known as "To Big To Fail." This can be attributed to larger banks tend to diversify assets so that the risks held are divided into several so that it does not focus on a single source of risk, such as the research conducted by de Mendonça and Silva (2018) that a more diverse portfolio that combines loans and other securitization assets can reduce the risk of failure of a bank. (Varotto dan Zhao, 2018; Kovacova, et al. 2019) which disputes the conventional relationship between systemic risk and bank size by stating that banks with large capital with low risk do not necessarily have a systemic impact.

This study shows that overall macroeconomic variables significantly influence the risk of the five commercial banks in Indonesia. The function of banks as channeling funds to the public is not only done to individuals but also to companies. When there is a weakening of the currency there will be many companies that reduce loans to banks because of the condition of the company that suffered losses. Apart from being seen

from credit risk, it is also necessary to pay attention from the side of banking debt if having a loan in the form of another currency can increase the debt burden that must be borne by the bank so that it will reduce profits from the company. The results of this study are in line with the theory and other studies conducted by (de Mendonça and Silva, 2018) get results that the weakening of the currency can increase systemic risk. These results are reinforced by research conducted by Benoit et al. (2017), Ramos-Tallada (2015), Mayordomo et al. (2014), Yeşin (2013), which states that currency depreciation can increase systemic risk levels.

In addition, macroeconomic variables are described through interbank money market (PUAB) interest rates. De Vries (2005) argues that through transmission or macro shock such as an increase in interest rates, it results in the moving of bank portfolio values simultaneously. The interbank money market rate is a price formed from the agreement of the parties who borrow and lend funds. The interbank money market rate experienced an increase, meaning that in the market there was a liquidity drought so that when it happened the bank that needed funds could not immediately get funds due to having to buy expensive funds (drought liquidity) because the bank kept funds for itself and would only lend money to the bank others if you are willing to pay a high interest rate. So that in this case many who need liquid funds must pay higher interest when interest rates increase. When the interbank rate increases, it can also be indicated that there is an unfavorable situation (liquidity drought) because banks are selective in lending to other banks that need funds. It can be concluded that when the interbank money market interest rate increases, it will increase systemic risk because banks that have difficulties will not be easy to get and because banks save for their own interests. The results of this study are also supported by previous studies put forward by de Mendonça and Silva (2018), Ramos and Tallada (2015), De Vries (2005), and Demirguc-Kunt and Detragiache (2007) higher interest rates can increase systemic risk.

Conclusion

The results of the study show that there are influences between internal banking variables (liquidity, leverage, deposit, ROA and size) on systemic risk in Indonesia. Liquidity, leverage, and ROA have an effect and are positively related to systemic risk but in this case the ROA variable does not significantly influence while liquidity and leverage have a significant effect. While the deposit and size variables significantly influence and are negatively related to systemic risk. In this case there is an internal banking variable that can refute the doctrine of "Too Big to Fail" which has been widely believed that the higher assets of a bank will further increase systemic risk. However, this does not occur in this research where size and systemic risk have a

negative or reversed relationship which means that the doctrine does not apply to the case of five commercial banks in Indonesia. In macroeconomic variables there is a significant influence on the exchange rate and interbank money market interest rates (PUAB). The relationship of these two variables also shows a positive direction and in accordance with other studies because the economic condition of a country will certainly affect the performance of the financial system in the banking system in the country and when the interbank exchange rate and interest rates increase it will automatically increase the risk systemic. The results of this study provide implications for management of the bank as the direction to mitigate the risk. For the regulator, the results of this study can also be an input in making policies regarding to managing the risk of banking individually (micro prudential) and as a whole (macroprudential). This study is limited to the commercial banks in Indonesia. Therefore, for the future research can be done in the cross-country.

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WPŁYW BANKOWOŚCI WEWNĘTRZNEJ I ZMIENNE MAKROEKONOMICZNE NA RYZYKO SYSTEMOWE

Streszczenie. Globalny kryzys finansowy z 2008 r. Sprawia, że ryzyko systemowe jest jednym z głównych kierunków badań, które stale się rozwija, i czyni sektor finansowy centrum analizy. Kryzys bankowy jest jednym ze źródeł kryzysu finansowego. W niniejszym badaniu podjęto próbę analizy wpływu zmiennych wewnętrznych banku i makroekonomii na ryzyko systemowe. Do pomiaru wkładu w ryzyko stosuje się model warunkowej wartości zagrożonej (CoVaR) z wykorzystaniem próby pięciu banków o największych aktywach w Indonezji. Wyniki badania pokazują, że między bankowością wewnętrzną a zmiennymi makroekonomicznymi istnieje wpływ na ryzyko systemowe w Indonezji. Płynność, dźwignia finansowa i ROA mają wpływ na ryzyko systemowe i są pozytywnie z tym związane, ale w tym przypadku zmienna ROA nie ma znaczącego wpływu, podczas gdy zmienne dotyczące depozytów i wielkości znacząco wpływają i są ujemnie powiązane. Wyniki tego badania obalają przyjętą doktrynę „Too Big to Fail". W przypadku zmiennych makroekonomicznych, a mianowicie kursu walutowego i międzybankowych stóp procentowych rynku pieniężnego (PUAB), istnieje dodatni związek z sytuacją gospodarczą kraju, która wpłynie na wyniki systemu finansowego w tym kraju.

Słowa kluczowe: ryzyko systemowe; Delta-CoVaR; Bankowość; Zarządzanie ryzykiem

内部银行业务和宏观经济变量对系统风险的影响

抽象。2008年全球金融危机使系统风险成为持续增长的研究重点之一，并使金融部门成为分析的中心。银行危机是金融危机的根源之一。本研究试图分析银行内部变量和宏观经济学对系统风险的影响。风险贡献的度量使用条件风险值（CoVaR）模型，并使用印度尼西亚资产最大的五家银行作为样本。研究结果表明，内部银行业务和宏观经济变量之间对印尼的系统风险有影响。流动性，杠杆率和ROA对系统性风险有影响并与之呈正相关，但在这种情况下，ROA变量不会显着影响，而存款和规模变量则具有显着影响并呈负相关。这项研究的结果驳斥了“太大而不能失败”的学说。在宏观经济变量中，汇率和银行间货币市场利率（PUAB）与一国的经济状况具有正相关关系，这将影响该国金融体系的绩效。

关键词：系统性风险Delta-CoVaR;银行业;风险管理