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Analysis of the Macroeconomic Impact towards the NPL National Banking in Indonesia: The Study of Macro-Economic Shock Using Vector Autoregression Models

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Abstract:

This paper specifically examines the macroeconomic impact of the NPL of individual banks using dynamic analysis.

Model PVAR proposed as an analytical tool because of its advantages analyze the interdependence between banks in a group of commercial banks in conducting business activities (BOOK), considering the heterogeneity of the bank, the factors that make up the diversity of the bank (unobservable variables), analytical transmission ortogonalisasi Cholesky as well and dynamics of the relationship between variables macro with the bank's internal variables.

This method will be very useful for dynamic studies of individual data bank in the banking industry.

Keywords: Credit (E51), PVAR (C32), Panel (C33), Banking Sector (E42), Interest Rate (E43), Exchange Rate (F32)

JEL classification: E51, C42, C33, E42, E43, F32

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1. Introduction

The study of the macroeconomic impact of the NPL has been done by researchers in various countries. In particular, studies on this topic have been done in Indonesia. Indonesia's economy, the credit is retained as the primary source of revenue. Banks have a must in taking the responsibility and the risks that may result from failure of the Credit. The quality of non-performing loans is usually reflected in the ratio of Non-Performing Loan (NPL). Islam and Nishiyama (2016) explains the lower the NPL ratio, the lower the level of problem loans. The low non-performing loan means the better the condition of the bank. Non-Performing Loans is one indicator in assessing the performance of the functions of the bank, where the bank is functioning as an intermediary institution. The high level of NPL shows the health of low bank because a lot going on non-performing loans in the bank's activities. By knowing the percentage of non-performing loans, which occurs in a bank, then the public and the Central Bank (Bank Indonesia) may take a wise step in addressing and facing the bank operational.

NPL developments very closely related to macroeconomic developments. This relationship influence one another and interdependent. Interdependent relationship occurs between sectors, between financial markets, between the banking industry and among global financial markets. Domestic interdependence is known to produce domestic business cycle fluctuations originating from a particular sector surprises. Some authors such as Long and Plosser (1983) says that the impact of spillovers from the financial sector to the economy is the key to understanding the recent global crisis (Stock and Watson, 2012; Ciccarelli *et al.,* 2012a). This study states that macroeconomic factors deemed plays an important role in the banking crisis. More specifically, this study suggests that the impact of deteriorating economic conditions, in which the low or negative growth, with high unemployment rates, high interest rates and high inflation, will open up greater opportunities for the banking crisis.

There are lots of feedbacks about the causes of the financial crisis, with consideration given by experts. This significant increase in NPLs of commercial banks may pose a risk to the financial sector and the economy of Indonesia. Every year banks in Indonesia among institutions deposits grew more than 76% and total loans grew about 75%. Indonesia's economic development greatly impact on investment decisions and consumption of population growth, and economic development. For this reason, the prevention of banking problems has become a major destination for policy makers in Indonesia. Thus, a full understanding of how macroeconomic impacted on NPL is very important.

The relationship between the macroeconomic environment and credit quality has often researched in the literature on business cycles and the stability of the bank. Most banks in Indonesia still rely on credit as a major income to finance its operations. Like other developing countries, a source of financing business in Indonesia is still dominated by bank lending which is expected to drive economic

growth. Lending is the primary activity of most banks making a profit, but the greatest risk in the bank is also sourced from loans. Linkage use PVAR methods for their interdependency between the bank's internal variables and external variables dynamically. Explanation of the relationship between variables derived from a variety of reference as follows.

From the aspect of internal, Altunbas (2000) found results that Net Interest Margin (NIM) positive effect on the NPL. Hughes and Mester (1993) and Girardone *et al.* (2004) found that there is a positive relationship between NIM and non-performing loans. Likewise, Misra and Dahl (2010) found that LDR positive effect on the NPL. Another factor that bank's assets, the research Misra and Dahl (2010) suggests that the negative effect on NPL assets. While the research conducted by Ranjan and Dahl (2003) states that there is a negative influence between Operational Assets (OCTA) and the Capital Adequacy Ratio (CAR) and NPL.

Whereas the causes of external financing problems represented by Gross Domestic Product (GDP) and inflation. Salas and Saurina (2002) show the relationship between GDP by the NPL. The results were confirmed by Jimenez and Saurina (2004) that the NPL is influenced by GDP. Wu, *et al.* (2003) in their study shows that GDP significant negative effect on problem loans. While in Ahemd research (2006) indicates otherwise, GDP significant positive effect on problem loans.

Bank credit situation in Indonesia can be seen from several aspects, including bank credit by sector, according to the size of the bank, or by ownership. Bank Indonesia (BI) classifies the business activities of commercial banks into four categories based on core capital (Bank Indonesia Regulation Number 14/26 / PBI / 2012 dated December 27, 2012 on Business Operations and Office Network Based on Core Capital Bank). Total core capital will determine the position of the bank as a commercial bank in conducting business activities (BUKU). The higher the core capital or the level of BUKU owned by bank, the broader ranges of products and activities that can be done.BI enter a bank with core capital from 100 billion to below 1 trillion in commercial bank conducting group business activities 1 (BUKU 1), from 1 trillion to below Rp 5 trillion in BUKU 2, of Rp5 trillion to below Rp30 trillion in BUKU 3, while the bank with a core capital of Rp30 trillion or more into the guide 4.

This article examines the mechanism of the interest rate channel and exchange rate channel to influence bank performance. Louis, Vouldis and Metaxas (2011) explain that the interest rate channel carried by the central bank to influence interest rates on loans and bank deposits. This research applies the interest rate path where the BI Rate change is expected to affect deposit rates and bank lending rates. BI rate is the reference rate set by the central bank of Indonesia. BI Rate is the interest rate that reflects the attitude of policy or monetary policy stance set by Bank Indonesia and announced to the public. If the economy experienced a decline in activity, Bank Indonesia can use expansionary monetary policy through lower interest rates. The

decline in the BI Rate cut their lending rates so that the demand for credit from companies and households will rise. The decline in lending interest rates will also decrease the cost of capital for investment. This will all increase the activity of consumption and investment and economic activity more passionate.

Conversely, if inflationary pressures increase, Bank Indonesia responded by raising the BI Rate to put the brakes ona fasteconomic activity, thereby reducing inflationary pressures. At the exchange rate channel, the BI Rate changes can also affect the exchange rate. Gosh research (2015) describes the relationship between interest rates and the exchange rate as a determinant of the NPL and the performance of the bank. The hike in BI Rate would certainly increase the difference between the interest rates in Indonesia and overseas interest rates. The greater interest rate differential encourages foreign investors to flow into financial instruments in Indonesia. Furthermore, foreign capital inflows encourage appreciation of the Rupiah exchange rate. The Rupiah appreciation caused the price of imported goods cheaper and our exports goods abroad become more expensive or less competitive so that it will encourage imports and reduce exports. The decline in net exports will have an impact on economic growth and the decline in economic activity.

The second mechanism requires a transmission time (time lag). Time lag of each track can be different from the others. Exchange rate channel normally work faster because of the impact of interest rate changes to the exchange rate works very fast. The condition of the financial and banking sector is also very influential on the speed of transmission monetary policy. If banks see the risk of the economy is quite high, the response of banks to decrease BI rate is usually very slow. Also, if banks are being consolidated to improve capital, decline in lending rates and credit demand is not necessarily responded by rising lending. On the demand side, the decline in bank lending rates is also not necessarily responded by rising credit demand from the public when the economic outlook is weak. In conclusion, the financial sector, the banking and the real sector was instrumental in determining the effectiveness of the monetary policy transmission process (Thalassinos and Kiriazidis, 2003; Thalassinos and Thalassinos 2006; Thalassinos and Pociovalisteanu, 2007; Thalassinos, 2007; 2008; Denisova *et al.,* 2017; Pontoh, 2017; Anureev, 2017; Boldeanu and Tache, 2016; Duguleanu and Duguleanu, 2016).

Researchers Canovaa and Ciccarelli (2004) explain that the econometric methods used for the analysis of interdependence among them is a model of dynamic stochastic general equilibrium (DSGE) constructed of multi sector, multi-market, where economic agents in their optimal state with full constraints specified. The role of the DSGE very important parameter, because this parameter can answer important questions of economic policy and provide an easy understanding achieving economic goals. DSGE models capable of generating parameter estimation and simulation impulse as a result of shock that occurs in one or more exogenous variables. DSGE models can be developed into a model of multi sector and multi market. However, many restrictions and assumptions that must be met for DSGE can

work well. The main limitations and assumptions that must be met is the exact identification on economic models. Total equality must be equal to the amount of endogenous parameter. Shock compiled based on stochastic processes and dynamics of transmission between variables linked via Impulse Response Function (IRF).

Another alternative approach to deal with economic interdependence using panel VAR. VAR captures the dynamic interdependence of the data with fewer restrictions. Identification of the shock can be transmitted through the reduced form into a structural equation through analysis of impulse response analyzes. Structural Panel VAR (SPVAR) subsequently developed to overcome the limitations of the standard model of structural VAR. (Cooley and Le Roy, 1983; Faust and Leeper, 1997; Cooley and Dweyer, 1998; Canova and Pina, 2005; Chari *et al.,* 2008; Thalassinos *et al.,* 2006; 2009; 2012; 2013; 2015; Hannias *et al.,* 2017).

Analysis that captures variables shock is using VAR analysis. This model is appropriate to analyze the relationship of interdependence variables related to bank credit. Grouping of banks according to the amount of core capital will be exactly solved using panel data analysis. The existence of interdependence among variables will be analyzed using several banks PVAR. This study has several objectives and contributes to solving the problem of the relationships NPL with some macro economic variables and some internal variables banks. Dynamic analysis between variables using the VAR is generally performed on a single sector or multiple sectors in a single data, without any analysis of linkages between sectors in a separate data.

Analysis by the Panel VAR allows researchers to carry data sector then analyzed the relationship between banks in the same group. Researchers allow doing variable macroeconomic shock, and then analyzed the response to the bank in the same group. Investigations concerning macro financial linkages (the interaction between the financial sector and the domestic economy / global), in particular between the NPL and macroeconomic variables such as BI Rate, GDP growth, and the exchange rate and other macroeconomic variables, using a Vector Autoregressive models Panel (PVAR). One example of the expected output of this modeling, which is a function Impulse Response (IRFs), which can give an idea of the magnitude of the shocks given by macroeconomic variables on the NPL, and vice versa. We hope that this PVAR, we can see the magnitude of the shocks between banks' liquidity indicators with macroeconomic indicators of vulnerability.

2. Research Methodology

The main obstacle completing this study was completed estimation with PVAR. Some applications do not currently provide PVAR model estimation. Some PVAR estimator has been proposed by some researchers. In their paper Eakin, Newey, and Rosen (1988) proposed concept PVAR estimator that can be solved using the GMM. This method was later developed by Benes (2002) using Matlab to process models PVAR. Benes (2014) used Matlab to process models PVAR.

Ekananda (2014) has conducted research on the Deposit Insurance Agency (LPS) using matlab following the procedures Eakin, Newey, and Rosen (1988). There is a big difference estimator VAR and PVAR. Buncic and Melecky (2012) estimate the determinants of NPL using GMM estimation using annual data from 54 high and middle-income countries from 1994 2004. Explanatory variables include lagged NPL ratio, real GDP growth, CPI inflation and the real interest rate.

PVAR method for measuring changes in the NPL due to shock at macro-economic variables. PVAR estimator uses the concept put forward by Eakin, Newey, and Rosen (1988). In the case of VAR panel, a data consist of i = 1, 2… N individual. Where every individual has the t= 1, 2, 3…T period. PVAR settlement described as follows. If W consists of three variables y_t, z_t and p_t. Briefly models PVAR (1) is

$$W_{it} = \beta_0 + \sum_{l=1}^{m+1} \beta_{lt} W_{it-l} + \varepsilon_{it}$$

Since W is a vector consisting of three variables, the equation PVAR consists of three pieces of the equation and exogenous variable x_t.The first equation
$y_{it} = \beta_{10} + \beta_{11} y_{it-1} + \beta_{12} z_{it-1} + \beta_{13} p_{it-1} + \alpha_{11} x_{it} + \varepsilon_{yit}$
vector dependent variable is

$$y_{it} = \begin{bmatrix} y_{1,m+2} \\ y_{N,m+2} \\ y_{1,m+3} \\ y_{N,m+3} \\ \\ y_{1,T} \\ y_{N,T} \end{bmatrix}_{[T-(m+2)+1]Nx1},$$

Where the variable yt vector compiled the first individual to individual columns N in the year to m+2, then the composition of recurring column for the first individual to N individual in year m+3 and so the first individual to individual N to T. Thus the column vector has dimension [T-(m+2) + 1]Nx1. For vector y_{t-1} is prepared in the same way but the data starts from time to m+1 to T-1. Other variables such as vector z_t and p_t are arranged in the same way but the data starts from time to m+1 to T-1.
From the description of this matrix can be understood that the dependent variable listed in order according to the individual, then repeated with a different time. The matrix on the right (independent) the first equation is denoted as Wy_{t-1}. This is a block diagonal matrix consisting of the matrix *w*.

$$Wy_{it-1} = \begin{bmatrix} w_{m+1} & & \cdots & \\ & w_{m+2} & \cdots & \\ \cdots & \cdots & w_{m+3} & \cdots \\ & & \cdots & w_T \end{bmatrix}_{[T-(m+2)+1]Nx[T-(m+2)+1]K}$$

Matrix *w* consists of data lag variables y_t, p_t, z_t and x_t.

$$w_{m+1} = \begin{bmatrix} 1 & y_{1,m+1} & z_{1,m+1} & p_{1,m+1} & x_{1,m+1} \\ 1 & y_{2,m+1} & z_{2,m+1} & p_{2,m+1} & x_{2,m+1} \\ 1 & y_{3,m+1} & z_{3,m+1} & p_{3,m+1} & x_{3,m+1} \\ 1 & y_{4,m+1} & z_{4,m+1} & p_{4,m+1} & x_{4,m+1} \\ 1 & & & & \\ 1 & y_{N-1,m+1} & z_{N-1,m+1} & p_{N-1,m+1} & x_{N-1,m+1} \\ 1 & y_{N,m+1} & z_{N,m+1} & p_{N,m+1} & x_{N,m+1} \end{bmatrix}_{[T-(m+2)+1]xK}$$

The second equation (z_t) is

$$z_{it} = \beta_{20} + \beta_{21}y_{it-1} + \beta_{22}z_{it-1} + \beta_{23}p_{it-1} + \alpha_{21}x_{it} + \varepsilon_{zit}$$

The third equation (p_t)

$$p_{it} = \beta_{30} + \beta_{31}y_{it-1} + \beta_{32}z_{it-1} + \beta_{33}p_{it-1} + \alpha_{31}x_{it} + \varepsilon_{pit}$$

vector dependent variable is

$$z_{it} = \begin{bmatrix} z_{1,m+1} \\ z_{N,m+1} \\ z_{1,m+2} \\ z_{N,m+2} \\ \\ z_{1,T-1} \\ z_{N,T-1} \end{bmatrix}_{[T-(m+2)+1]Nx1}, \quad p_{it} = \begin{bmatrix} p_{1,m+1} \\ p_{N,m+1} \\ p_{1,m+2} \\ p_{N,m+2} \\ \\ p_{1,T-1} \\ p_{N,T-1} \end{bmatrix}_{[T-(m+2)+1]Nx1}$$

The independent variables second and third equations, have an independent structure similar to the first equation is denoted as Wz_{it-1} and Wp_{it-1}

$$Wy_{it-1} = Wz_{it-1} = Wp_{it-1} = \begin{bmatrix} w_{m+1} & & \cdots & \\ & w_{m+2} & \cdots & \\ \cdots & \cdots & w_{m+3} & \cdots \\ & & \cdots & w_T \end{bmatrix}_{[T-(m+2)+1]Nx[T-(m+2)+1]K}$$

The series of all vectors become dependent *Wit* and independent *Wit-1*

$$W_{it-1} = \begin{bmatrix} Wy_{it-1} & & \\ & Wz_{it-1} & \\ & & Wp_{it-1} \end{bmatrix}_{[T-(m+2)+1]3Nx[T-(m+2)+1]3K}$$

β parameters can be completed with unbiased estimator

$$\hat{\beta} = \left(W'V^{-1}W\right)^{-1}\left(W'V^{-1}Y\right) = \left(\sum_{i=1}^{n}\sum_{j=1}^{n}\sigma^{ij}W'_i\right)^{-1}\left(W_j\sum_{i=1}^{n}\sum_{j=1}^{n}\sigma^{ij}W'_i Y_j\right).$$

Analysis PVAR applying Cholesky orthogonalization to implement the transmission and the order (order) on several variables banking before the response at some later period. Transmission and order (order) using Cholesky method will produce two kinds of analysis, ie the analysis of the response is instantaneous (contemporaneous) and the response that occurs in the next period after the impulse occurs. Variables that are arranged to form a sequence on the structure Cholesky orthogonalization shows the total impact between the variable time of the shock. Response is happening in the next period will record the combined impact over time.

Therefore, response in the next period is very dependent on the lag structure, stationer variables and the role of exogenous variables in the VAR model. All kind of response is strongly influenced by the behavior of individual data bank. Therefore, the individual banks are divided according to the size of the core capital, so the group BUKU 1 and 2 will consist of banks that are relatively smaller but has many members. While BUKU 3 and 4 consist of banks that are much bigger but has very few members. Then use the model Fixed Effect on PVAR expected to be able to capture unobserved variables bank.

β Parameter as a parameter describes the bank dynamic relationship between times. In this study it is assumed that banks only consider information from one period earlier. This study therefore uses PVAR (1). The β parameters as a component that describes the dynamic relationship between variables so that we can establish a

relationship between variables with the shock that occurs in variable NPL become a major variable in the study.

Through this answer then we can understand that the impact on the period 1 is contemporaneous response, whereas the lag to 2.3, and the next is the response that has interacted as described above. According to standard, shock on macroeconomic variables is done by 1% intended to facilitate the calculation of response that occurs in variable NPL and LOAN observed in this study. If at that time the exchange rate at the level of Rp. 10,000 / US $, the shock of 1% showed an increase in the exchange rate to Rp. 10,100 / US $ in a short time. If the graph, response value of 0.8 means there response NPL of 0.8% as a result of shock on macroeconomic variables at 1%. If supposed occur shock 2.5% in the exchange rate, then the response occurs NPL 2% (0.8% x 2.5).

3. Results

3.1 Data

In general, the bank has a specific behavior. Banks in Indonesia can be classified into several groups. This article was compiled by examining the phenomenon of bank NPLs of commercial banks group in conducting business activities (BUKU). The population is listed banks in Indonesia, while the samples used in this study are some banks that meet the adequacy / completeness required for the process of calculating VAR econometric panel. In this research, there are two types of panel data analysis: analysis by business groups.

Analysis by bank grouping consists of core capital BUKU 1 through BUKU 4. In this analysis, the data derived from all banks from 2004 to 2014 (data semi-annually). The use of the range this year is intended to obtain information the behavior of banks during the financial crisis of 2005 and 2008. In particular the research using panel data observing the behavior of NPL ratio and CAR due to changes in some macroeconomic variables such as inflation, interest rates (IRD), economic growth (Growth) and exchange rate changes (DEPR). Bank internal variable used is total assets (TA), the bank's internal variables (InternalBank) as Net Interest Margin (NIM), Assets (ASSETS) and Loan Deposit Ratio (LDR). NPL ratio was calculated from the ratio of nonperforming loans to total loans. Bank assets calculate in the natural logarithm.

Table 1. *Data*

Information	BUKU1	BUKU2	BUKU3	BUKU4
Total bank	24	27	14	5
Average NPL (%)	3.28	3.47	4.11	6.25
Core capital max (triillion Rp)	934.2	4,682.8	26,218.78	100,631.6
Core capital min (trillion Rp)	110.71	1,046.29	5,352.30	31,818.63

Total Credit (million Rp)	2475.447	11239.25	58152.94	298744.1
Average CAR (%)	20.33	19.65	18.46	18.64
Average NIM (%)	7.53	6.99	6.27	6.05
NIM Max (%)	19.19	16.25	15.47	12.25
Average Aset (trillion Rp)	618.57	2,424.46	17,624.14	138,321.33

The study uses panel data derived from 88 pieces bank with a time of observation from 2000 to 2014. The number of banks adjust dalat availability of data collected in order to meet the estimated PVAR good results. Distribution of banks is according to the value of core capital (BUKU).

3.2 Method

Research conducted an analysis on the two types of transmissions. The first transmission following the concept of monetary transmission through the interest rate policy is a response variable economic growth, NIM, NPL and CAR due to a change in domestic interest rates. PVAR variable structure arranged in order of domestic interest rates (IRD), Growth, NIM, NPL, and CAR with exogenous depreciation of the Rupiah against the US Dollar (DEPR) and inflation (inflation).

Thus, the early explains the transmission of monetary policy through the interest rate channel. Monetary policy through control of interest rates is expected to affect the climate of the Indonesian economy, which in turn will boost economic growth. The economic growth caused by the economic situation of the productive sectors that produce goods and services. High economic development will enhance the company's ability to repay their loans to the banks so that the status of non-performing loan (NPL) will be reduced. Furthermore, the more liquid credit is formed which generates interest and profit so that the net interest margin (NIM) of banks increased. The increase in NIM will increase the profits of banks that will ultimately increase the CAR of the bank.

Transmission lines starting from their exchange rate policy of the central bank to change interest rates eventually widen the average difference between domestic interest rates and interest rates abroad. This difference encourages foreign capital inflows and encourages the appreciation of the rupiah. The appreciation of the rupiah led to a relatively cheaper price and increase consumer purchasing ability and the ability to restore bank lending. This change will reduce the NPL ratio. Furthermore, the more liquid credit is formed which generates interest and profit so that the net interest margin (NIM) of banks increased. The increase in NIM will increase the profits of banks that will ultimately increase the CAR of the bank.

3.3 Panel Unit Root Test

Data interaction of various countries in a long period can lead to suspicions of a link between data cointegration country during the time of observation. Cointegration relationship is important because it will define the method of analysis and interpretation of research results Breitung and Pesaran (2005).

The test results below the ADF - Fisher Chi-square according to Maddala and Wu (1999). In the first model of the variable PVAR Which are involved, namely Growth, NIM, NPL, CAR with exogenous domestic interest rates (IRD), depreciation of the USD against the US Dollar (DEPR) and inflation (inflation). These variables apply to all bank groups, BUKU 1 through 4 BUKU. BUKU 1 is comprised of a group of banks with a core capital of the smallest shows all data at the level of rejecting H_0, ie stationary conditions. Banks in this group has the most people and very diverse. Testing unit root indicates that the magnitude of the diversity of the data bank, showing a stationary position in the data structure of the panel.

Table 2. *Panel Unit Root Test*

Variabel	BUKU 1	BUKU 2	BUKU 3	BUKU 4
Asset	88.6978*	176.486*	293.928*	0.09772*
CAR	103.654*	145.165*	65.4372*	16.4965***
Depreciation	367.831*	399.149*	206.434*	73.5642*
Growth	170.672*	161.441*	87.7752*	28.3638*
Inflation	207.372*	229.842*	115.312*	43.9922*
IRD	86.7986*	97.6484*	50.6325*	18.0830**
NIM	128.730*	174.376*	70.5783*	32.0915*
NPL	189.087*	471.771*	92.1696*	81.7557*

(,**,***) Signicance at 1% 5% and 10% level.*

Similar results were shown in testing unit root bank in groups BUKU 2. There are 46 banks included in this group. The amount is almost the same as the group of banks with the smallest core capital. The test results showed the same results. All data reject H_0, indicating a stationary condition.

Bank variables in a group of BUKU 3 shows the same behavior, where all the variables to be used stationer at the current level. BUKU 4 consists of six banks that have the largest capital. Most are government-owned bank. Only Assets shows non-stationery data. Special estimation strategies in this group, the asset estimated at the level of difference.

The next step is testing the cointegration panel to explain their long-term relationship between the variables of individual banks being used. Testing cointegration in panel data following the procedures Eviews applications, where data is arranged in the form of stacked, then the variables involved in the model are classified as Group. Tests use Maddala and Wu (1999) methods. The data is grouped NPL, GROWTH, DEPRSIASI, NIM, ASSETL, CAR, IRD, and inflation. The type of testing is using Kao Residual Cointegration Test. Trend assumption: No deterministic trend, User-specified lag length: 1, Newey-West bandwidth selection and automatic Bartlett kernel. The test results of cointegration as follows.

Table 3. *Cointegration panel Test*

Groups of BUKU	t-Statistic
BUKU 1	-5.326729*
BUKU 2	-13.81330*
BUKU 3	-14.13320*
BUKU 4	-2.297114*

(,**,***) Signicance at 1% 5% and 10% level.*

Based on unit root test and co-integration test, it is clear that the estimated PVAR using data at the level for the unit root test showed stationerity at the current level and there is a relationship of cointegration in the group of data.

3.4 Empirical Results

Using panel data analysis by considering the structure PVAR fixed effect, order of variables, structural lag, stationerity and their exogenous variables in the model. Applications using STATA programming developed by Love *et. al* (2002) and Love *et. al* (2006). All of these components to be considered in order to uncover the response to the banking variable due to shock (impulse) variable economic growth and domestic variable interest rate compared to using a standard VAR. For that reason, the study sought to use all the determining factors of the model PVAR complete.

The first model describes the response to some internal variable bank NPL, NIM and CAR due to the impulse in domestic interest rates (IRD). Monetary policy is expected to give a stimulus to increase the productivity in the economy to produce goods and services. All sectors will increase production to bring a positive impact to the lender's ability to repay their loans to the bank. Here is the results visualization (graph) the dynamic response of the bank due to some internal variable impulse (shock) on several macroeconomic variables that is domestic interest rates (BIRATE) and Depreciation (DEPR).

Impulse response function (IRF) on the NIM, NPL and CAR, shows a variety of effects. Firstly, total effect of a parameter in a dynamic relationship (between variables impact over time). Secondly, indirect effect between macroeconomic variables and the internal bank variables). Third, there is shock effect at the certain variables that trigger changes in the bank's internal variables. Fourth, there is iteration process at the parameter PVAR to produce variable response at the future.

The increase in domestic interest rates generally always responded positively increase in lending rates. Interest rates on deposits are usually not immediately respond to this increase. This response occurs in a more intensive bank expects a profit through interest income base. Banks with a core capital is smaller commonly rely on profits through interest income base. Banks with a small core capital generally do not have a flagship product that is widely recognized and the public interest in addition to products that rely on the services of flowers. Banks with a core

capital are generally long established and have a large market share. Banks with a core capital are generally long established and have a large market share. The bank has had quite a lot of different products (differentiated product). Of these products they rely on profits through fee-based income.

Figure 1. *Impulse Response Function Model 1*

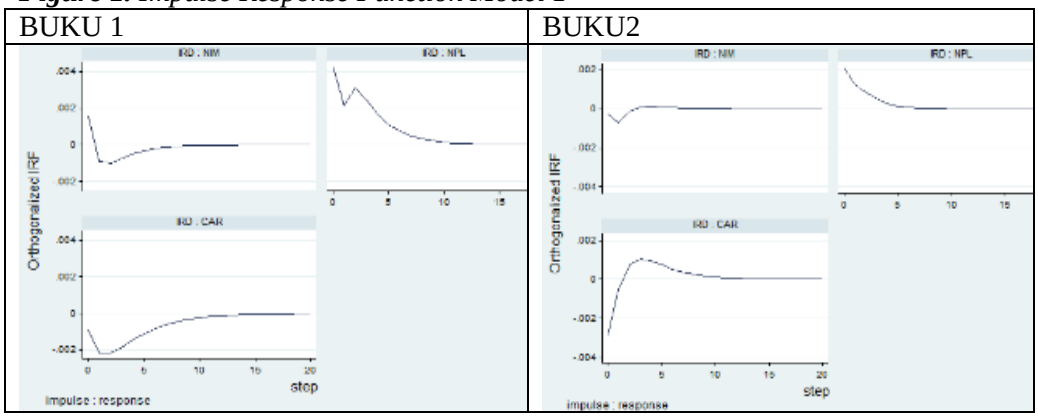


Figure 1 left panel describes Impulse Response Function banks in the group's core capital from Rp100 billion to Rp1 trillion below. NPL responded positively at the time of the increase in interest rates (contemporaneous). Banks with a small capital will response positively by increasing interest rates on loans, resulting in an increase in NPLs. Response NPL for the next period is getting smaller. This shows the effect of increase in interest rates is getting smaller.

NIM respond negatively to an increase in domestic interest rates due to the higher NPL. The average NIM of banks is the largest among the other groups by 7526%. NIM at the beginning of the period showed a positive response, but immediately respond negatively in the next period. NIM's response to the second period until the next show the response NIM due to changes in the variables of the previous period. This dynamic interrelated (interdependence) between the variables used in the model. The decline in NIM will reduce profits and will lower the bank's capital increase. CAR responds negatively to all the changes in the domestic interest rate variable, NPL and NIM.

Figure 1 describes the right panel Impulse Response Function banks in the group's core capital from Rp1 trillion to below Rp 5 trillion (BUKU 2). Response NPL for the next period is getting smaller. This shows the effect of increase in interest rates is getting smaller. NIM respond negatively to an increase in domestic interest rates due to the higher NPL. NIM at the beginning of the period immediately showed a negative response and then disappear in the next period. Similar to the previous explanation, the decline in NIM will reduce profits and will lower the bank's capital increase. CAR respond negatively to all the changes in the domestic interest rate variable, NPL and NIM.

Figure 2. *Impulse Response Function Model 1*

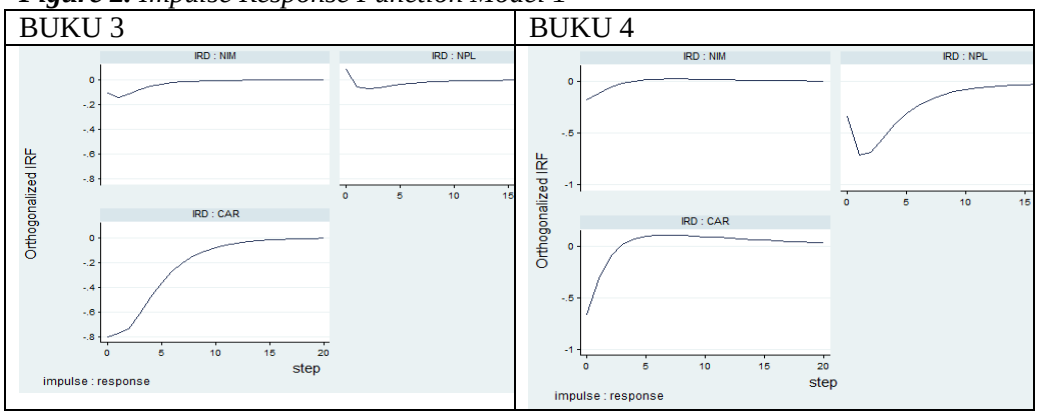


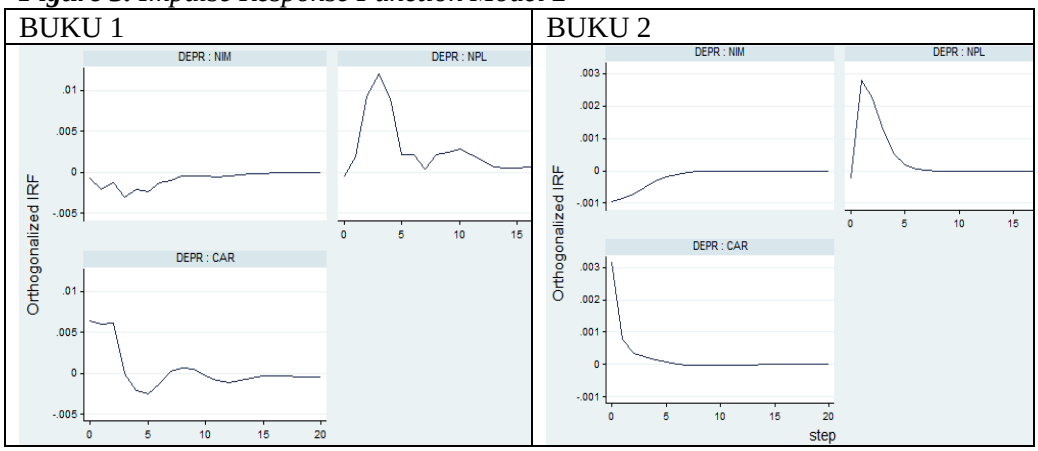
Figure 2 describes the left panel Impulse Response Function banks in the group's core capital ranging from 5 trillion to below Rp30 trillion (BUKU 3). Judging from the amount of core capital, the bank belonging to the BUKU 3 has the ability sizeable capital. However, NIM and CAR smaller than the previous group. The average NPL BUKU 3 was greater than BUKU 1 and BUKU 2. Increasing domestic interest rates make bank in this group immediately responded positively to the NPL, but NPL respond negatively to an increase in domestic interest rates in the period to the second and subsequent. Negative response indicates a decline in the NPL. NIM respond negatively at the beginning of the period, then the response will be lost in the next period. CAR respond negatively to all the changes in the domestic interest rate variable, NPL and NIM. Bank on BUKU 3 to make adjustments CAR improvement is slow to the point that no longer response.

Figure 2 describes the right panel Impulse Response Function banks in the group's core capital above Rp 30 trillion (BUKU 4). Judging from the amount of core capital, the bank belonging to the BUKU 3 has great ability cuku capital. However, NIM and the CAR small compared to all groups. The average NPL BUKU 4 turned out to be the biggest compared to all other groups. The increase in domestic interest rates make bank in this group immediately responded positively to the NPL, but NPL respond negatively to an increase in domestic interest rates in the period to the second and subsequent. Negative response indicates a decline in the NPL. NIM respond negatively at the beginning of the period, then the response will be lost in the next period. CAR respond negatively to all the changes in the domestic interest rate variable, NPL and NIM. Bank on BUKU 3 to make adjustments faster increase in CAR to the extent that no longer response.

This article also discusses the IRP as a result of exchange rate depreciation impulse responded by variable NPL, NIM and CAR. One of the main tasks of Bank Indonesia is to stabilize prices by controlling the exchange rate. Depreciation will lead to higher asset prices, high interest rates and will further the community's ability

to consume goods. For economic agents who have a loan at the bank will reduce the ability of loan repayment, due to greater operating costs.

Figure 3. *Impulse Response Function Model 2*



Indonesian economy was affected by exchange rate stability, given Indonesia's economy relies heavily on export and import activities. Figure 3 explains the left panel Impulse Response Function banks in the smallest group of core capital, from Rp100 billion to Rp1 trillion below. NPL responded positively at the time of the depreciation of the exchange rate. Response at the beginning of the period immediately improved positively in the period to 2. Response then declined gradually until it finally disappeared. Initially NIM does not respond when the impulse exchange rate, but negatively responds slowly several periods later, and then gradually disappear ranging period to 5. Bank Group BUKU 1 which has the highest ratio of CAR positive responders at the beginning of the impulse, then the response gradually down quickly and eventually disappear.

The same behavior is shown in Figure 3 right, with the Impulse Response Function banks in the smallest group of core capital, from Rp100 billion to Rp1 trillion below. NPL responded positively at the time of the depreciation of the exchange rate. Response at the beginning of the period immediately improved positively in the period to 2. Response then declined gradually until it finally disappeared. Variable NIM respond negatively at the time of the impulse. Starting from a negative response then gradually disappeared at 5 the next period. CAR response behavior both groups are similar. Both groups showed an average CAR of the greatest in the group.

Figure 4. *Impulse Response Function Model 2*

BUKU 3	BUKU 4

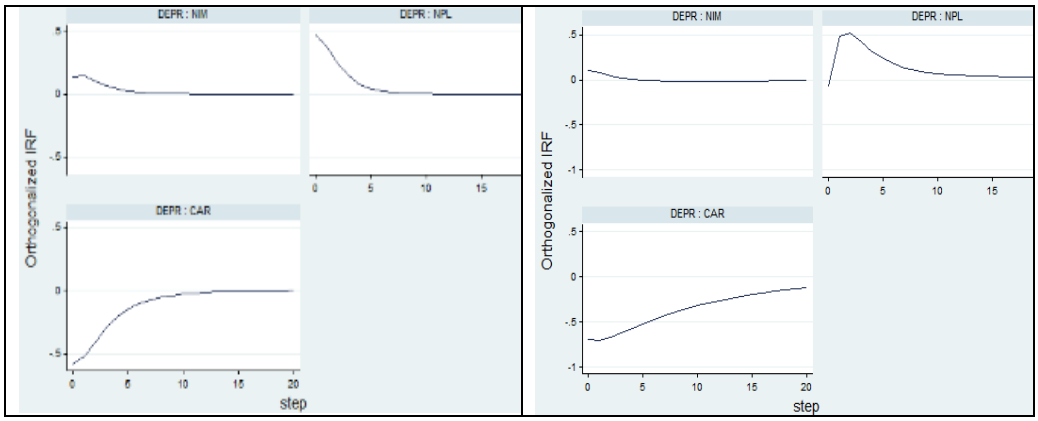


Figure 4, left panel is for BUKU 3 and the right panel is for BUKU 4 shows the same behavior but very different compared to group BUKU 1 and BUKU 2. Differences occur mainly on the negative response CAR in the early period due to exchange rate depreciation. The second model in which the order of depreciation and transmission begins, followed by NPL, NIM and CAR resulted in a large enough reduction in CAR. The cause of this change comes from the NPL responded positively at the beginning of the period is large enough. NPL's second biggest group among the 4 groups.

However, both groups responded positively NIM at the beginning of the period. Despite the increase in NPLs, the bank was still able to generate profits from diversifying products based on interest rates (interest-based income). Banks in this group belong to the large banks and have products based on foreign currency (exchange rate). Depreciation of course will cause damage to this product that will reduce the CAR systematically. This is different from a bank group BUKU 1 and 2, the CAR to respond positively to the depreciation likely caused most of the banks do not have foreign currency-based products.

The table 4 describes the role change between variables in dynamic systems due to the impulse of domestic variable interest rates on the first model BUKU 1 up to BUKU 4. Measurements using a variance decomposition role with the method developed by Love *et al.* (2002) and Love *et. al* (2006). In this model, the transmission sequence starts of domestic interest rates, economic growth, the NPL ratio, net interest margin (NIM) and CAR. In all BUKU, IRD role in a dynamic system PVAR biggest shock occurred in domestic interest rates then followed with another variable according to the model. In all bank groups, the role of the variables began to stabilize in the period to 11. During this period, the composition of the role of variables other than the IRD getting bigger, but the biggest composition remains at IRD.

Table 4. *Variance Decomposition Model 1*

	Period	IRD	GROWTH	NPL	NIM	CAR

BUKU 1	1	0.87121	0.117977	0.001055	0.009232	0.000525
	5	0.831903	0.144584	0.002415	0.016027	0.005071
	10	0.830404	0.14476	0.002545	0.016558	0.005733
	11	0.830384	0.144761	0.002546	0.016561	0.005747
BUKU 2	1	0.860024	0.123029	0.011442	0.000307	0.005198
	5	0.763618	0.216974	0.013814	0.001565	0.004029
	10	0.76319	0.216991	0.013864	0.00161	0.004345
	11	0.76319	0.216991	0.013864	0.00161	0.004345
BUKU 3	1	0.834646	0.126334	0.000886	0.006037	0.032096
	5	0.723977	0.201704	0.001902	0.019154	0.053263
	10	0.720428	0.201062	0.002153	0.019705	0.056652
	11	0.720358	0.201048	0.002158	0.019711	0.056726
BUKU4	1	0.740234	0.129473	0.006376	0.078755	0.045162
	5	0.687559	0.211564	0.043366	0.039467	0.018044
	10	0.688306	0.213118	0.048158	0.03479	0.015629
	11	0.688344	0.213198	0.048285	0.034648	0.015524

In all BUKU, the order of the role of the first and second biggest variable is the IRD and Growth. The role of variable NPL, NIM and CAR vary at each bank group. The biggest role of IRD is in BUKU 1, BUKU 2 BUKU 3 and then the smallest is BUKU 4. The biggest role of NPL is in BUKU 4 and the smallest is in BUKU 1. Similarly, the largest role of the NIM is in BUKU 4 and the smallest is in BUKU 1. Greater CAR role in the dynamic relationship PVAR is in BUKU 3 and smallest is in BUKU 1.

The Table 5 describes the role change between variables in dynamic systems due to the impulse variable exchange rate depreciation in the second model BUKU 1 through BUKU 4. In this model the transmission sequence starting from depreciation, domestic interest rates, the NPL ratio, net interest margin (NIM) and CAR. In all BUKU, Depreciation role in a dynamic system PVAR biggest shock occurred in domestic interest rates then followed with another variable according to the model. In all bank groups, the role of the variables are stabilizing after a period to 10. During this period, the composition of the role of variables in addition to the depreciation of the greater, but the biggest composition remains on depreciation.

Table 5. *Variance Decomposition Model 2*

		DEPR	NPL	CAR	NIM
BUKU 1	1	0.754478	1.08E-05	0.019597	0.002
	5	0.55172	0.011644	0.01841	0.050639
	10	0.566058	0.012437	0.016265	0.072227
	20	0.576619	0.013266	0.015674	0.075791
BUKU	1	0.93346	0.000132	0.006832	0.003874

	5	0.888544	0.03819	0.004857	0.008531
	10	0.888241	0.038272	0.004791	0.008671
	20	0.888241	0.038272	0.004791	0.008671
BUKU3	1	0.940235	0.029022	0.018985	0.011758
	5	0.905994	0.045419	0.024418	0.024169
	10	0.905318	0.045628	0.024618	0.024435
	20	0.905315	0.045629	0.02462	0.024436
BUKU4	1	0.914083	0.000313	0.056857	0.028747
	5	0.871205	0.035	0.074913	0.018882
	10	0.863304	0.039606	0.080737	0.016353
	20	0.860346	0.040174	0.082475	0.017005

The greater depreciation role is in BUKU 3 BUKU 4 BUKU 2 and the smallest is at BUKU 1. The biggest NPL role in BUKU 3 and the smallest is at BUKU 1. Similarly, the largest role of the NIM is at BUKU 1 and the smallest BUKU 2. The biggest CAR role in the dynamic relationship PVAR is on BUKU 4 BUKU 3 and the smallest is in BUKU 2.

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